



AGRICULTURAL ALTERNATIVES

Cucumber Production

Cucumbers lend themselves well to small-scale and part-time farming operations. Multiple markets exist for growers with fewer than 5 acres, and many field operations, such as land preparation, planting, and harvesting, can be custom hired.

Cucumbers (*Cucumis sativas*) are a member of the Cucurbitaceae family, which also includes squashes, pumpkins, muskmelons, watermelons, and gourds. Normally, cucumber plants are monoecious—they produce both male and female flowers on the same plant. Male flowers appear on the main stem earlier and in much larger numbers than female flowers. Many modern hybrids are gynoecious—they produce only female flowers and are referred to as all-female varieties. Recommended varieties for Pennsylvania are provided in the table on the right.

Cucumbers are native to India and were introduced into China 2,000 years ago. They were then brought to Europe, most likely first into Greece, from which their cultivation spread into Italy, Germany, and France. Pliny the Great stated that cucumbers were grown in Africa as well as Italy in his time, and that the Emperor Tiberius (14–37 AD) had cucumbers at his table every day. Cucumbers were grown by Christopher Columbus in Haiti in 1494. In 1539, Hernando De Soto found varieties of cucumbers in Florida that were better



Recommended Slicing Cucumber Cultivars for Pennsylvania

CULTIVAR	DISEASE RESISTANCE*
Standard Slicers (gynoecious—mostly or all female flowers)	
Bristol	Scab, PM, AN, ALS, CMV, WMV, ZYMV, PRSV
Dasher II	Scab, PM, AN, ALS, CMV
Dominator	Scab, PM, AN, ALS, CMV
General Lee	Scab, PM, CMV
Intimidator	Scab, PM, AN, ALS, CMV
Mongoose	Scab, PM, AN, ALS, CMV, WMV, ZYMV, PRSV
Python	Scab, PM, AN, ALS, CMV
Speedway	Scab, PM, AN, ALS, CMV
Stonewall	Scab, PM, AN, ALS, CMV
SV3462CS	Scab, PM, AN, DM, ALS, ZYMV
SV4719CS	Scab, PM, AN, DM, ALS, ZYMV
Talladega	Scab, PM, AN, ALS, CMV, WMV
Thunder	Scab, PM, AN, ALS, CMV, ZYMV
Long Slicers (monoecious—both male and female flowers)	
Suyo Long	PM
Tasty Green	PM

All of the above are hybrids, except 'Suyo Long'.

*High or intermediate disease resistance:

- Scab = scab
- PM = powdery mildew
- AN = anthracnose
- DM = downy mildew
- ALS = angular leaf spot
- CMV = cucumber mosaic virus
- WMV = watermelon mosaic virus
- ZYMV = zucchini yellow mosaic virus
- PRSV = papaya ring spot virus

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than those grown in Spain, and cucumbers were also reported to be grown in Virginia in 1609. Early cucumber varieties were not as smooth or symmetrical as current varieties, and breeding work to produce hybrids did not begin until 1880.

The United States harvests cucumbers for two basic purposes: pickling and fresh marketing. In 2012, the 11,200 farms in the northeast states produced more than 6,600 acres of cucumbers. The value of production for the United States is over \$410 million. Pennsylvania produced 337 acres of cucumbers, primarily for fresh marketing.

Marketing

Fresh-market cucumbers are usually available in Pennsylvania from the end of June until the end of November. They are traditionally sold in 47- to 55-pound wooden crates or cardboard boxes. Several marketing alternatives are available to the cucumber grower: wholesale marketing, produce auctions, cooperatives, local retailers, roadside stands, and pick-your-own operations. When planning production, first consider your ability to market. You should conduct some market research because often growers overestimate their ability to sell in a given market. Production of less than one acre of many vegetable crops is typical for most growers.

In wholesale marketing, producers often contract with shippers to market and ship the cucumbers for a predetermined price. If you do not use a contractor and ship your cucumbers to a wholesale market yourself, your product will be subject to the greatest price fluctuations. Produce auctions operate weekly; however, you must deliver the cucumbers to the auction. Marketing cooperatives generally use a daily pooled cost and price, which spreads price fluctuations over all participating producers. Local retailers are another possible market, but you must take the time to contact produce managers and provide good-quality cucumbers when stores require them. Depending on your location, processors may or may not be a marketing option. Processors are less likely to contract with small-acreage growers (those with fewer than 5 acres). For more information on marketing, consult “Agricultural Alternatives: Fruit and Vegetable Marketing for Small-Scale and Part-Time Growers.”

Retail marketing options include roadside stands (either your own or another grower’s) and pick-your-own operations, which provide opportunities to receive higher-than-wholesale prices for your cucumbers, but

you may have some additional expenses for advertising, building and maintaining a facility, and providing service to your customers. With pick-your-own operations, you save on harvest costs, but you must be willing to accept some waste. Farmers markets are another retail option, but you should contact the markets well in advance of the marketing season to be sure space is available and to find out what requirements you must follow. For more information about roadside markets, see “Agricultural Alternatives: Developing a Roadside Farm Market.”

Site Selection

Cucumbers should be grown on soils that have good water infiltration rates and moisture-holding capacities. The soil should not be compacted and the pH should be 5.8–6.6. Cucumbers are very sensitive to cold, and the plants as well as the fruit can be injured by even a slight frost. The best average temperature range for cucumber production during the growing season is between 65°F and 95°F; temperatures above 95°F or below 50°F slow the growth and maturity of the crop. Cucumbers require a constant supply of moisture during the growing season. Moisture fluctuation, especially soil water depletion, will cause growth deformity, which can reduce both the yield and the quality of the crop.

Cucumbers are generally seeded when soil temperatures exceed 60°F and air temperatures do not fall below 50°F at night. In cooler regions, cucumbers are commonly grown from transplants started in the greenhouse 18–24 days prior to being planted in the field. Because they are a warm-season crop, they should not be transplanted until the soil temperature reaches 60°F at 3 inches beneath the soil surface. They may be grown on raised beds with black, blue, or silver plastic mulch and using drip irrigation for optimum plant growth and yields. Drip irrigation can be used for fertilizer application during the growing season. Pickling cucumbers are usually grown for processing and without the use of raised beds and plastic mulch.

Slicing cucumbers are generally planted in single rows on plastic beds with 9–12 inches between plants in the row and 5–7 feet between rows. If you are not using plastic-covered raised beds, 3–4 feet between rows can be used. Machine-harvested pickling cucumbers are normally planted on three-row beds. For harvesters with 84-inch heads, rows are 26–28 inches apart and plants are 4–5 inches apart in the row. For harvesters

with 90-inch heads, rows are 30 inches apart and plants are 3–4 inches apart in the row. This spacing provides approximately 55,000 to 65,000 plants per acre.

Fertilizer recommendations should be based on annual soil test results. The nitrogen recommendation for cucumbers is 75 pounds per acre for processing and fresh-market types. Generally, for Pennsylvania soils, apply half before planting with the remainder injected through the drip irrigation system during the growing season.

Pollination

Insect pollinators, including honey bees, squash bees, bumble bees and other wild bees, are essential for pollination and fruit set. Insecticides applied to flowers or weeds in bloom can adversely affect pollinating insect populations, especially honey bees. Seedless cucumbers are parthenocarpic and do not require pollination for production.

Pest Management

Weed control can be achieved with a good crop rotation system, herbicides, and plastic mulch in the case of fresh-market cucumbers. Several preplant and postemergence herbicides are available for cucumbers, depending on the specific weed problem and the stage of cucumber growth. If infestation levels are mild, early cultivation (prior to vine running) can help minimize weed problems.

Insects can be a major problem in cucumber production. Cucumber beetle, aphids, cutworms, seed corn maggot, leaf miners, and mites can all cause crop losses. Monitoring insect populations will help you determine when you should use pesticides and how often you should spray.

Several cucumber diseases—especially bacterial wilt, powdery mildew, downy mildew, angular leaf spot, anthracnose, and phytophthora blight—and viruses, such as cucumber mosaic (CMV), zucchini yellow mosaic (ZYMV), and watermelon mosaic (WMV, types 1 and 2), can reduce crop yields. Many of these diseases can be prevented by having a good crop rotation system, using soil with good water and air drainage, and planting disease-resistant cultivars.

Many of the pesticides required for cucumber production are restricted-use pesticides and require a pesticide license to purchase. Pesticide applicator tests are usually administered through the Pennsylvania

Department of Agriculture. For more information, visit extension.psu.edu/pennsylvania-pesticide-applicator-certification. When using any pesticides in your enterprise, remember to follow all label recommendations regarding application rates and personal protection equipment (PPE) requirements. Also remember that any Worker Protection Standards (WPS) apply to the owner as well as to employees.

Harvest and Storage

For best taste and texture, slicing cucumbers should be harvested when they are 1.25–2 inches in diameter and 6–8 inches in length, depending on cultivar. Because cucumbers are pollinated at different times, multiple hand-harvests over the field are necessary, usually every other day. To ensure you are marketing a high-quality product, grade cucumbers by size and maturity and check them for insect damage.

Pickling cucumbers are generally harvested by machine and under contract with a local processor, though a limited market for fresh pickling cucumbers also exists.

Removing field heat from cucumbers is critical for extending their shelf life and maintaining a good appearance. Refrigeration immediately after harvest will help guarantee high quality. Cucumbers that are maintained at 55°F and 95 percent relative humidity will retain good quality for approximately 10–14 days.

Environmental Regulations

All agricultural operations in Pennsylvania, including small-scale and part-time farming enterprises, operate under the Pennsylvania Clean Streams Law. A specific part of this law is the Nutrient Management Act. Portions of the act may or may not pertain to your operation, depending on whether you have livestock on your farm. However, all operations may be a source of surface water or groundwater pollution. Because of this possibility, you should contact your local Soil and Water Conservation District to determine what regulations may pertain to your operation.

Good Agricultural Practices and Good Handling Practices

Good Agricultural Practices (GAP) and Good Handling Practices (GHP) are voluntary programs that you may

wish to consider for your operation. The idea behind these programs is to ensure a safer food system by reducing the chances for foodborne illnesses resulting from contaminated products reaching consumers. Also, several major food distribution chains are beginning to require GAP- and GHP-certified products from their producers. These programs set standards for worker hygiene, use of manure, and water supply quality.

These practices require an inspection from a designated third party and there are fees associated with the inspection. Prior to an inspection, you will need to develop and implement a food safety plan and designate someone in your operation to oversee this plan. You will need to have any water supply used by your workers or for crop irrigation and pesticide application checked at least twice each year. A checklist of the questions to be asked during the inspection can be found at www.ams.usda.gov/services/auditing/gap-ghp/audit. For more information about GAP and GHP, contact your local extension office or your state's Department of Agriculture.

Risk Management

You should carefully consider how to manage risk on your farm. First, you should insure your facilities and equipment. This may be accomplished by consulting your insurance agent or broker. It is especially important to have adequate levels of property, vehicle, and liability insurance. You will also need workers' compensation insurance if you have any employees. You may also want to consider your needs for life and health insurance and if you need coverage for business interruption or employee dishonesty. For more on agricultural business insurance, see "Agricultural Alternatives: Agricultural Business Insurance."

Second, check to see if there are multi-peril crop insurance programs available for your crop or livestock enterprises. There are crop insurance programs designed to help farmers manage both yield risk and revenue shortfalls. However, individual crop insurance coverage is not available for all crops. If individual coverage is not available for what you grow, you may be able to use the Whole Farm Revenue Protection (WFRP) program to insure the revenue of your entire farm operation. To use WFRP you must have 5 years of Internal Revenue Service (IRS) Schedule F forms. For more information concerning crop insurance, contact

a crop insurance agent or check the Pennsylvania Crop Insurance Education website at www.rma.usda.gov.

Finally, the USDA Farm Service Agency has a program called the Noninsured Assistance Program (NAP) that is designed to provide a minimal level of yield risk protection for producers of commercial agricultural products that don't have multi-peril crop insurance coverage. NAP is designed to reduce financial losses when natural disasters cause catastrophic reduction in production. NAP coverage is available through your local USDA Farm Service Agency office. The application fee for this program may be waived for eligible limited-resource farmers.

Sample Budget

Included in this publication is a sample fresh-market cucumber production budget. This budget utilizes custom hire for most of the field work, which could be more economical for a smaller acreage. Farmers who have their own equipment should substitute their costs for the custom hire. The budget summarizes the receipts, costs, and net returns of a cucumber enterprise. This sample budget should help ensure that all costs and receipts are included in your calculations.

Costs and returns are often difficult to estimate in budget preparation because they are numerous and variable. Therefore, you should think of this budget as an approximation and make appropriate adjustments in the "Your Estimate" column to reflect your specific production and resource situation. This budget is developed for one acre; however, your scale of production should be based on market considerations. More information on the use of crop budgets can be found in "Agricultural Alternatives: Budgeting for Agricultural Decision Making."

Initial Resource Requirements

- Land: 1 acre
- Production labor: 7–10 hours
- Harvesting and grading: \$3,800–4,200 per acre
- Capital: \$8,500–9,500
- Equipment:
 - Tractor
 - Plastic mulch layer
 - Vegetable transplanter
 - Boom sprayer

Sample Fresh-Market Cucumber Budget

Summary of estimated income and costs per acre for wholesale marketing.

ITEM	QUANTITY	UNIT	PRICE	TOTAL	YOUR ESTIMATE
Variable Costs					
Custom hire ¹	1	acre	\$212.20	\$212.20	
Fertilizer and lime	1	acre	\$90.80	\$90.80	
Herbicide	1	acre	\$60.70	\$60.70	
Fungicide	1	acre	\$127.92	\$127.92	
Insecticide	1	acre	\$93.47	\$93.47	
Cucumber transplants	9,450	plants	\$0.30	\$2,835.00	
Drip tape	7,260	feet	\$0.03	\$217.80	
Black plastic mulch	7,260	feet	\$0.02	\$145.20	
Marketing and advertising	450	sales	\$1.90	\$855.00	
Hand harvesting	164	hours	\$12.00	\$1,968.00	
Packing and grading	450	cartons	\$1.10	\$495.00	
Cartons (25 lb)	450	cartons	\$1.15	\$517.50	
Fuel ²	49.5	gallon	\$2.80	\$138.60	
Hourly labor	5.5	hours	\$15.00	\$82.50	
Operator labor	3.2	acres	\$17.00	\$54.40	
Repair and maintenance					
Tractors and implements ³	1	acre	\$92.48	\$92.48	
Additional inputs	1	acre			
Additional inputs	1	acre			
Interest on operating costs	1	acre	\$127.79	\$127.79	
<i>Total variable costs</i>				\$8,114.36	
Fixed Costs					
Tractors	1	acre	\$64.59	\$64.59	
Implements ³	1	acre	\$140.79	\$140.79	
Land charge	1	acre	\$200.00	\$200.00	
Additional inputs	1	acre			
<i>Total fixed costs</i>				\$405.38	
Total costs				\$8,519.74	

This budget is developed for one acre; however, your scale of production should be based on market considerations.

1. Custom hire expenses include soil testing, lime application, land preparation, pest scouting, and bee rental.
2. Includes fuel for tractors, implements, and irrigation pump.
3. Includes irrigation installation, including operation, filter, and mainline to the drip line, and is calculated to have a seven-year useful life.

You should monitor local markets and contact suppliers to determine current prices for all items contained in this sample budget.

Net returns for six different yields and prices

PRICE	YIELD (1½-BUSHEL CARTONS)		
	350	450	500
\$18.00	(\$1,367.41)	(\$419.74)	\$54.09
\$18.50	(\$1,192.41)	(\$194.74)	\$304.09
\$19.00	(\$1,017.41)	\$30.26	\$554.09
\$19.50	(\$842.41)	\$255.26	\$804.09
\$20.00	(\$667.41)	\$480.26	\$1,054.09
\$20.50	(\$492.41)	\$705.26	\$1,304.09

For More Information

Dunn, J. W., J. W. Berry, L. F. Kime, R. M. Harsh, and J. K. Harper. "Agricultural Alternatives: Developing a Roadside Farm Market." University Park: Penn State Extension, 2006.

Dunn, J. W., J. K. Harper, and L. F. Kime. "Agricultural Alternatives: Fruit and Vegetable Marketing for Small-Scale and Part-Time Growers." University Park: Penn State Extension, 2009.

Gross, K. C., C. Y. Wang, and M. Saltveit. *The Commercial Storage of Fruits and Nursery Stocks*. USDA-ARS, Agricultural Handbook Number 66. Washington, D.C.: Superintendent of Documents, Government Printing Office, 2004.

Harper, J. K., S. Cornelisse, L. F. Kime, and J. Hyde. "Agricultural Alternatives: Budgeting for Agricultural Decision Making." University Park: Penn State Extension, 2013.

Kime, L. F., J. A. Adamik, E. E. Gantz, and J. K. Harper. "Agricultural Alternatives: Agricultural Business Insurance." University Park: Penn State Extension, 2004.

Lamont, W. J., M. D. Orzolek, J. K. Harper, L. F. Kime, and A. R. Jarrett. "Agricultural Alternatives: Drip Irrigation for Vegetable Production." University Park: Penn State Extension, 2012.

Macher, R., and H. W. Kerr. *Making Your Small Farm Profitable: Apply 25 Guiding Principles/Develop New Crops and New Markets/Maximize Net Profits per Acre*. North Adams, Mass.: Storey Books, 2010.

MacNab, A. A., A. E. Sherf, and J. K. Springer. *Identifying Diseases of Vegetables*. University Park: Penn State Extension, 1983.

Maynard, D. M., and G. J. Hochmuth. *Knott's Handbook for Vegetable Growers*. 5th ed. Hoboken, N.J.: John Wiley and Sons Inc., 2006.

Wyenandt, C. A., et al. *2018 Mid-Atlantic Commercial Vegetable Production Recommendations*. Newark, DE: Delaware Cooperative Extension, 2018.

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