

# AGRICULTURAL ALTERNATIVES

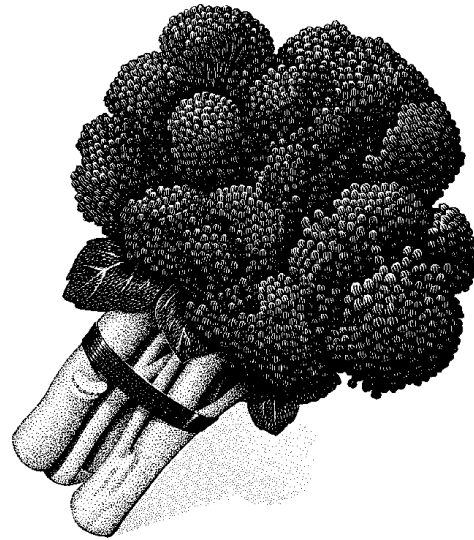
## Broccoli Production

Broccoli is a vegetable crop that lends itself well to small-scale and part-time farming operations. Initial investment is relatively low, and many field operations, such as land preparation, planting, and harvesting, can be custom hired. Equipment needs on a small-acreage farm are not very great, and most of the equipment can be used for other purposes.

“Broccoli” can mean different things to different people. When most people think of broccoli, they are thinking of sprouting broccoli (often referred to as “Italian” or “Calabrese” broccoli). “Heading” broccoli is not a broccoli at all—it is a late season or overwintering cauliflower. Another broccoli, broccoli rabe, does not produce a head and is used as a greens crop. This publication will cover the production and marketing of sprouting broccoli.

Native to the Mediterranean region, broccoli was cultivated in Italy in ancient Roman times and was introduced into England about 1720. Unlike cauliflower, broccoli is a fairly new crop to American consumers. Broccoli was first grown commercially in California, and the first ice-packed crop was shipped east in 1924. However, broccoli did not become a crop of any significance in the United States until after World War II.

The United States is the world’s largest producer of broccoli. Most of the broccoli harvested in the United States is sold as fresh produce. In 2011, the United States



produced more than 2 billion pounds of broccoli with a value of over \$750 million on more than 130,000 acres.

Leading broccoli-producing states are California (90 percent of the crop), Arizona, Texas, and Oregon. Broccoli also is grown on a large scale in Italy, northern Europe, and the Far East. In recent years, the northeastern United States produced more than 500 acres.

### Marketing

Broccoli produced in the northeastern United States is usually available from June through October. Broccoli cultivars recommended for the region are listed below. Fresh-market broccoli traditionally is sold whole from open bulk containers, in portioned amounts of small florets, or as several small heads wrapped together with a rubber band. Several marketing alternatives are available to the broccoli grower: wholesale marketing, produce auctions, cooperatives, local retailers, and roadside stands. When planning production, first con-

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sider your ability to market. You should conduct some market research since growers often overestimate their ability to sell in a given market. Production of less than one acre of many vegetable crops is typical for most growers.

Recommended broccoli cultivars for the northeastern United States in order of maturity (early to late):

- |                  |                 |
|------------------|-----------------|
| 1. Captain*      | 6. Pinnacle*    |
| 2. Everest*      | 7. Packman      |
| 3. Imperial      | 8. Diplomat*    |
| 4. Emerald Pride | 9. Premium Crop |
| 5. Gypsy*        | 10. Windsor*    |

\*Hybrid

In wholesale marketing, producers often contract with shippers to market and ship the broccoli for a predetermined price. If you do not use a contractor and choose to ship your broccoli to a wholesale market yourself, your product will be subject to the greatest price fluctuations. Most produce auctions operate weekly; however, you must deliver the broccoli to the auction. Marketing cooperatives generally use a 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 broccoli when stores require it. For more information on marketing, consult *Agricultural Alternatives: Fruit and Vegetable Marketing for Small-scale and Part-time Growers*.

Retail marketing options, including roadside stands (either your own or another grower's), provide opportunities for you to receive higher-than-wholesale prices for your broccoli. You will have additional expenses for advertising, building and maintaining a facility, and providing service to your customers. 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

Broccoli grows best on well-drained soils that have good water-holding characteristics. If you grow broccoli on sandy soil, irrigation is important for optimum plant growth and proper main head and side shoot development. For more information about irrigation, see *Agricultural Alternatives: Drip Irrigation for Vegetable Production*.

## Planting and Fertilization

Because broccoli is a cool-season crop, it generally is planted in the spring. You should begin planting when soil temperatures reach at least 50°F and the possibility of hard frosts (28°F or lower) has passed in your area. Flower heads (the edible portion of broccoli) develop relative to ambient temperatures, and in the heat of summer, broccoli heads maturing in July may bolt (produce flowers and seeds) more quickly (4–6 days) than those maturing in the cooler spring and fall periods. Broccoli heads must be closed and tight (no yellow petals showing) to be considered good quality.

While broccoli generally is transplanted in the spring, it can be sown directly from seed in late summer or early fall, when soil temperatures are in the high 60s and ambient air temperatures are in the 80s. Under these conditions, seeds generally emerge in less than 7 days. Adequate soil moisture is essential for optimum broccoli seed germination. Depending on climate, transplanting begins in late March to mid-April. Successive plantings can occur every 2 weeks through August.

Optimal plant populations for broccoli are 14,000 to 24,000 plants per acre. Therefore, the amount of seed per acre that you should buy varies with plant spacing, final plant stand, and percent seed germination. Depending on the planter type used (random or precision), you should sow 0.5–1.5 pounds of broccoli seed per acre, with seeds placed 12–18 inches apart in 36-inch rows. When transplanting, you should have a minimum of 11,000 plants per acre. Spacing decisions depend on the row spacing of your equipment, your ability to irrigate, the planting date, and your specific market requirements (small or large heads).

Fertilizer rates should be based on annual soil test results. If you are unable to conduct a test, the recommended N-P-K application rates are 120-100-100 pounds per acre broadcast or 35-50-50 pounds per acre banded at planting. Liming may also be necessary to maintain soil pH in the 5.8–6.6 range for optimal growth. Cruciferous crops such as broccoli require more boron than most other crops. Applying 3 pounds of boron per acre will eliminate broccoli stems that are brown and hollow. Severe boron deficiency can produce browning on head surfaces. These affected heads are not marketable.

## Pest Control

Weed control can be achieved with herbicides, mechanical control, and a good crop-rotation system. Broccoli competes fairly well with weeds, but it should be kept weed free until plants reach the preheading stage. Many pretransplant and postemergence herbicides are available for broccoli, depending on the specific weed

problem and the broccoli growth stage. If infestation levels are mild, cultivation can be used to reduce weed problems.

Insects are a major potential problem in broccoli production. Flea beetles, cabbage loopers, imported cabbageworms, diamondback moths, and aphids all can cause crop losses. Monitoring insect populations with traps or by scouting will help you determine when you should use pesticides and how often you should spray.

Several broccoli diseases can cause crop losses. Black rot, blackleg, bacterial head rot, downy mildew, and *Alternaria* are common problems. Many of these diseases can be prevented by having a good crop-rotation program and by using disease-resistant varieties.

Many of the pesticides required for broccoli production are restricted-use pesticides and require a pesticide applicator license to purchase. Pesticide applicator tests are usually administered at county extension offices, so you should contact your local office for dates and times of these examinations. 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

Because there are no mechanical harvesters for broccoli, it is necessary to hand-harvest the crop. To ensure marketing a high-quality product, you should check the broccoli heads for worms, which tend to hide underneath the florets. You also will need to grade the heads for size (head diameter generally averages 6 inches) and for flower bead tightness.

Broccoli should be cooled with packed ice or a hydrocooler immediately after harvest. Broccoli that is cooled and maintained at 32°F and 95–100 percent relative humidity can be stored for 10–14 days. If broccoli is stored this long, however, it will begin to lose its dark green color and firmness.

## Environmental Impacts

In the normal course of operations, farmers handle pesticides and other chemicals, may have manure to collect and spread, and use equipment to prepare fields and harvest crops. Any of these routine on-farm activities can be a potential source of surface or groundwater pollution. Because of this possibility, you must understand the regulations you must follow concerning the proper handling and application of chemicals and the disposal and transport of waste. Depending on the watershed where your farm is located, there may be additional environmental regulations regarding erosion control, pesticide leaching, and nutrient runoff. Contact your

soil and water conservation district, extension office, zoning board, state departments of agriculture and environmental protection, and local governing authorities to determine what regulations may pertain to your operation.

## Good Agricultural Practices and Good Handling Practices

Good agricultural practices (GAPs) and good handling practices (GHPs) 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/fv/gapghp.htm](http://www.ams.usda.gov/fv/gapghp.htm). For more information about GAP and GHP programs, 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 multiperil crop insurance programs available for your crop or live-stock 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 AGR/AGR-Lite program to insure the revenue of your entire farm operation. To use AGR-Lite

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 [extension.psu.edu/crop-insurance](http://extension.psu.edu/crop-insurance).

Finally, the USDA Farm Service Agency has a program called the Non-insured Assistance Program (NAP), which is designed to provide a minimal level of yield risk protection for producers of commercial agricultural products that don't have multiperil 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 an annual broccoli budget that summarizes the receipts, costs, and net returns of a broccoli 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. More information on the use of crop budgets can be found in *Agricultural Alternatives: Enterprise Budget Analysis*.

## For More Information

*American Vegetable Grower, Centennial Edition*. Willoughby, Ohio: Meister Publishing, 2007.

MacNab, A. A., A. F. Sherf, and J. K. Springer. *Identifying Diseases of Vegetables*. University Park: Penn State College of Agricultural Sciences, 1998.

Maynard, D. M., and G. L. Hochmuth. *Knott's Handbook for Vegetable Growers*. 5th ed. New York: John Wiley and Sons, 2007.

*Pennsylvania Commercial Vegetable Production Guide*. University Park: Penn State College of Agricultural Sciences, 2012.

### Initial Resource Requirements

- Land: 1 acre
- Total labor: 45–55 hours per year
- Capital
  - Annual production and harvest costs: \$6,000–6,500
  - Existing equipment and capital: \$1,300–1,500
- Necessary equipment: tractor (40–60 hp), transplanter, and boom sprayer

Net returns for five different yields and prices.

Price Received	Yield (20-lb carton)				
	350	450	550	650	750
\$11.50	\$(2,654.19)	\$(1,872.74)	\$(1,091.29)	\$(309.83)	\$471.62
\$12.50	\$(2,304.19)	\$(1,422.74)	\$(541.29)	\$340.17	\$1,211.62
\$13.50	\$(1,954.19)	\$(972.74)	\$8.72	\$990.17	\$1,971.62
\$14.50	\$(1,604.19)	\$(522.74)	\$558.72	\$1,640.17	\$2,721.62
\$15.50	\$(1,254.19)	\$(72.74)	\$1,108.72	\$2,290.17	\$3,471.62

## Sample Fresh-market Broccoli Budget

Summary of estimated costs and returns per acre.

Item	Number of operations	Unit	Price	Total	Your estimate
<b>Variable costs</b>					
Custom					
Moldboard plowing	1	acre	\$19.80	\$19.80	_____
Disk and harrow	1	acre	\$17.90	\$17.90	_____
Applying calcium lime	1	acre	\$12.20	\$12.20	_____
Spread fertilizer	1	acre	\$ 9.85	\$9.85	_____
Pest scouting	1	acre	\$35.00	\$35.00	_____
Soil amendments					
Lime	0.5	ton	\$14.50	\$7.25	_____
Nitrogen	120	pound	\$0.85	\$102.00	_____
Phosphorus	100	pound	\$0.62	\$62.00	_____
Potassium	100	pound	\$0.55	\$55.00	_____
Herbicide	1	acre	\$33.41	\$33.41	_____
Insecticide	1	acre	\$195.10	\$195.10	_____
Other variable costs					
Drip tape	14,520	feet	\$0.02	\$290.40	_____
Broccoli transplants	14,520	plants	\$0.12	\$1,684.32	_____
Pack and grading	15	hour	\$12.00	\$180.00	_____
Ice	2,750	pound	\$0.18	\$495.00	_____
Cartons (wax lined)	550	box	\$2.00	\$1,100.00	_____
Operator labor	4.95	hour	\$15.00	\$74.25	_____
Labor	20.25	hour	\$12.00	\$243.00	_____
Harvest labor	21	hour	\$12.00	\$252.00	_____
Fuel	202.89	gallon	\$3.50	\$710.12	_____
Repairs and maintenance					
Tractors and implements	1	acre	\$452.20	\$452.20	_____
Interest charge	1	acre	\$69.05	\$69.05	_____
<i>Total variable costs</i>				\$6,099.85	_____
<b>Fixed costs</b>					
Tractors	1	acre	\$291.65	\$291.65	_____
Implements	1	acre	\$824.79	\$824.79	_____
Land charge	1	acre	\$200.00	\$200.00	_____
<i>Total fixed costs</i>				\$1,316.44	_____
<b>Total costs</b>				<b>\$7,416.29</b>	_____

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