STAFF PAPER

Cost of Fresh Market Sweet Bell Pepper Production in Macomb County, Michigan

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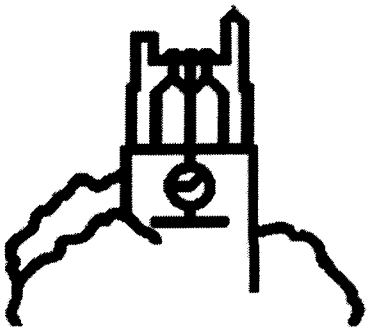

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This bulletin represents a tool that can help producers, consultants, educators, and agribusinesses working with producers estimate costs of production and expected profit based on "typical" sweet bell pepper management strategies found in Macomb County, Michigan. The tools and techniques these producers use do not vary substantially from typical practices found in other regions of the state. The budget included in this bulletin will allow users to revise inputs based on their management strategies and calculate their expected cost and profit. This flexibility provides a decision aid to search for systems that generate higher net returns to the farm's resource base.

The brief outline of cultural and pest management practices included in this publication should be supplemented with publications from Michigan State University or from other Universities. See the References section for resources. Many are available on-line.

Pepper Production and Climatic Requirements

Bell peppers are grown throughout Michigan with principal growing regions in the southwest, west central and southeast. Peppers are a warm season crop that produce best during a long growing season. They are sensitive to temperature extremes, preferring daytime temperatures of 70-80°F and an average nighttime temperature of 65°F with soil temperatures above 65°F. The crop is killed or seriously injured by frost and can also be injured by long periods of temperatures below 50°F. Both high and low temperatures have an adverse effect on flowering and fruit set. Blossoms often drop if day temperatures are above 90°F and fruit will not set well when night temperatures are below 55°F or above 75°F. Plants growing below 70°F grow very slowly and usually do not set flowers. Thus, maximum production will usually be obtained during a moderately warm summer with daytime highs in the 80°F range and nighttime lows in the 60s.

Plasticulture

Many Michigan-grown peppers are produced on raised, plastic-mulched, drip irrigated beds. Plasticulture provides earlier production, higher yields and quality, more efficient use of water and nutrients, and other benefits. After working the soil in the spring, beds are shaped, plastic laid and drip tube inserted in one pass using a specifically designed piece of equipment attached to a tractor. Beds may or may not be fumigated at this time. Plants are then planted through the

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plastic in double rows, generally 14 inches between rows and 12-18 inches between plants in the row. Peppers may also be staked and tied using this production system. In plasticulture systems, approximately one third of the recommended nitrogen and potassium should be applied prior to bed shaping. The remainder is applied through the drip irrigation system during the growing season. A favorable ratio of nitrogen: potassium is 1:2.

Site Selection and Planting

Peppers grow well on any type of well-drained soil. Sandy loam with good water retention is ideal. Tile drainage, raised beds and plasticulture are becoming the standard for fresh market pepper production because of the mitigating effects this system has on cool and wet soils as well as other benefits. Growers in this study find it beneficial to plow down fall planted winter wheat or rye cover crops in the spring to add organic matter, improve soil structure and lessen some weed pressure. The grain is broadcast the preceding fall and plowed down in the spring accompanied by a fertilizer application.

All Michigan-grown peppers are established by transplanting. In Macomb, and throughout the state, growers typically produce their own plants or have them grown locally. Seed is started in greenhouses from February through April, depending upon the region and transplanting schedule, using clean seed, a soilless mix and cultural practices suitable for the particular operation. Obtaining 6-8 inch tall transplants requires about 8 weeks, which includes a 3-5 day conditioning period. Field planting occurs late May and early June.

Land for pepper production should have soils with a pH between 6.5 and 6.8. Growers in Macomb County find they need to lime about every third year to maintain proper pH levels. Bed preparation involves four cultivations, with the last pass forming 66-78" wide beds. Before planting, transplants should be only slightly hardened. Over-hardened transplants are slow to develop once in the field. Characteristically, 10,000-11,000 plants are placed, per acre, using a cell or waterwheel planter. Two rows of transplants are placed in each 8-10" raised bed with 14 inches between plants. About 10 pounds per acre of soluble 20-20-20 is applied in the transplant water. Fertigation begins about two to three weeks after transplantation. Once plants begin to set fruit, fertigation of soluble 20-20-20 is replaced with 100 pounds per acre of soluble greenhouse grade calcium nitrate.

In addition to temperature related fruit set problems already discussed, peppers may experience delayed fruit set due to over-fertilization with nitrogen. Blossom end rot is due to insufficient calcium that may be caused by low soil calcium but is also aggravated by excess nitrogen, moisture stress, genetics and high temperatures

Pest Management

When seeking advice on use of labeled pesticides (including herbicides), please refer to the most current versions of Michigan State University Extension Bulletins titled "Insect, Disease and Nematode Control for Commercial Vegetables" (Extension Bulletin E-312) and "Weed Control Guide for Vegetable Crops" (Extension Bulletin E-433). They are available on-line at http://www.msue.msu.edu/vegetable/Resources/E312/E312.htm and http://www.msue.msu.edu/vegetable/Resources/weeds/weed.htm *respectively. Specific herbicide and pesticide names have been used in this publication to facilitate accurate budgeting, but*

Michigan State University does not endorse any of the brand name products listed and does not direct producers to limit management systems to these products.

Pest management is critical to reduce damaged fruit and disease build-up. Field scouting can detect early pest outbreaks and greatly reduce yield losses and unnecessary pesticide applications. A subscription to the MSU Vegetable Crop Advisory Alert would provide a good pest management reference. It is available as a mail subscription or over the Internet at http://www.msue.msu.edu/ipm/vegCAT.htm

Weed Control A plasticulture system results in weeds between the rows or beds. Cultivation may be difficult and labeled herbicides may be used as needed.

Insect Pests European corn borer, green peach aphid and cutworm may cause losses in peppers.
European corn borer larvae should be monitored and treated just after they hatch, between mid-July and late August. Control is not necessary until the second generation and then only when fruit are present. There is a 4-7 day window when the eggs, which are laid on the underside of the leaf, hatch and the larvae feed on the leaves. The caterpillars then bore a pin-sized hole at the edge of the fruit cap and enter inside the fruit to feed. When applying an insecticide be sure to cover the stem-end of the fruit.

Aphids secrete a honeydew upon which sooty mold grows, discoloring leaves and fruit and making the fruit unmarketable. Aphids also vector several virus diseases. Frequent use of insecticides such as pyrethroids which are not effective on aphids may cause outbreaks by destroying natural enemies.

Diseases. Viruses, transmitted by aphids, affect a wide range of cultivated crops and weeds. Symptoms vary; depending upon the virus involved, age of the plants when infected, and upon environmental conditions. As no controls are available once the plants are infected, cultural controls must be employed to avoid infection and spread. Insect control does not guarantee virus control.

Bacterial spot (*Xanthomonas vesicatoria)* can be brought in on infected seed or transplants and may over-winter in diseased plant residue for up to one year. Leaf, stem and fruit spotting may be mild or severe and can destroy the crop given warm temperatures, abundant moisture and water splashing. It is imperative to avoid planting symptomatic transplants. Affected and adjoining plants should be removed from the greenhouse as soon as they are identified. Bacterial soft rot (*Erwinia carotovora)* is not often seen in the field but often appears after harvest. The bacterium enters the fruit through wounds and rapidly causes a soft, watery breakdown of fruit.

Phytophthora blight causes severe losses in peppers and vine crops in Michigan. Root rot, stem canker, leaf blight and fruit rot may all indicate this disease. While selective fungicides may be used preventatively, satisfactory controls will not be achieved without strict attention to prevention through cultural management. These include good drainage, rotation out of susceptible crops, and avoidance of inoculum from water sources and equipment.

Fungal diseases, which may occur on pepper, include early blight, Cercospora leaf spot, downy mildew and verticillium wilt. These diseases have not been typically known to cause losses in Michigan.

Harvest and Handling
Immature fruit do not hold up well after harvest, therefore, it is important to recognize when fruit of a particular cultivar is ready for harvest. Fruit are hand-harvested four to five times from August 1 to frost, using a harvest-aid conveyer. They are then graded and packed into 11/9 bushel boxes. Fruit is cooled and marketed as quickly as possible. At storage temperatures of 45-50° F and relative humidity of 90-95% peppers will store for three weeks. Later harvest might include mature fruit of red, orange or yellow colors. Yield ranges from 800 to1500 bushels per acre depending upon the growing system and cultivar.

Cost of Production Budget
The budget developed using information gathered from growers is presented in Table 1. Details of some practices are mentioned in footnotes. To adapt this budget, insert or remove individual practices as necessary.

Because expected prices and yields vary across years and producers, no revenue was included in this budget. However, Table 2 shows expected net returns at a variety of typical prices and yields. Where indicated in the budget, the cost structure does vary by yield. Use of this table should help producers compare expected returns from typical prices and yields using practices outlined above and detailed in the budget. ***If the budget is modified to better fit a different production system, Table 2 will not accurately represent net returns per acre.***

Approach
The information on sweet bell pepper cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a pepper production system and strategic planning context representative of Macomb County, Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions were collected. This process resulted in a list of inputs and input prices that were then translated into costs, which were verified against grower records.

Because the production system and details were derived from grower input, fertilizer and chemical use may not match some horticultural recommendations. All grower practices were verified and do reflect current procedures. The following budget reproduces, as completely as possible, all costs incurred by these growers.

Pricing Annual Costs of Capital Services (Buildings, Machinery, and Equipment)
Estimating the annual cost of using buildings, machinery, equipment and other assets is a challenge in cost of production studies. In previous studies of Michigan horticultural crops, focus groups constructed a representative farm with fixed acreage and then constructed the buildings, machinery, and equipment needed to operate this farm. They also generated associated labor needs and repair and operating costs. This approach has the advantage of being very tangible but also makes it difficult to interpret results for alternative farm sizes.

In this study, an alternative approach was taken. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service/task reflecting both the machinery and labor components of the service.

This approach requires some judgment because costs such as buildings to house machinery and equipment, the farm shop, and labor used in maintenance of machinery and equipment must be included in the "custom fee" as well as the "depreciation and interest" on the machinery and equipment. The fact that this custom fee approach was used does not imply that custom operators did all the tasks. It simply means the tasks are priced to the enterprise as if a custom operator had completed them. The services may well have been provided by the "machinery services enterprise" of the farm. As a double check, members of the focus group attempted to compare the aggregate custom fee costs to those based on their accounting records which included labor, custom fees, and depreciation and interest on buildings, machinery, and equipment. Custom fees were also double-checked against survey information when available.

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Table 1. Fresh market pepper budget. Michigan, 2002.

Peppers, Fresh Market Green Bell, On Beds with Plastic and Trickle	Quantity	Unit	Price per Unit	Cost per Acre	Your Farm
REVENUE SOURCES					
Peppers	1,100	1 1/9 bu		$ -	
TOTAL REVENUE				**$ -**	
EXPENSES					
Soil test				$ 2	
Fall ground preparation					
Tillage[1]				$ 16	
Rye seed				$ 6	
Fall fertilizer					
Potash	400	lb	$ 0.13	$ 52	
Limestone	0.33	ton	$ 20.00	$ 7	
Spring ground preparation					
Tillage[2]				$ 65	
Black plastic and drip tape				$ 284	
Laying plastic and drip tape[3]				$ 98	
Plants					
Seed				$ 220	
Flat production	85	flats	$ 8.00	$ 680	
Transplanting					
Machinery[4]				$ 31	
Labor[5]				$ 100	
Fertilizer					
Urea	200	lb	$ 0.25	$ 50	
20-20-20[6] (preplant)	10	lb	$ 0.54	$ 5	
20-20-20[7] (postplant)	150	lb	$ 0.54	$ 81	
20-20-20[8]	35	lb	$ 0.54	$ 19	
Calcium nitrate[7]	300	gal	$ 1.00	$ 300	
Herbicide Materials[9]				$ 12	
Insecticide Materials[10]				$ 85	
Disease Control Materials[11]				$ 201	
Fumigation[12]				$ 400	
Spray applications	8	apps	$ 7.00	$ 56	
Hoeing				$ 50	
Irrigation[13]				$ 150	
Harvest					
Machinery[14]				$ 18	
Labor[15]	1540	bu	$ 1.50	$ 2,310	
Grading and Packing	1540	bu	$ 0.80	$ 1,232	
Cooling	1100	bu	$ 0.10	$ 110	
Cardboard box	1100	boxes	$ 1.10	$ 1,210	
Land rent				$ 150	
Insurance				$ 7	
Interest[16]	7%			$ 66	
Tool shed & repair overhead[17]				$ -	
Marketing, management & supervision[18]				$ 992	
TOTAL EXPENSES				**$ 9,065**	

FOOTNOTES

1	1 Includes discing, broadcasting rye, and broadcasting fertilizer.
2	2 Includes spreading fertilizer, moldboard plowing, discing (twice), packing with cultimulcher and field cultivating.
3	3 Includes machinery and labor costs to fit beds, fumigate, and lay plastic and drip tape.
4	4 Cost for tractor, waterwheel transplanter and transporting flats to field.
5	5 Includes costs for 4 workers and a total of 13.3 man-hours per acre, management supervision, flat delivery and clean-up, and one person fitting the soil ahead of the transplanter. Assumes transplanting rate of 1 acre per hour.
6	6 Applied as soluble mix with transplanter.
7	7 Applied greenhouse grade in solution 3 times through trickle irrigation.
8	8 Applied 6 times with sprayer in conjunction with crop chemicals.
9	9 Includes 2 applications of Gramoxone.
10	10 Includes 4 applications of Lannate and 2 applications of Orthene.
11	11 Includes 2 applications of Ridomil Gold EC, 2 applications of Maneb and 2 applications of Kocide.
12	12 Fumigation with methyl bromide under plastic.
13	13 Includes labor, electricity and fixed costs. Drip tape is included above.
14	14 Charge for a conveyor belt (harvest aid) in the field and transporting crates to shed.
15	15 Assumes a 7 person crew takes 4.5 hours to harvest each acre. Due to culling, harvested yield is 40% less than packed yield.
16	16 Operating capital assumed to be half of the variable costs (excluding custom charges) for half of the year.
17	17 These costs are included in custom rates.
18	18 Includes a 9% brokerage fee on revenue and $200 for management and supervision.

Table 2. Expected fresh market pepper net income (loss) per acre at selected price and yield combinations.

	Yield, bushels per acre				
Price	700	900	1,100	1,300	1,500
$ 6.00	$ (3,097)	$ (2,781)	$ (2,465)	$ (2,149)	$ (1,833)
$ 7.00	$ (2,397)	$ (1,881)	$ (1,365)	$ (849)	$ (333)
$ 8.00	$ (1,697)	$ (981)	$ (265)	$ 451	$ 1,167
$ 9.00	$ (997)	$ (81)	$ 835	$ 1,751	$ 2,667
$ 10.00	$ (297)	$ 819	$ 1,935	$ 3,051	$ 4,167