W 831

Sample Budget for Large-Scale Bell Pepper Operations and the Impact of Phytophthora Blight on Farm Revenue and Costs - 2022

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Preface

This sample budget aims to guide bell pepper producers and those interested in producing bell peppers on the factors to consider when estimating their potential net revenue from growing and marketing bell peppers. Additionally, we used this sample budget to help producers 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. This document will also help producers navigate the Excel version of this sample budget created by the University of Tennessee (UT), available on the Department of Agricultural & Resource Economics website at https://arec.tennessee.edu/extension/budgets/.

At the end of this document, we provide some instructions on how to use the Excel version of this sample budget.

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 tiny.utk.edu/W810, and for up-to-date fungicide recommendations, see the latest version of the Southeast U.S. Vegetable Crop Handbook.

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, 2017). The number of operations growing bell peppers and the number of acres of bell pepper production in Tennessee increased by 280 percent and 8 percent, respectively, between 2012 and 2017. Although many alternative production methods exist, 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 U.S. Department of Agriculture, Agricultural Marketing Services (USDA AMS); 2) a 2017 bell pepper variety trial conducted in Dayton, TN (University of Tennessee Extension); 3) input suppliers; 4) the 2022 Southeast U.S. 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 (the 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 growing one-acre of green bell pepper using plasticulture.[1] We are assuming a 5-ft spacing between bed centers. We also are assuming plants are planted in a double, staggered row 12 inches apart and with 12-inch in-row spacing.

Gross Returns

Yield – For yield estimates, we used information from the 2017 bell pepper variety trials from Dayton, TN (University of Tennessee Extension). We used yield for 'Aristotle,' which is a standard green bell pepper variety and adjusted this yield to 5-ft spacing[2] between bed centers, as this spacing between bed centers is the one commonly used in bell pepper production. In the Excel version of this sample budget, you can modify yield assumptions.

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). We looked at the 2022 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). 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, unit of sale, and production environment.

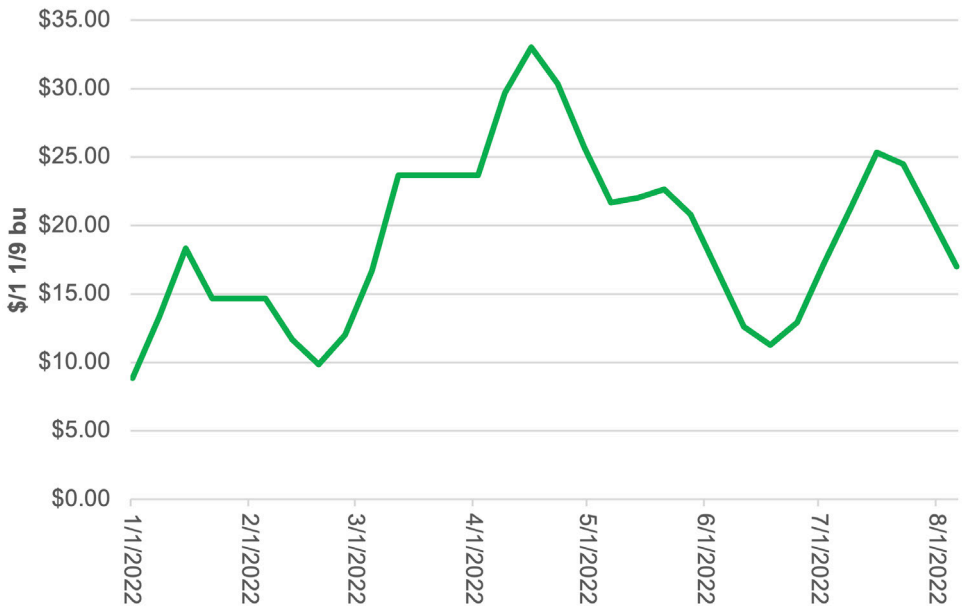

Figure 1. 2022 Green Bell Pepper Weekly Average Shipping Point Prices per 1 1/9 bu box.
Source: USDA AMS Custom Average Pricing Tool

[1]Plasticulture is a management-intensive system which 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 2022 Southeast U.S. Vegetable Crop Handbook (Southeastern Vegetable Extension Workers, 2022).

[2]The grower where the on-farm variety trial was conducted used 6-ft spacing between bed centers.

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-ft spacing between centers, we estimated 17,424 plants per acre based on information from the 2022 Southeast U.S. Vegetable Crop Handbook. The number of plants per acre will vary depending on spacing between rows and plants (see the 2022 Southeast U.S. Vegetable Crop Handbook, p. 36). We gathered bell pepper plant cost information from various companies in Georgia, North Carolina and Virginia. Based on this information, we estimated a cost of $172 per 1,000 pepper plants or $0.17 per plant.

2. **Fertilizer** – Application rates are those recommended by the 2022 Southeast U.S. Vegetable Crop Handbook for pepper production using a plasticulture production system for a soil that tested high in potassium (2022 Southeast U.S. Vegetable Crop Handbook, p. 101). 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 five input suppliers in the U.S. Southeastern region.

- *10-10-10* - This fertilizer is sold in 50-lb bags and costs on average $19.36 per 50-lb bag or $0.39 per lb. The estimated pre-plant application rate for 10-10-10 used in this sample budget is 500 lbs per acre.
- *Calcium Nitrate* - It is sold in 50-lb bags and costs on average $24.95 per bag or $0.50 per lb. The estimated application rate for calcium nitrate used for fertigation and alternated with potassium nitrate applications (below) in this sample budget is 135 lbs per acre.
- *Potassium Nitrate* - It is sold in 50-lb bags and costs on average $35 per bag or $0.70 per lb. The estimated application rate for potassium nitrate used for fertigation and alternated with calcium nitrate applications (above) in this sample budget is 225 lbs per acre.[3]

3. **Plastic Mulch** – We estimated that slightly over two, 4 x 4,000-ft rolls of polyethylene mulch per acre are needed, assuming 5-ft spacing between bed centers (43,560 sq ft per acre/5 ft bed centers = 8,712 linear bed ft/4,000 ft). The estimated average cost per roll is $167.

4. **Drip Tape** – We estimated 11.62 rolls (750 ft per roll) per acre, assuming 5-ft spacing between bed centers (43,560 sq ft per acre/5 ft bed centers = 8,712 linear bed ft/750 ft drip tape per roll). The estimated average cost per roll is $188.

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 (University of Tennessee Extension). We assumed 48″ stakes were used for the trellis system. The cost per stake was estimated at $0.66/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 8.3, 6,300-ft tube rolls of twine per acre (i.e., (8,712 linear bed ft per acre x 2 sides of the row x 3 trellising heights)/6,300 ft twine per roll). The estimated average cost per 6,300-ft tube roll is $8.03.

[3] Application rates use 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 2022 Southeast U.S. Vegetable Crop Handbook, p. 101, for fertilizer recommendations for plasticulture pepper.

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 University of Tennessee recommendations. We also included a variation of the budget, which includes the 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. **In the Excel version of the sample budget, you would be able to select different assumptions related to yield losses due to Phytophthora blight (e.g., 10, 20, 30, or 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). **If UT Extension recommendations are followed for Phytophthora blight management, farmers should not expect to see yield losses greater than 20 percent in most seasons. Nonetheless, it could be possible for a grower to follow the suggested fungicide program and still see losses higher than 20 percent, but this would be the exception and not the norm**. The list of fumigants and fungicides is based on management recommendation examples by Dr. Zachariah Hansen (zhansen1@utk.edu), Assistant Professor and Extension Specialist in UTIA's Department of Entomology & Plant Pathology. **Tables 1 and 2** in the Appendix show fungicides 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.

9. **Insecticides** – Insecticides are used as needed. In this budget, we assume 5 applications of pyrethroids for stink bugs and caterpillars (e.g., Mustang Maxx, at an application rate of 3.12 fl oz/acre), plus a drip chemigation application of chlorantraniliprole (e.g., Coragen, a diamide class of insecticide, at an application rate of 2.75 fl oz/acre). Then, an application of Movento for green peach aphids control at an application rate of 4.5 fl oz/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, refer to the latest version of the Southeast U.S. Vegetable Crop Handbook.

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 post-emergence. 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. For other options for pepper herbicides, consult the latest version of the Southeast U.S. Vegetable Crop Handbook.

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, harvesting, packing/grading, plastic removal and disposal, and other activities, based on information we 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 $13.89/hour, which is the 2022 Adverse Effect Wage Rate for Tennessee (U.S. Department of Labor, Employment & Training Administration ETA). The hourly rate for operator labor is estimated at $16.27 (Bureau of Labor Statistics). Harvesting and packing/grading labor costs were estimated based on personal communications with pepper growers. Similar to the 2017 UK budgets, we assumed a harvest rate of 15 boxes/hour and a grading and packing rate of 10 boxes per hour. These costs were adjusted using Tennessee wage rates as described above. **In the Excel version of this sample budget, you can modify harvesting, grading, and packing rates assumptions**.

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 $2.83.
13. **Diesel Fuel** – Fuel cost is based on estimates of fuel consumption associated with a 2WD 75 HP tractor pulling

various implements related to land preparation, planting, harvesting and post-harvest activities, as calculated by the Mississippi State Budget Generator (Version 6.0). Diesel fuel cost per gallon was estimated at $4.99. We used 2022 diesel fuel prices as projected by the U.S. Energy Information Administration.[4]

14. **Repairs and Maintenance** – We assumed the use of a 2WD 75 HP tractor, a 10' disk harrow, cyclone fertilizer spreader, plastic mulch layer, 27′ sprayer, 10′ utility trailer, and a plastic mulch lifter. Repairs and maintenance costs are estimated using the Mississippi State Budget Generator (Version 6.0). 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 costs vary by location. There are some counties where the disposal cost will only include the transportation cost associated with moving polyethylene mulch from the farm to the landfill. In contrast, other counties have a disposal fee of anywhere between $20 and $50 per ton of mulch. Some landfills may not even accept polyethylene mulch for disposal. In this study, we assumed an average disposal cost of $35/ton. We assumed the weight of the plastic mulch is going to increase by 50 percent during the growing season (Kasirajan and Ngouajio, 2012), due to soil and plant debris adhering to the mulch. 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 4.35 percent.

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 cost 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 calculated using Mississippi State Budget Generator (Version 6.0), for equipment and implements mentioned 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** – 2022 Tennessee State Average Cropland Cash Rents as reported by USDA NASS are used (USDA NASS); however, rental rates are subject to local market conditions.

The Impact of Phytophthora Blight on Farm Revenue and Costs

In **Table 1** we showed 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 111 percent, while overall costs decreased by about 1.14 percent or $228/acre, given that harvesting, packing and grading labor costs, and cardboard box costs also decreased because we assumed a yield loss of 10 percent due to Phytophthora blight. Additionally, net returns are reduced by about $2,364/acre, going from $5,986/acre to $3,622/acre. **Yield losses due to Phytophthora blight are a factor of a grower's cultural practices and environmental conditions. As such, losses vary year to year and farm to farm. If UT Extension recommendations are followed for Phytophthora blight management, farmers should not expect to see yield losses greater than 20 percent in most seasons. Nonetheless, it could be possible for a grower to follow the suggested fungicide program and still see losses higher than 20 percent, but this would be the exception and not the norm.** Suppose cultural practices necessary to reduce disease pressure are not followed, and the environmental conditions favor the presence of phytophthora blight; in that case, a total crop loss can be expected, or, following the example presented in **Table 1**, expected net losses could be around $12,841 per acre.

[4] https://www.eia.gov/dnav/pet/PET_PRI_GND_DCUS_R20_W.htm

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 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 $14.78 per box or nearly $4.44 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 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 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 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)	$19.22	1,349	$25,919.44
VARIABLE COST				
1. Pepper Plants	plant	$0.17	17,424	$2,988.09
2. Pre-plant: 10-10-10 Fertilizer	50 lb bag	$19.36	10.00	$193.59
2. Fertigation: Calcium Nitrate	50 lb bag	$24.95	2.70	$67.37
2. Fertigation: Potassium Nitrate	50 lb bag	$35.00	4.50	$157.50
3. Plastic mulch	roll (4x4,000)	$166.99	2.18	$364.04
4. T-tape (drip tape, 750')	roll (750')	$187.50	11.62	$2,178.00
5. Water costs	ac-in			-
6. Stakes	per 1400 stakes	$929.89	4.15	$3,867.73
7. Twine	per 6,300 ft tube	$8.03	8.30	$66.60
8. Fumigant				
Telon C17	gal	$20.30	37.20	$755.16
8. Fungicides				
Kocide	lb	$10.68	15.00	$160.13
Manzate	lb	$5.79	14.00	$81.08
Quadris	fl oz	$1.54	10.00	$15.42
Bravo	pt	$5.32	1.50	$7.99
Cabrio	oz	$2.72	10.00	$27.22
Priaxor	fl oz	$4.66	6.00	$27.97
Aprovia Top	fl oz	$3.98	24.00	$95.43
9. Insecticdes				
Mustang Maxx	fl oz	$1.58	14.04	$22.12
Coragen	fl oz	$8.57	2.75	$23.56
Movento	fl oz	$8.30	4.50	$37.35
Orthene	lb	$16.15	0.38	$6.06
10. Herbicides				
Poast	pt	$14.60	1.50	$21.91
Sandea	oz	$34.12	0.75	$25.59
11. Hired Labor				
Operator Labor	hour	$16.27	6.69	$108.85
Transplant Labor	hours	$13.89	28.84	$400.59
Harvest Labor	box	$0.93	1,348.80	$1,248.99
Grade/Packing Labor	box	$1.39	1,348.80	$1,873.48
Plastic removal	hour	$13.89	12.00	$166.68
Plastic disposal	hour	$13.89	2.00	$27.78
12. Other Marketing and Harvesting Costs				
Cardboard boxes	box	$2.83	1,348.80	$3,819.03
13. Diesel Fuel				
Tractors	gal	$4.99	21.49	$107.25

Table 1. Estimated Gross Returns and Costs Per Acre for a Pepper Operation with No Phytophthora Blight (Continued)

VARIABLE COST	UNIT	$/UNIT	QUANTITY	TOTAL
14. Repairs and Maintenance				
Tractor 2WD 75 HP	acre	$7.90	1	$7.90
Implements	acre	$6.62	1	$6.62
15. Plastic Mulch Disposal				
Plastic mulch disposal	free per ton	$35.00	0.14	$4.90
16. Operating interest	interest rate	4.35 %		$412.42
TOTAL VARIABLE COST				$19,374.38
FIXED COSTS				
17. Irrigation	acre	$315.50	1	$315.50
18. Power Equipment	acre	$39.26	1	$39.26
18. Implements	acre	$17.15	1	$17.15
19. Land Rent	acre	$187.00	1	$187.00
TOTAL FIXED COST				$558.91
TOTAL COSTS				$19,933.29

Table 2 . Estimated Gross Returns and Costs Per Acre for a Pepper Operation with Phytophthora Blight

ITEM	UNIT	$/UNIT	QUANTITY	TOTAL
GROSS RETURN				
Bell Peppers	box (1 1/9 bu)	$19.22	**1,214**	$23,327.50
VARIABLE COST				
1. Pepper Plants	plant	$0.17	17,424	$2,998.09
2. Pre-plant: 10-10-10 Fertilizer	50 lb bag	$19.36	10.00	$193.69
2. Fertigation: Calcium Nitrate	50 lb bag	$24.95	2.70	$67.37
2. Fertigation: Potassium Nitrate	50 lb bag	$35.00	4.50	$157.50
3. Plastic mulch	roll (4x4,000)	$166.99	2.18	$364.04
4. T-tape (drip tape, 750')	roll (750')	$187.50	11.62	$2,178.00
5. Water costs	ac-in			-
6. Stakes	per 1400 stakes	$929.89	4.15	$3,857.73
7. Twine	per 6,300 ft tube	$8.03	8.30	$66.60
8. Fumigant				
Telon C17	gal	$20.30	37.20	$755.16
8. Fungicides				
Kocide	lb	$10.68	15.00	$160.13
Manzate	lb	$5.79	14.00	$81.08
Quadris	fl oz	$1.54	10.00	$15.42
Bravo	pt	$5.32	1.50	$7.99
Cabrio	oz	$2.72	10.00	$27.22
Priaxor	fl oz	$4.66	6.00	$27.97
Aprovia Top	fl oz	$3.98	24.00	$95.43
Orondis Gold 200	fl oz	$2.34	9.60	$22.50
Ridomil Gold SL	pt	$117.11	1.00	$117.11
Ranman	fl oz	$8.10	5.50	$44.56
Revus	fl oz	$3.49	16.00	$55.83
Presidio	fl oz	$10.43	8.00	$83.47
Zampro	fl oz	$2.81	14.00	$39.33
Orondis Ultra	fl oz	$6.22	16.00	$99.53
9. Insecticdes				
Mustang Maxx	fl oz	$1.58	14.04	$22.12
Coragen	fl oz	$8.57	2.75	$23.56
Movento	fl oz	$8.30	4.50	$37.35
Orthene	lb	$16.15	0.38	$6.06

Table 2 . Estimated Gross Returns and Costs Per Acre for a Pepper Operation with Phytophthora Blight (Continued)

VARIABLE COST	UNIT	$/UNIT	QUANTITY	TOTAL
10. Herbicides				
Poast	pt	$14.60	1.50	$21.91
Sandea	oz	$34.12	0.75	$25.59
11. Hired Labor				
Operator Labor	hour	$16.27	6.69	$107.38
Transplant Labor	hours	$13.89	28.84	$400.59
Harvest Labor	box	$0.93	1,213.92	$1,124.09
Grade/Packing Labor	box	$1.39	1,213.92	$1,686.13
Plastic removal	hour	$13.89	12.00	$166.68
Plastic disposal	hour	$13.89	2.00	$27.78
12. Other Marketing and Harvesting Costs				
Cardboard boxes	box	$2.83	1,3213.92	$3,437.13
13. Diesel Fuel				
Tractors	gal	$4.99	21.49	$113.50
14. Repairs and Maintenance				
Tractor 2WD 75 HP	acre	$7.90	1	$8.30
Implements	acre	$6.62	1	$7.37
15. Plastic Mulch Disposal				
Plastic mulch disposal	free per ton	$35.00	0.14	$4.90
16. Operating interest	interest rate	4.35 %		$407.51
TOTAL VARIABLE COST				$19,143.59
FIXED COSTS				
17. Irrigation	acre	$315.50	1	$315.50
18. Power Equipment	acre	$39.26	1	$41.61
18. Implements	acre	$17.15	1	$18.00
19. Land Rent	acre	$187.00	1	$187.00
TOTAL FIXED COST				$562.11
TOTAL COSTS				$19,705.70

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 Phytophthora Blight

Breakeven ($/box)											
Bell Pepper		$11.64	$12.06	$12.58	$13.19	$13.91	$14.78	$15.48	$17.16	$18.86	$21.13	$24.30
Percent	**Yield**											
50	674	$(8,560)	$(8,255)	$(7,902)	$(7,490)	$(7,004)	$(6,420)	$(5,707)	$(4,815)	$(6,669)	$(2,140)	**$0**
60	809	$(7,704)	$(7,338)	$(6,914)	$(6,420)	$(5,837)	$(5,136)	$(4,280)	$(3,120)	$(1,834)	**$0**	$2,568
70	944	$(6,848)	$(6,420)	$(5,927)	$(5,350)	$(4,669)	$(3,852)	$(2,854)	$(1,605)	**$0**	$2,140	$5,136
80	1,079	$(5,992)	$(5,503)	$(4,939)	$(4,280)	$(3,502)	$(2,568)	$(1,427)	**$0**	$1,834	$4,280	$7,704
90	1,214	$(5,136)	$(4,586)	$(3,951)	$(3,210)	$(2,335)	$(1,284)	**$0**	$1,605	$3,669	$6,420	$10,273
100	1,349	$(4,279)	$(3,669)	$(2,963)	$(2,140)	$(1,167)	**$0**	$1,427	$3,210	$5,503	$8,561	$12,841
110	1,484	$(3,423)	$(2,752)	$(1,976)	$(1,070)	**$0**	$1,284	$2,854	$4,815	$7,338	$10,701	$15,409
120	1,619	$(2,567)	$(1,834)	$(988)	**$0**	$1,167	$2,568	$4,280	$6,420	$9,172	$12,841	$17,977
130	1,753	$(1,711)	$(917)	**$0**	$1,070	$2,335	$3,852	$5,707	$8,026	$11,006	$14,981	$20,545
140	1,888	$(855)	**$0**	$988	$2,140	$3,502	$5,136	$7,134	$9,631	$12,841	$17,121	$23,113
150	2,023	**$0**	$917	$1,976	$3,210	$4,669	$6,420	$8,561	$11,236	$14,675	$19,261	$25,682

Conclusion

The information presented in this publication suggests that losses due to Phytophthora blight can be significant. There are additional costs associated with managing 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: tiny.utk.edu/W810.

Excel Sample Budget

The large-scale bell pepper budget Excel tool is available on the University of Tennessee Department of Agricultural & Resource Economics website at https://arec.tennessee.edu/extension/budgets/. This sample budget spreadsheet tool was developed as a decision aid to assist large-scale Tennessee pepper producers in estimating the cost of production. Additionally, this decision aid could help pepper producers assess the economic impact of Phytophthora blight by comparing a baseline budget ("Budget no PB") with an alternative budget that includes managing costs and potential yield losses associated with the disease ("Budget PB"). Below is important information the user will need to consider when using this tool:

- The "Budget no PB" spreadsheet will show gross returns, variable, fixed and total costs associated with a one-acre bell pepper operation, assuming there is no presence of Phytophthora blight. Spreadsheet cells highlighted in grey in this spreadsheet can be modified by users to reflect their specific situation. For example, the user can modify yield, harvesting, grading and packing rate assumptions on the table, listing all assumptions at the top of the spreadsheet. Additionally, they can modify assumptions related to input use, including product, price and application rates. Finally, at the top of this spreadsheet, the user will be able to see the breakeven yield and price based on the information provided regarding variable and fixed costs. The breakeven yield is the minimum yield that will cover total costs while holding the price constant. The breakeven price is the minimum price that will cover total costs while holding the yield constant.

- The "Budget PB" spreadsheet will show gross returns, variable, fixed and total costs associated with a one-acre bell pepper operation, assuming Phytophthora blight is present. Just like in the previous spreadsheet, cells highlighted in gray in this spreadsheet can be modified by users to reflect their specific situation. Additionally, at the top of this spreadsheet, the user will be able to modify assumptions related to potential yield losses associated with Phytophthora blight. When clicking on the cell associated with the assumptions related to yield losses, the user will have to click the arrow and select one of the five possible yield loss scenarios (i.e., 10 percent, 20 percent, 30 percent, 40 percent and 50 percent). In the "Budget PB" spreadsheet, the user will be able to see the difference in costs and net returns between the "Budget PB" and the "Budget no PB" scenarios.

- The print button allows the user to print a one-page summary of the budget/scenario.

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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	Fumigants1 (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 (1.5 lbs per acre)
2	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
3	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot *(Colletotrichum spp.)*	12 oz per acre
4	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
5	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
5	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Cabrio (pyraclostrobin)	Anthracnose fruit rot *(Colletotrichum spp.)*	10 oz per acre
6	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
7	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Priaxor (fluxapyroxad + pyraclostrobin)	Anthracnose fruit rot *(Colletotrichum spp.)*	6 oz per acre
8	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
9	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	azoxystrobin (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Quadris as an example (10 oz per acre)

[1] Examples of fumigants include InLine (29-56.7 gal/treated acre), Pic-Clor 60 (48.6 gal/treated acre), Telone C17 (32.4-42 gal/treated acre) and Telone C35 (39-50 gal/treated acre).

Table 1. Example of Fungicide Program When Phytophthora Blight Does Not Need to Be Managed (Continued)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
10	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 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 per 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	Fumigants1 (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 (1.5 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 (1.5 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 (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Aprovia Top (difenoconazole + benzovindiflupyr)	Anthracnose fruit rot *(Colletotrichum spp.)*	12 oz per acre
	Revus (mandipropamid)	Phytophthora blight *(Phytophthora capsici)*	8 fl oz per acre
4	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs 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 (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Cabrio (pyraclostrobin)	Anthracnose fruit rot *(Colletotrichum spp.)*	10 oz per 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 (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per 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 C17 (32.4-42 gal/treated acre) and Telone C35 (39-50 gal/treated acre).

Table 2. Example of Fungicide Program When Phytophthora Blight Needs to Be Managed (Continued)

Week (post-transplanting spray #)	Product (active ingredient)	Target disease	Rate per acre
7	fixed copper (various)	Bacterial spot *(Xanthomonas euvesicatoria)*	Kocide as an example (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per acre)
	Priaxor (fluxapyroxad + pyraclostrobin)	Anthracnose fruit rot *(Colletotrichum spp.)*	6 oz per 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 (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs 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 (1.5 lbs per acre)
	mancozeb (various)	Anthracnose fruit rot *(Colletotrichum spp.)*	Manzate as an example (2 lbs per 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 (1.5 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 per acre
	Orondis Ultra (oxathiapiprolin + mandipropamid)	Phytophthora blight *(Phytophthora capsici)*	8 fl oz per acre

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