

Enterprise Guide for Southern Maryland: Growing Broccoli

Broccoli is a popular vegetable in both fresh and frozen forms and has become a common vegetable in salad bars. Recently it has been found to contain certain substances associated with reducing the risk of cancer. Higher concentrations of the substance are found in seed sprouts than in heads.

Broccoli is a member of the cabbage family. Production is somewhat similar to cauliflower's; broccoli is easier to produce, however, since blanching--tying leaves over the heads--is not needed. Broccoli can be grown in a much wider geographic area. Although broccoli is more tolerant of temperature extremes, high or low temperatures can have unfavorable effects on head formation. Generally, the culture is similar to that of cabbage.

Varieties

Older varieties that are adapted to Maryland include Green Comet, Green Duke, Packman, and Premium Crop. Other newer varieties recommended for the Northeast are Baccus, Barbados, Claudia, Durango, Liberty, Excelsior, Signal, Pinnacle, and Emperor. Most of the recommended varieties are hybrids. Select the variety or varieties based on your needs and growing conditions. Some varieties have a shorter growing season and others are more heat tolerant. Most seed catalogs list variety characteristics.

Soil Preparation and Fertilization

Broccoli grows best in fertile, well-drained soil with a pH of 6.5. The crop requires 150 to 200 pounds of nitrogen per acre and 25 to 200 pounds per acre of phosphate and potash, depending on the fertility level already in the soil. Before applying any fertilizer or lime, test soil pH and fertility at the University of Maryland Soil Testing Lab.

If soil test results show a medium level of phosphate and potash is present or if the soil has not been tested, the following applications are recommended:

- 1,000 pounds/acre of 5-10-10 broadcast before transplanting.
- 50 pounds of nitrogen/acre sidedressed 2 to 3 weeks after transplanting.
- 50 pounds of nitrogen/acre sidedressed 4 to 6 weeks after transplanting.

Broccoli is a crop that often needs additional boron (B). Most soils in Maryland test low to medium for boron content; if this is the case, apply 2 or 3 pounds of boron per acre.

Planting

Broccoli can sometimes be grown successfully in Maryland as a spring crop since it is less sensitive to temperature extremes than cauliflower. However, in most years broccoli does best as a fall crop, with the exception of the mountain regions in western Maryland where temperatures are more moderate in late spring and early summer.

Start seeds in a greenhouse or cold frame 4 to 6 weeks before transplanting time. If you are growing a spring crop, transplant in late March or early April in southern and Eastern Shore areas, early to late April in central Maryland, and late April to early May in western Maryland. Exposure of transplants to low temperatures (such as 50 to 60° F for 10 to 14 days) may cause premature bolting (flowering), rather than the desired early vegetative growth. For a fall crop, transplant broccoli around August 5 in western Maryland, August 15 in central Maryland, and August 20 in southern Maryland and on the Eastern Shore. Use cell-grown transplants that retain an intact root system for best results. Bare-root plants drawn from beds will not begin growing fast enough after transplanting to give marketable-size heads.

In the field, plants should be set 12 to 18 inches apart in 36-inch rows. Plant spacing affects the size of the head, with wider spacing producing larger heads. However, narrow spacing produces greater total yields on a weight per acre basis. Consumers generally prefer a three-head bunch of broccoli weighing approximately 1 pound.

Irrigation

Irrigation will increase broccoli yield and improve its quality during dry seasons. Irrigation is needed to establish a fall crop, which is transplanted in August when soil moisture is usually inadequate. Even relatively short periods of dry conditions can reduce yield, especially when heads are developing.

Weed Management

Heavy weed populations can significantly reduce yields. In most instances, weeds will be more of a problem in spring plantings than in fall plantings. Preparing weed-free fields is the first important step in managing weeds. Herbicides can be applied either pretransplant or posttransplant. Consult the current revision of EB 236, "Maryland Commercial Vegetable Production Recommendations," or contact your county Extension office for specific recommendations. Mechanical cultivation is also an alternative method of weed control; however, cultivation should be shallow (2 inches) since broccoli has a spreading root system that can be damaged by deep cultivation. Good weed management the previous fall (to control winter annuals in the mustard family) can also help to delay insect infestation of the crop.

Insect Management

Insects that can infest broccoli are root maggots, cutworms, aphids, harlequin bugs, flea beetles, cabbage worms, and loopers. Infestation can reduce crop yields and quality. Scout fields weekly to monitor levels of infestation.

The *cabbage root maggot (larvae)* feeds by tunneling into the roots. Young plants may be stunted or even killed. Feeding by root maggots can deform roots; root injury is sometimes mistaken for a disease called clubroot. A large population of root maggots can potentially destroy a young crop.

Cutworms are greyish or dark caterpillars that grow up to 2 inches long. When disturbed, they will curl up quickly. Cutworms will chew the plant off above or below ground level. Most cutworm damage occurs in newly planted fields.

Aphids are small, soft-bodied insects. Most often found on the undersurface of leaves, they will also group on the stem. Aphids vary in color from black to yellow, but most are various shades of green. Aphids feed by sucking the sap from the plant. Large populations can slow crop growth.

Adult *harlequin bugs*, which can appear throughout the growing season, are light brown to reddish brown and about 5 to 6 mm long. They prefer to feed on the head, causing brown blemishes that reduce broccoli quality and marketability.

Flea beetles are small (2 mm long), shiny black beetles. Their damage is characterized by small pinholes through the plant leaves. Flea beetles are most active early in the season during sunny days. Although they can seriously damage young plant growth, they usually do not cause economic damage to older plants.

The adult imported *cabbage worm* is a white butterfly. Females travel from plant to plant depositing eggs during summer. The eggs hatch into a velvety green larvae with one yellow stripe down the middle of the back.

The *cabbage looper* is a green larvae with lighter stripes along the back and sides. The looper gets its name from the way it forms a loop as it moves.

Recently, *diamondback moths* have become a serious problem. The larvae are light green, slender, and up to 1 inch long. They typically wiggle rapidly when disturbed and may drop from the plant and hang by a silken thread.

Larvae of cabbage worms, cabbage loopers, and diamondback moths will eat holes in broccoli leaves and heads. Insect populations will normally peak and decline during the growing season, but they tend to be more prevalent during late summer.

Several chemical insecticides are available for controlling the insects mentioned above. Consult the current revision of EB 236, "Maryland Commercial Vegetable Production Recommendations," or contact your county Extension office for specific recommendations. Scouting can determine populations of beneficial insects as well as insect pests. Delay treatment if natural enemy populations are high and pest populations are low. As a general rule, treat plants when about half of them begin to show feeding injury. Broccoli has less tolerance to damage once heads begin to form.

If you want to produce broccoli without using chemical insecticides, consider using one of several materials utilizing *Bacillus thuringiensis* (Bt) for controlling cabbage worms, cabbage loopers, and diamondback moths. Selected strains of Bt may be more effective on diamondback moth than others. Currently recommended brands of Bt formulations are also listed in EB 236.

Disease Management

Some diseases that infect broccoli are black rot, blackleg, bacterial head rot, clubroot, downy mildew, alternaria, white mold, and fusarium (yellows). Generally, diseases are not a problem with broccoli if you follow these cultural practices:

1. Use disease-free seeds or plants. If you grow your own transplants, be sure seeds have been hot-water treated by the seed company. Grow transplants in soilless media.
2. Use resistant varieties or strains.
3. Use long crop rotations (do not plant broccoli in a field where cabbage, cauliflower, kale, turnips, or other members of the cabbage family have been recently grown).

Fungicides are available for disease control. Consult the current EB 236, "Maryland Commercial Vegetable Production Recommendations," or contact your county Extension office for specific recommendations.

Harvesting

Broccoli is usually ready for harvesting when the central heads are 3 to 6 inches across. Here are some guidelines to follow when harvesting broccoli:

- Cut broccoli when the stems reach 6 to 8 inches long and when the head is fully developed, but before the small flowers open enough to show yellow. Avoid over-maturity, which results in woodiness of the outer stems and lowers the vegetable's market value. After the initial cuttings, some types of broccoli continue to produce side shoots which range from 1 to 3 inches across. These small heads are good for freezing.
- Tie harvested heads together in bunches of three. Pack side-shoot heads separately from central heads.
- Broccoli is perishable. Cool it promptly after harvest and keep it cool until marketed.

Mention of trade names does not constitute an endorsement by Maryland Cooperative Extension.

Broccoli Budget (Per acre)

Item	Unit	Unit price (in dollars)	Quantity	Total price (in dollars)
Income from crop	lb	0.50	6,000	3,000.00
Variable/operating costs		Unit cost		Total cost
Transplants	1	0.02	10,000	200.00
Cover crop	acre	30.00	1	30.00
Nitrogen	lb	0.30	150	45.00
Phosphate	lb	0.30	100	30.00
Potash	lb	0.16	100	16.00
Lime	ton	26.00	0.33	8.58
Treflan	pint	4.20	2	8.40
Dipel, 5 sprays	lb	35.00	1	35.00
Diazinon	pint	3.60	1	3.60
Harvest & packing labor	hour	6.00	200	1,200.00
20-lb boxes	box	1.00	325	325.00
Ice	lb	0.05	2,000	100.00
Total variable costs listed above				2,001.80

Fixed/overhead costs

(custom rates are used acre as a proxy for field operation costs)

Plowing	acre	12.00	1	12.00
Disking	acre	10.00	1	10.00
Fertilizer application	acre	6.00	3	18.00
Planting	acre	100.00	1	100.00
Pesticide applications	acre	6.00	8	48.00
Land charge	acre	50.00	1	50.00

Total fixed cost listed above				\$238.00
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Interest on operating capital	\$2,008.08	0.5	10%	\$100.40
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Total variable and fixed cost above				\$2,399.98
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Net income over variable & fixed costs listed above				\$898.02
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Net income above variable and fixed costs for various yields and costs

	Costs (in dollars)	0.40	0.50	0.60
Yields				
4,000		(501.98)	(101.98)	298.02
6,000		298.02	898.02	1,498.02
8,000		1,098.02	1,898.02	2,698.02

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