Sample Budgets for Large-scale Bell Pepper Operations and the Impact of *Phytophthora* Blight on Farm Revenue and Costs, 2019

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Preface

The objective of this sample budget is to guide bell pepper producers and those interested in producing bell peppers on the factors to consider when estimating their net revenue from growing and marketing bell peppers. Additionally, in this publication, we evaluate the economic impact of *Phytophthora* blight at the farm level, by comparing a baseline budget with an alternative budget that includes managing costs and potential yield losses associated with this disease.

The budget presented here is an example. Therefore, users should modify numbers to estimate their net farm revenue. Every farm is unique; hence, estimated costs and revenue will vary depending on soil conditions, pepper varieties, production practices used, pest and disease pressure and other factors.

One of the most common diseases for bell peppers in Tennessee is *Phytophthora* blight, a soil-borne disease caused by the oomycete (water mold) *Phytophthora capsici*. *Phytophthora* blight reduces yield by killing plants outright as well as causing pre- and post-harvest fruit rot. Disease severity is influenced by environmental conditions, including temperature and rainfall, and cultural factors such as soil drainage and irrigation source and method, making it challenging to estimate expected losses to disease. Once the disease becomes established in the soil, it is nearly impossible to eradicate and must be managed each season through cultural practices and fungicides (Hansen, Siegenthaler, and Swafford, 2019). However, in fields where the disease has not been introduced, there is no need to use *Phytophthora* blight-specific fungicides, thereby significantly decreasing disease management costs. For information about managing *Phytophthora* blight go to https://extension.tennessee.edu/publications/Documents/W810.pdf.

Bell Pepper Production in Tennessee

According to the U.S. Department of Agriculture (USDA) 2017 Census of Agriculture, there were 434 farms growing bell peppers in Tennessee on 235 acres (USDA NASS, 2019). The number of operations growing bell peppers and the number of acres on bell pepper production in Tennessee increased by 280 percent and 8 percent, respectively, between 2012 and 2017.

Although alternative production methods exist, like organic production and the use of biodegradable mulch, this publication focuses on conventional plasticulture, which is the most common method of pepper production in Tennessee.

Data

Sources of information used to create this sample budget include: 1) custom vegetable price reports from the USDA Agricultural Marketing Service (USDA AMS); 2) a 2017 bell pepper variety trial conducted in Dayton, TN (University of Tennessee Extension); 3) input suppliers; 4) the Southeastern U.S. 2019 Vegetable Crop Handbook; 5) labor data collected from a pepper farm in East Tennessee; 6) labor data collected from a 2019 Tennessee fruit and vegetable survey; 7) the U.S. Department of Labor and the Bureau of Labor Statistics; 8) the Mississippi State University (MSU) Traditional Vegetables 2018 Planning Budgets (MSU, Department of Agricultural Economics, 2017); 9) the University of Kentucky (UK) 2017 Vegetable and Melon Budgets (Center for Crop Diversification, UK); and 10) the U.S. Energy Information Administration.

Sample Budget Details and Explanation

The example presented in this sample budget is based on 1 acre of green bell pepper using plasticulture.[1] We are assuming a 5-foot space between bed centers. We also assume plants are planted in staggered rows 12 inches apart and with 12-inch in-row spacing.

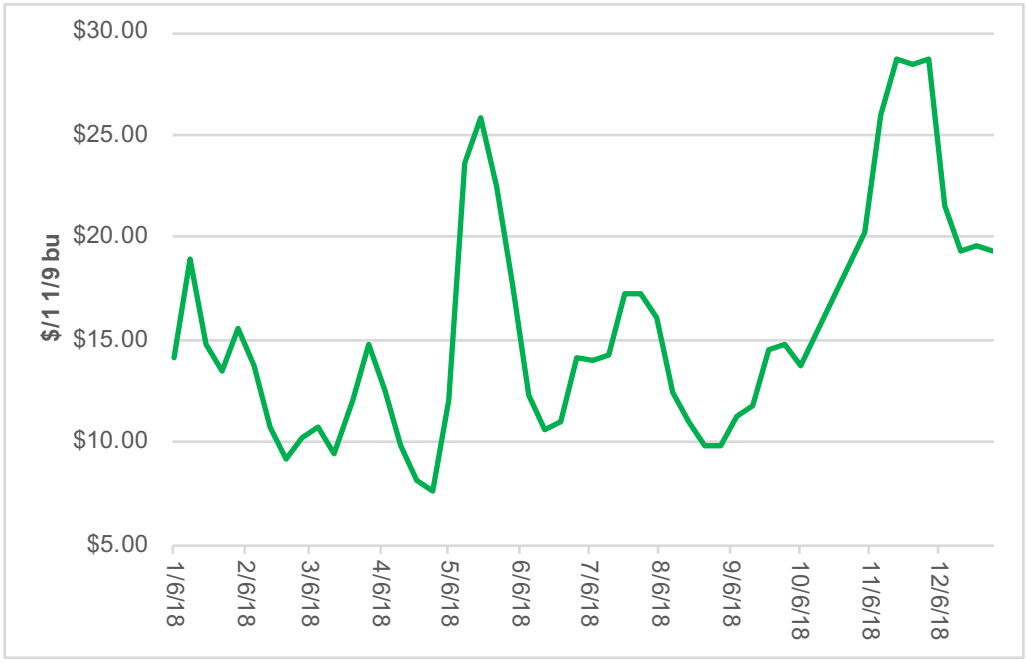
1 Plasticulture is a management-intensive system that combines raised beds, plastic mulch, drip irrigation and the option of fumigation. This system allows producers to increase yield, crop quality and access early spring markets. For more information about plasticulture for commercial vegetables, go to https://bit.ly/2WYAdyv and the Southeastern U.S. 2019 Vegetable Crop Handbook (Southeastern Vegetable Extension Workers, 2019).

Gross Returns

Yield — For yield estimates, we used information from the 2017 bell pepper variety trials from Dayton, TN (UT Extension). We used yield for "Aristotle," which is a standard green bell pepper variety and adjusted this yield for a 5-foot space[2] between bed centers, as this space between bed centers is the one commonly used in bell pepper production.

Price — We used information from the vegetable prices custom reports from USDA AMS. We are using free on board (FOB) shipping point prices. These prices are those of products quoted or sold to be placed on a boat, car, truck or another type of land transportation at the shipping point in suitable shipping condition (USDA AMS, 2019). We looked at 2018 weekly average prices for green bell peppers (see **Figure 1**) in various districts in Florida, Georgia and North Carolina, as we could not find shipping point prices when selecting Tennessee as a shipping point. We used a tool available through the USDA AMS website called the custom average tool (USDA AMS, 2019). This tool allows you to estimate the average terminal market, shipping point and retail prices for various crops during a specific period of time for specific locations. You can specify crop variety, package type, a unit of sale and production environment.

Figure 1. 2018 green bell pepper weekly average shipping point prices per 1 1/9 bu box.



Source: USDA AMS Custom Average Tool.

Variable Costs

1. **Bell Pepper Plant Costs** — To estimate costs associated with pepper plants, we need the number of plants per acre and plant prices. Assuming a 5-foot space between centers, we estimated 17,424 plants per acre, based on information from the Southeastern U.S. 2019 Vegetable Crop Handbook (Southeastern Vegetable Extension Workers, 2019). The number of plants per acre will vary, depending on assumptions regarding space between rows and plants (see the Southeastern U.S. 2019 Vegetable Crop Handbook, p. 17). We gathered bell pepper plant cost information from various companies in Georgia. Based on this information, we estimated a cost of $160 per 1,000 pepper plants or $0.16 per plant. This price includes the shipping cost.

2 Variety trials used a 6-foot space between bed centers.

2. **Fertilizer** — Application rates are those recommended by the Southeastern U.S. 2019 Vegetable Crop Handbook for pepper production, using a plasticulture production system for a soil that tested high in potassium (Southeastern U.S. 2019 Vegetable Crop Handbook, p. 76). Appropriate N-P-K recommendations are determined by soil test results and tissue analysis and, therefore, will vary from operation to operation. Average fertilizer prices were estimated, using information from two input suppliers in Tennessee and one input supplier in Kentucky.
   - *10-10-10* — This fertilizer is sold in 50-pound bags and costs, on average, $10.88 per 50-pound bag or $0.22 per pound. The estimated pre-plant application rate for 10-10-10 used in this sample budget is 500 pounds per acre.
   - *Calcium Nitrate* — It is sold in 50-pound bags and costs, on average, $16.15 per bag or $0.32 per pound. The estimated application rate for calcium nitrate used for fertigation and alternated with potassium nitrate applications (below) in this sample budget is 135 pounds per acre.
   - *Potassium Nitrate* — It is sold in 50-pound bags and costs, on average, $31.53 per bag or $0.63 per pound. The estimated application rate for potassium nitrate used for fertigation and alternated with calcium nitrate applications (above) in this sample budget is 225 pounds per acre.[3]
3. **Plastic Mulch** — We estimated two (2.18) 4 x 4,000-foot rolls per acre, assuming a 5-foot space between bed centers (43,560 square feet per acre/5-foot bed centers = 8,712 linear bed feet/4,000 feet). The estimated average cost per roll is $111.50.
4. **Drip Tape** — We estimated 11.62 rolls (750 feet per roll) per acre, assuming a 5-foot space between bed centers (43,560 square feet per acre/5-foot bed centers = 8,712 linear bed feet/7, 50 feet drip tape per roll). The estimated average cost per roll is $141.50.
5. **Water Cost** — Irrigation costs will vary based on the water source, irrigation system, energy source, irrigation quantities and irrigation frequency. *Water cost is not included in our budget*; however, if county or municipal water is used for irrigation, prevailing water rates from the utility company should be included. The cost of establishing a water source (pond or well) is not included. The user should include annualized capital costs, if the construction of a well or pond is required for their operation.
6. **Stakes** — We estimated approximately 5,808 stakes per acre, based on variety trial information (UT Extension). We assumed 48-inch stakes were used for the trellis system. The cost per stake was estimated at $0.57/stake.
7. **Twine** — Twine goes on both sides of the row up and back to trellis the plants in place. We assumed at least three trellising heights as the plants grow. Therefore, we estimated eight (8.3) 6,300-foot tube rolls of twine per acre (i.e., [8,712 linear bed feet per acre x 2 sides of the row x 3 trellising heights]/6,300 feet of twine per roll). The estimated average cost per 6,300-foot tube roll is $7.16.
8. **Fumigants and Fungicides** — Currently, the four most common diseases of bell pepper in Tennessee are bacterial spot, anthracnose, southern blight and *Phytophthora* blight. We assumed disease pressure from bacterial spot, anthracnose and southern blight and included costs for managing these diseases based on UT Extension recommendations. We also included a variation of the budget, which includes costs of managing *Phytophthora* blight. Managing *Phytophthora* blight can increase disease management costs but is only necessary if the disease is present in the soil. Additionally, growers can expect some yield losses due to *Phytophthora* blight, even under the aggressive management plan outlined in this budget. We assume a 10 percent yield loss due to *Phytophthora* blight. Yield losses can be anywhere between 10 percent and 50 percent. As stated in the preface, yield losses due to *Phytophthora* blight could vary greatly, depending on various factors such as environmental conditions, soil drainage, and irrigation source and method. Previous studies have suggested yield losses of up to 100 percent in pumpkins due to *Phytophthora* blight (Tian and Babadoost, 2004). The list of fumigants and fungicides are based on management recommendation examples by Zachariah Hansen (zhansen1@utk.edu), assistant professor and Extension specialist in UTIA's Department of Entomology and Plant Pathology. **Tables 1 and 2 in the Appendix** show fungicide programs with weekly fungicide application instructions for two scenarios, one where *Phytophthora* blight does not need to be managed and one where this disease needs to be managed.

3 Application rates used in this publication are on the low end of what is recommended at 100 lbs N/acre. Others may apply nearly double this amount of N, which of course would increase fertilizer costs. See the Southeastern U.S. 2019 Vegetable Crop Handbook, p. 76, for fertilizer recommendations for plasticulture pepper.

9. **Insecticides** — Insecticides are used as needed. In this budget, we assume 4.5 applications of pyrethroids for stink bugs and caterpillars (e.g., Mustang Maxx, at an application rate of 3.12 fluid ounces/acre), plus a drip chemigation application of chlorantraniliprole (e.g., Coragen, a diamide class of insecticide, at an application rate of 2.75 fluid ounces/acre). Then, an application of Movento for green peach aphid control at an application rate of 4.5 fluid ounces/acre. Also, a late-season application of Orthene for caterpillars at an application rate of 0.38 lb/acre. Application rates will vary, depending on the types of caterpillars targeted, as well as insect incidence. For more information on insect management, contact Frank Hale, professor in UTIA's Department of Entomology and Plant Pathology (fhale1@utk.edu).
10. **Herbicides** — Like insecticides, herbicides are used as needed, depending on the emergence of specific weeds. In this budget, we assume the use of pre-plant application of a fumigant and assume no use of pre-plant herbicide. We assume the use of Poast for the control of grasses, postemergence. We also assume the use of Sandea for nutsedge and broadleaf weed control. Sandea can be applied to row middles, but contact should be avoided with crop and plastic mulch.
11. **Hired Labor** — We estimated hand and operator labor hours associated with various activities including land preparation, plastic mulch laying, fertilizer and other chemical applications, packing/grading, harvesting, plastic removal and disposal, and other activities, based on information we have gathered from pepper growers, a 2019 Tennessee Fruit and Vegetable survey, the MSU Traditional Vegetables 2018 Planning Budgets, and the UK 2017 Vegetable and Melon Budgets. The hourly minimum wage rate for manual labor used in this publication is $11.63/hour, which is the 2019 Adverse Effect Wage Rate for Tennessee (U.S. Department of Labor, Employment and Training Administration, 2019). The hourly rate for operator labor is estimated at $13.26 (Bureau of Labor Statistics, 2019). Harvesting and packing/grading labor costs were estimated on a per-box basis, similar to the UK 2017 Vegetable and Melon Budgets. These costs were adjusted using Tennessee wage rates, as described above.
12. **Other Marketing and Harvesting Labor**
    - *Cardboard boxes* — peppers are packed in 1 1/9-bushel cardboard boxes. The average cost per cardboard box is estimated at $1.92.
13. **Diesel Fuel** — Fuel cost is based on estimates of fuel consumptions associated with a two-wheel drive (2WD), 75-horsepower (HP) tractor, pulling various implements related to land preparation, planting, harvesting and postharvest activities, as estimated by the MSU Traditional Vegetables 2018 Planning Budgets, **Appendix Tables 1 to 3**. Diesel fuel cost per gallon was estimated at $2.45. We used 2019 diesel fuel prices, as estimated by the U.S. Energy Information Administration,[4] and applied a farm fuel cost discount of $0.48/gal.
14. **Repairs and Maintenance** — We assumed the use of a 2WD, 75-HP tractor; a 10-foot disk harrow; cyclone fertilizer spreader; plastic mulch layer; 27-foot sprayer; 10-foot utility trailer; and a plastic mulch lifter. Repairs and maintenance costs are estimated using the MSU Traditional Vegetables 2018 Planning Budgets, **Appendix Tables 1 to 3**. Variable machinery costs (i.e., fuel, operator labor, and repairs and maintenance) will vary from farm to farm, depending on the horsepower of the tractor and the equipment used.
15. **Plastic Mulch Disposal Fees** — In Tennessee, disposal cost varies by location. There are some counties where the disposal cost will only include the transportation cost associated with moving polyethylene (PE) plastic mulches from the farm to the landfill. In contrast, other counties have a disposal fee of anywhere between $20 and $50 per ton. Some landfills may not even accept PE mulch for disposal. In this study, we assumed an average disposal cost of $35/ton. We assumed plastic mulch weight is going to increase by 50 percent during the growing season (Kasirajan and Ngouajio, 2012). This information helped us determine the cost of disposal.
16. **Operating Interest** — Operating interest is assumed to be charged on half of the specified variable expenses at an interest rate of 6.5 percent.

4 https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_R20_DPG&f=W

Fixed Costs

17. **Irrigation** — Estimated fixed costs associated with a drip-tape irrigation system are based on the MSU Traditional Vegetables 2018 Planning Budgets. These costs represent ownership costs of all items included in setting up a drip-tape irrigation system (e.g., coupler, hole punch, PVC fitting). As mentioned above, well or pond establishment is not accounted for in this analysis.
18. **Power Equipment and Implements** — Fixed costs are those presented in the MSU Traditional Vegetables 2018 Planning Budgets, **Appendix Tables 1 to 3**, for equipment and implements listed above. These costs are estimated by first computing the capital recovery factor and then using this estimate on the annual capital recovery charge estimates.
19. **Land Rent** — 2018 Tennessee State Average Cropland Cash Rents, as reported by USDA NASS, are used (USDA NASS, 2018). However, rental rates are subject to local market conditions.

The Impact of *Phytophthora* Blight on Farm Revenue and Costs

In **Table 1**, we show a baseline budget that assumes no *Phytophthora* blight on the farm. In **Table 2**, we show a budget that captures the potential impacts of *Phytophthora* blight on gross returns and costs. Because actions are taken to control *Phytophthora* blight, there are additional costs associated with the application of additional fungicides (i.e., product, labor and equipment costs). **Table 2** shows that fungicide costs increased by 139 percent, while overall costs increase by about 1 percent or $91/acre, given that harvesting, packing and grading labor costs also decreased because we assumed a yield loss of 10 percent due to *Phytophthora* blight.

Table 1. Estimated gross returns and costs per acre for a pepper operation with no *Phytophthora* blight

Item	Unit	$/unit	Quantity	Total
Gross Returns				
Bell Peppers	box (1 1/9 bu)	$ 15.28	1,348.80	$ 20,609.66
Variable Costs				
1. Pepper plants	plant	$ 0.16	17,424	$ 2,787.84
2. Pre-plant: 10-10-10 Fertilizer	50 lb bag	$ 10.88	10.00	$ 108.75
2. Fertigation: Calcium Nitrate	50 lb bag	$ 16.15	2.70	$ 43.61
2. Fertigation: Potassium Nitrate	50 lb bag	$ 31.53	4.50	$ 141.89
3. Plastic mulch	roll (4x4,000)	$ 111.50	2.18	$ 243.07
4. T-tape (drip tape, 750')	roll (750')	$ 141.50	11.62	$ 1,643.66
5. Water costs	ac-in			$ -
6. Stakes	per 100 stakes	$ 57.08	58.08	$ 3,315.21
7. Twine	per 6,300 ft tube	$ 7.16	8.30	$ 59.39
8. ***Fumigant***				
Telone C-17	gal	$ 20.30	37.20	$ 755.16
8. ***Fungicides***				
Kocide	lb	$ 9.20	12.50	$ 114.98
Manzate	lb	$ 4.20	14.00	$ 58.86
Quadris	fl oz	$ 1.45	10.00	$ 14.51
Bravo	pt	$ 7.55	1.50	$ 11.32
Cabrio	oz	$ 2.36	10.00	$ 23.65
Priaxor	fl oz	$ 4.12	6.00	$ 24.74
Aprovia Top	fl oz	$ 2.50	24.00	$ 59.91
9. ***Insecticides***				
Mustang Maxx	fl oz	$ 1.20	14.04	$ 16.88
Coragen	fl oz	$ 11.17	2.75	$ 30.72
Movento	fl oz	$ 8.07	4.50	$ 36.30
Orthene	lb	$ 13.08	0.38	$ 4.90
10. ***Herbicides***				
Poast	pt	$ 15.13	1.50	$ 22.70
Sandea	oz	$ 39.00	0.75	$ 29.25
11. ***Hired Labor***				
Operator labor	hour	$ 13.26	6.69	$ 88.71
Transplant labor	hours	$ 11.63	28.84	$ 335.41
Harvest labor	box	$ 1.02	1,348.80	$ 1,375.78
Grade/Packing labor	box	$ 1.63	1,348.80	$ 2,198.54
Plastic removal	hour	$ 11.63	12.00	$ 139.56
Plastic disposal	hour	$ 11.63	2.00	$ 23.26
12. ***Other Marketing and Harvesting Costs***				
Cardboard boxes	box	$ 1.92	941.50	$ 1,810.37
13. Diesel Fuel				
Tractors	gal	$ 2.45	19.67	$ 48.26
14. ***Repairs and Maintenance***				
Tractor 2WD 75 HP	acre	$ 6.88	1	$ 6.88
Implements	acre	$ 7.41	1	$ 7.41
Item	**Unit**	**$/unit**	**Quantity**	**Total**
15. ***Plastic Mulch Disposal***				
Plastic mulch disposal	fee per ton	$ 35.00	0.21	$ 7.35
16. ***Operating Interest***	Interest rate (6.5%)		0.065	$ 506.64
Total Variable Cost				$ 16,095.44
Fixed Costs				
17. Irrigation	acre	$315.50	1	$ 315.50
18. Power Equipment	acre	$31.41	1	$ 31.41
18. Implements	acre	$17.86	1	$ 17.86
19. Land Rent	acre	$95.00	1	$ 95.00
Total Fixed Costs				$ 459.77
Total Costs				$ 16,555.21

Expected net returns are not provided in **Tables 1 and 2**. Gross returns presented in **Tables 1 and 2** are based on variety trials for a specific bell pepper variety ("Aristotle"). Gross and net returns will vary greatly, depending on variety, location, weather, weed, disease and insect pressure, as well as fresh vegetable price volatility.

Table 2. Estimated gross returns and costs per acre for a pepper operation with *Phytophthora* blight

Item	Unit	$/unit	Quantity	Total
Gross Returns				
Bell Peppers	box (1 1/9 bu)	$ 15.28	1,213.92	$ 18,548.70
Variable Costs				
1. Pepper plants	plant	$ 0.16	17,424	$ 2,787.84
2. Pre-plant: 10-10-10 Fertilizer	50 lb bag	$ 10.88	10.00	$ 108.75
2. Fertigation: Calcium Nitrate	50 lb bag	$ 16.15	2.70	$ 43.61
2. Fertigation: Potassium Nitrate	50 lb bag	$ 31.53	4.50	$ 141.89
3. Plastic mulch	roll (4x4,000)	$ 111.50	2.18	$ 243.07
4. T-tape (drip tape, 750')	roll (750')	$ 141.50	11.62	$ 1,643.66
5. Water costs	ac-in			
6. Stakes	per 100 stakes	$ 57.08	58.08	$ 3,315.21
7. Twine	per 6,300 ft tube	$ 7.16	8.30	$ 59.39
8. Fumigant				
Telone C-17	gal	$ 20.30	37.20	$ 755.16
8. Fungicides				
Kocide	lb	$ 9.20	12.50	$ 114.98
Manzate	lb	$ 4.20	14.00	$ 58.86
Quadris	fl oz	$ 1.45	10.00	$ 14.51
Bravo	pt	$ 7.55	1.50	$ 11.32
Cabrio	oz	$ 2.36	10.00	$ 23.65
Priaxor	fl oz	$ 4.12	6.00	$ 24.74
Aprovia Top	fl oz	$ 2.50	24.00	$ 59.91
Orondis Gold 200	fl oz	$ 2.31	9.60	$ 22.14
Ridomil Gold SL	pt	$ 101.85	1.00	$ 101.85
Ranman	fl oz	$ 7.80	5.50	$ 42.89
Revus	fl oz	$ 2.90	16.00	$ 46.48
Presidio	fl oz	$ 9.84	8.00	$ 78.75
Zampro	fl oz	$ 2.69	14.00	$ 37.67
Orondis Ultra	fl oz	$ 6.22	16.00	$ 99.53
9. Insecticides				
Mustang Maxx	fl oz	$ 1.20	14.04	$ 16.88
Coragen	fl oz	$ 11.17	2.75	$ 30.72
Movento	fl oz	$ 8.07	4.50	$ 36.30
Orthene	lb	$ 13.08	0.38	$ 4.90
10. Herbicides				
Poast	pt	$ 15.13	1.50	$ 22.70
Sandea	oz	$ 39.00	0.75	$ 29.25
11. Hired Labor				
Operator labor	hour	$ 13.26	6.60	$ 87.52
Transplant labor	hours	$ 11.63	28.84	$ 335.41
Harvest labor	box	$ 1.02	1,213.92	$ 1,238.20
Grade/Packing labor	box	$ 1.63	1,213.92	$ 1,978.69

Plastic removal	hour	$	11.63	12.00	$ 139.56
Plastic disposal	hour	$	11.63	2.00	$ 23.26
Item	**Unit**		**$/unit**	**Quantity**	**Total**
12. Other Marketing and Harvesting Costs					
Cardboard boxes	box	$	1.92	941.50	$ 1,810.37
Bins/Stacking					
13. Diesel Fuel					
Tractors	gal		$2.45	22.30	$ 54.72
14. Repairs and Maintenance					
Tractor 2WD 75 HP	acre	$	7.87	1	$ 7.87
Implements	acre	$	9.17	1	$ 9.17
15. Plastic Mulch Disposal					
Plastic mulch disposal	fee per ton	$	35.00	0.21	$ 7.35
16. Operating interest	Interest rate (6.5%)			0.065	$ 509.23
Total Variable Cost					$ 16,177.92
Fixed Costs					
17. Irrigation	acre	$	315.50	1	$ 315.50
18. Power Equipment	acre	$	37.79	1	$ 37.79
18. Implements	acre	$	20.14	1	$ 20.14
19. Land Rent	acre	$	95.00	1	$ 95.00
Total Fixed Costs					$ 468.43
Total Costs					$ 16,646.35

Table 3 shows the breakeven price per box (1 1/9 bu) above total expenses and net returns for price/yield combinations on a per-acre basis. For example, the middle row in **Table 3** shows that the breakeven price for the assumed yield in the baseline budget (1,349 boxes/acre) is $12.27 per box or nearly $3 below the price assumed in **Tables 1 and 2**. The five rows above the middle row in this table represent the net returns for different price and yield loss (i.e., 10 percent, 20 percent, 30 percent, 40 percent, 50 percent) combinations. We assumed yield losses of anywhere between 10 and 50 percent, with 10 percent increments, due to *Phytophthora* blight when no actions are taken to control this disease.

The five rows below the middle row in this table represent net returns for a yield of anywhere between 10 percent and 50 percent above the assumed yield in the baseline budget (1,349 boxes/acre), assuming no *Phytophthora* blight is affecting the farm operation.

Table 3. Breakeven price above total expenses and net returns for price/yield combinations per acre for a scenario where no actions are taken to control for *Phytophthora* blight

Bell Pepper		Breakeven Price ($/box)										
		$ 9.09	$ 9.55	$ 10.07	$ 10.68	$ 11.41	$ 12.27	$ 13.33	$ 14.66	$ 16.36	$ 18.63	$ 21.81
Percent	**Yield**											
50	674	$ (8,576)	$ (8,270)	$ (7,917)	$ (7,504)	$ (7,017)	$ (6,432)	$ (5,718)	$ (4,824)	$ (3,676)	$ (2,144)	**$0**
60	809	$ (7,719)	$ (7,351)	$ (6,927)	$ (6,432)	$ (5,848)	$ (5,146)	$ (4,288)	$ (3,216)	$ (1,838)	**$0**	$ 2,573
70	944	$ (6,861)	$ (6,432)	$ (5,938)	$ (5,360)	$ (4,678)	$ (3,859)	$ (2,859)	$ (1,608)	**$0**	$ 2,144	$ 5,146
80	1,079	$ (6,004)	$ (5,513)	$ (4,948)	$ (4,288)	$ (3,509)	$ (2,573)	$ (1,429)	**$0**	$ 1,838	$ 4,288	$ 7,719
90	1,214	$ (5,146)	$ (4,595)	$ (3,958)	$ (3,216)	$ (2,339)	$ (1,286)	**$0**	$ 1,608	$ 3,676	$ 6,432	$ 10,292
100	1,349	$ (4,288)	$ (3,676)	$ (2,969)	$ (2,144)	$ (1,170)	**$0**	$ 1,429	$ 3,216	$ 5,513	$ 8,576	$ 12,865
110	1,484	$ (3,431)	$ (2,757)	$ (1,979)	$ (1,072)	**$0**	$ 1,286	$ 2,859	$ 4,824	$ 7,351	$ 10,721	$ 15,438
120	1,619	$ (2,573)	$ (1,838)	$ (990)	**$0**	$ 1,170	$ 2,573	$ 4,288	$ 6,432	$ 9,189	$ 12,865	$ 18,011
130	1,753	$ (1,715)	$ (919)	**$0**	$ 1,072	$ 2,339	$ 3,859	$ 5,718	$ 8,040	$ 11,027	$ 15,009	$ 20,584
140	1,888	$ (858)	**$0**	$ 990	$ 2,144	$ 3,509	$ 5,146	$ 7,147	$ 9,649	$ 12,865	$ 17,153	$ 23,156
150	2,023	**$0**	$ 919	$ 1,979	$ 3,216	$ 4,678	$ 6,432	$ 8,576	$ 11,257	$ 14,703	$ 19,297	$ 25,729

Conclusion

The information presented in this publication suggests that losses due to *Phytophthora* blight can be significant. There are additional costs associated with taking actions to control this disease, but these actions may reduce potential yield losses. Given the challenges associated with removing this disease once it is established, preventive measures are the best way to manage it. For more information on preventive measures for *Phytophthora* blight management, go to https://extension.tennessee.edu/publications/Documents/W810.pdf.

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Appendix

Table 1. Example of fungicide program when *Phytophthora* blight does not need to be managed

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
Pre-plant	Fumigants[1] (1,3-dichloropropene + chloropicrin)	Nematodes, soil-borne pathogens, weeds	Various[1]
Pre-plant	Agri-Mycin 17, Firewall	Bacterial spot (*Xanthomonas euvesicatoria*)	1 lb/100 gallon
0 (at planting)	Blocker (PCNB)	Southern blight (*Sclerotium rolfsii*)	4.5-7.5 pt/100 gal; use 0.5 pt solution per plant
1	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
2	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
3	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot (*Colletotrichum* spp.)	12 oz/acre
4	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
5	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
5	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Cabrio (pyraclostrobin)	Anthracnose fruit rot (*Colletotrichum* spp.)	10 oz/acre
6	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
7	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Priaxor (fluxapyroxad + pyraclostrobin)	Anthracnose fruit rot (*Colletotrichum* spp.)	6 oz/acre
8	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
9	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	azoxystrobin (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Quadris as an example (10 oz per acre)
10	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
	Chlorothalonil	Anthracnose fruit rot (*Colletotrichum* spp.)	Bravo as an example (1.5 pt per acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot (*Colletotrichum* spp.)	12 oz/acre

[1] Examples of fumigants include InLine (29-56.7 gal/treated acre), Pic-Clor 60 (48.6 gal/treated acre), Telone C-17 (32.4-42 gal/treated acre), and Telone C-35 (39-50 gal/treated acre).

Table 2. Example of fungicide program when *Phytophthora* blight needs to be managed

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
Pre-plant	Fumigants[1] (1,3-dichloropropene + chloropicrin)	Nematodes, soil-borne pathogens, weeds	Various[1]
Pre-plant	Agri-Mycin 17, Firewall	Bacterial spot (*Xanthomonas euvesicatoria*)	1 lb/100 gallon
0 (at planting)	Blocker (PCNB)	Southern blight (*Sclerotium rolfsii*)	4.5-7.5 pt/100 gal; use 0.5 pt solution per plant
	Orondis Gold 200 (oxathiapiprolin)	*Phytophthora* blight (*Phytophthora capsici*)	9.6 fl oz per acre
1	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	Ridomil Gold SL (mefenoxam)	*Phytophthora* blight (*Phytophthora capsici*)	1 pt per acre
2	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	Ranman (cyazofamid)	*Phytophthora* blight (*Phytophthora capsici*)	2.75 fl oz per acre
3	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot (*Colletotrichum* spp.)	12 oz/acre
	Revus (mandipropamid)	*Phytophthora* blight (*Phytophthora capsici*)	8 fl oz per acre
4	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
	Presidio (fluopicolide)	*Phytophthora* blight (*Phytophthora capsici*)	4 fl oz per acre
5	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Cabrio (pyraclostrobin)	Anthracnose fruit rot (*Colletotrichum* spp.)	10 oz/acre
	Zampro (ametoctradin + dimethomorph)	*Phytophthora* blight (*Phytophthora capsici*)	14 fl oz per acre
6	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Orondis Ultra (oxathiapiprolin + mandipropamid)	*Phytophthora* blight (*Phytophthora capsici*)	8 fl oz per acre
7	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	Priaxor (fluxapyroxad + pyraclostrobin)	Anthracnose fruit rot (*Colletotrichum* spp.)	6 oz/acre
	Ranman (cyazofamid)	*Phytophthora* blight (*Phytophthora capsici*)	2.75 fl oz per acre
8	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
	Revus (mandipropamid)	*Phytophthora* blight (*Phytophthora capsici*)	8 fl oz per acre
9	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Manzate as an example (2 lbs/acre)
	azoxystrobin (various)	Anthracnose fruit rot (*Colletotrichum* spp.)	Quadris as an example (10 oz per acre)
	Presidio (fluopicolide)	*Phytophthora* blight (*Phytophthora capsici*)	4 fl oz per acre
10	fixed copper (various)	Bacterial spot (*Xanthomonas euvesicatoria*)	Kocide as an example (1.25 lbs per acre)
	Chlorothalonil	Anthracnose fruit rot (*Colletotrichum* spp.)	Bravo as an example (1.5 pt per acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot (*Colletotrichum* spp.)	12 oz/acre
	Orondis Ultra (oxathiapiprolin + mandipropamid)	*Phytophthora* blight (*Phytophthora capsici*)	8 fl oz per acre

[1] Examples of fumigants include InLine (29-56.7 gal/treated acre), Pic-Clor 60 (48.6 gal/treated acre), Telone C-17 (32.4-42 gal/treated acre) and Telone C-35 (39-50 gal/treated acre).

Disclaimer

This publication contains herbicide/insecticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the herbicide/insecticide applicator's responsibility, by law, to read and follow all current label directions for the specific herbicide/insecticide being used. The label always takes precedence over the recommendations found in this publication.

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This material is based upon work that is supported by the National Institute of Food and Agriculture under award number 2014-51181-22382. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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