



THE UNIVERSITY OF GEORGIA

## COOPERATIVE EXTENSION

Colleges of Agricultural and Environmental Sciences & Family and Consumer Sciences



# Broccoli

## COMMERCIAL VEGETABLE PRODUCTION

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Broccoli (*Brassica oleracea* var *botrytis*) is a member of the cabbage family. Broccoli was developed from leafy *Brassica* forms, commonly known as “Calabrese broccoli,” found in the northeastern Mediterranean and southern Europe.

Broccoli can be produced commercially throughout Georgia, but careful consideration must be given to proper scheduling. With the introduction of new hybrid varieties and increased consumption, broccoli offers potential as a profitable crop for growers who consistently do a good job of production and marketing.

### SOILS AND ROTATION

Broccoli grows best on well-drained, fertile soils. If possible, avoid heavy, stiff soils and very light, sandy soils. Follow a three- to four-year rotation including a cover crop to provide a good supply of organic matter. If rye is used in the rotation, 50 pounds of nitrogen (N) should be broadcast prior to turning the rye crop under. This nitrogen will help speed up crop decomposition and help in the production of humus.

### VARIETIES

Consider head size, yield, color, market acceptability and adaptability to the area when selecting varieties. Hybrid broccoli is preferred because it matures more uniformly. This means a high percentage of the heads can be harvested at one time.

Hybrid varieties recommended for Georgia are Bravo, Green Duke, Premium Crop, Green Hornet, Green Comet and Gem. Try new varieties only on a small scale to determine their production potential and their market acceptability.

### TRANSPLANT PRODUCTION

Locate seedbeds on well-drained soils. Sterilize the soil before seeding to reduce the chance of transferring plant diseases to the field.

If the plant bed is properly managed, 4 to 6 ounces of seed will produce enough transplants for 1 acre at recommended spacing. Plant broccoli seed  $\frac{1}{4}$  inch deep in rows

6 inches apart. Fertilize plant beds with approximately  $\frac{1}{3}$  pound of complete fertilizer (10-10-10 plus micronutrients) per square yard of bed. Too much nitrogen will cause rapid growth and weak, spindly plants.

Broccoli will usually require five to seven weeks from seeding to transplanting, depending on conditions of growth. Proper watering is essential. Never allow soil to dry completely. However, for a period of one week prior to transplanting, condition the plants by gradually exposing them to less water. Spraying for insects and diseases may be necessary. Contact your county Extension agent for pest control recommendations.

### DIRECT SEEDING

A well-prepared seedbed with adequate moisture is a must for direct seeded broccoli. Broccoli seed should be placed  $\frac{1}{4}$  inch deep and firmed. When using a 6-foot bed, two or three rows may be seeded per bed. An in-row spacing of 8 inches to 12 inches is recommended. Broccoli may be direct seeded in both spring and fall. Adjust actual seeding rate to the desired plant population. This rate will depend on germination of the seed lot, size of seed and the weather conditions that influence germination. Approximately 9 ounces per acre of seed are needed for two rows of broccoli spaced 12 inches within the row. The critical factor in direct seeding is moisture. Never let the seedbed dry out. In sandy soils this may require two to three waterings per day. You must maintain adequate moisture until seedlings are well established.

### BUTTONING

Broccoli plants are sensitive to environmental conditions. Any condition that results in a prolonged cessation or checking of vegetative growth during the early stages of plants' development can trigger the onset of buttoning. Buttoning is the development of small, unmarketable heads or “buttons” while the plant is immature. Buttons can form when plants are grown below 50°F in the bed and are exposed to periods of cool weather (35°-50°F) following field setting. Lack of nitrogen or other nutrient stresses as well as competition from

weeds, insects, or diseases that slow vegetative growth can promote buttoning. Transplants that are older and less vigorous are more likely to button than young, fast-growing plants. Barerooted plants that have been exposed to drying or severe water stress immediately following transplanting are also more likely to button.

Buttoning can be prevented by:

1. Maintaining a steady, moderate rate of growth in the plant bed.
2. Setting young, healthy transplants that have not initiated head formation.
3. Setting plants under favorable conditions for growth and irrigating to relieve moisture stress.
4. Maintaining rapid vegetative growth, particularly for the first few weeks after field setting.

### LAND PREPARATION

Proper land preparation for broccoli is essential. Proper preparation allows the plant to attain maximum root growth and development. Plants grown under these conditions will be able to remove water and nutrients from a larger volume of soil and will not be as susceptible to drought stress.

Research in Georgia shows that the best broccoli yields are obtained by deep turning (burying litter at bottom of furrow), disking and rolling just prior to bed formation. **Do not** use a disk harrow after turning because this will result in undesirable soil compaction. Smoothing operation should be in the same direction of rows leaving tire tracks exposed so that all future trips can be in the same tracks, thus eliminating further compaction.

### FERTILIZER AND LIME

Broccoli is a fast-growing crop, and the fertilization schedule should always be based on a soil test recommendation. Test the soil several months prior to planting to determine lime requirements. It is very important to test new ground and soils that have not received lime in the past several years. A pH of 6.0 to 6.5 is a very important factor in reaching optimum broccoli yields. If test results show that lime is needed, apply dolomitic lime three months before planting.

The soil test recommendations for a medium-medium reading are 110 units of  $P_2O_5$  and 110 units of  $K_2O$ . A minimum of 160 units of N is needed. Make additional nitrogen adjustments when high rainfall or irrigation causes excessive leaching. In addition, Sul-Po-Mag may be needed to ensure adequate sulfur and magnesium. This can be used as part of the  $K_2O$  source. Apply 2 pounds of actual boron in a slow release form in the initial fertilizer application.

Fertilizer can be broadcast, mixed in the row, or applied in bands. Use the broadcast method when a heavy rate is applied initially. However, it is better to band at least one-third of the fertilizer especially in the spring when soils are cold. Fertilizer is more efficiently used by banding about one-third at planting and applying the balance in two equal side-dress

applications. The first side dressing should be applied three to four weeks after transplanting and the final application approximately three weeks later.

### SPACING AND SETTING

Yield of broccoli and size of head are affected by plant spacing and density. A greater number of plants per acre increases yields, but size and weight per head are decreased. For approximately 8-ounce heads, plants should be set 8 to 10 inches apart in 30- to 36-inch rows. This will result in 17,500 to 26,250 plants per acre depending on actual spacing and row width.

Use transplant water when wetting to wash soil around roots and help establish plants. A high phosphorus starter solution such as 10-34-0 at the rate of 3 pounds per 100 gallons of water can also be beneficial in getting plants off to a good start, particularly when the soil is cold in early spring.

### DATES OF PLANTING

Successful broccoli production requires proper timing of planting dates, well-developed transplants and an adequate supply of nutrients and moisture following transplanting. A projected schedule using 5-week-old transplants follows.

#### Projected Schedule for Broccoli Production in Southern Georgia (using 5-week-old transplants)\* 60-80 days maturity

Planting Dates	Harvesting Period
<b>Spring Production</b>	
February 15**	April 11 - May 2
February 22	April 18 - May 9
February 29	April 25 - May 15
March 14	May 9 - May 30
March 28	May 16 - June 6
April 11	May 30 - June 20
April 25	June 13 - July 4
<b>Fall Production</b>	
August 8	Oct. 3 - Oct. 24
August 22	Oct. 17 - Nov. 5
September 5	Oct. 24 - Nov. 14
September 19	Nov. 14 - Dec. 5

Spring production from April through June.

Fall production from October through November.

\*If field grown plants are used, add 2 additional weeks.

\*\*Weather is very critical.

### INSECT CONTROL

It is critical to control insects to produce high quality broccoli. Accurate timing of insecticide applications and use of the recommended chemical for a specific pest will ensure proper control.

**Aphids (plant lice)** are small, delicate insects usually yellowish-green in color. Some are winged while others are wingless. These sucking insects cause the leaves to curl and become discolored. Plant lice reproduce rapidly and have

a short life cycle. Under favorable weather conditions, an aphid's life can be as short as 10 days. Use insecticides immediately after finding an aphid infestation. It is very important to be sure that an aphicide is being used. Many of the common insecticides used to control caterpillars will not control aphids.

**Caterpillars** are usually more injurious to the young plant, although they will feed on broccoli until harvest. They include the cabbage looper, imported cabbage worm, and diamond back moth. The female flies from plant to plant laying eggs on the leaves. The eggs hatch in three to five days and the young worms begin feeding. During this stage caterpillars are easiest to control. Make insecticide applications immediately upon finding young worms on the broccoli. Once the worms reach 2 inch in length, they are more difficult to control with an insecticide. Most caterpillars have a similar life cycle and cause similar damage.

Several species of general feeders, including cutworms, corn earworm, fall armyworm and garden webworm can cause damage to broccoli.

## DISEASES

Diseases must be controlled in order to produce quality broccoli. Diseases often reduce yields and in some cases may eliminate an entire stand.

Most serious broccoli diseases can be introduced to a clean field on diseased transplants. Therefore, it is imperative that a grower plant **DISEASE FREE TRANSPLANTS**. Growers can avoid two of the most serious diseases, black rot and black leg by purchasing certified transplants or direct seeding only seed certified free of black rot and black leg.

**Black rot** is caused by the seedborne bacterium *Xanthomonas campestris*. It is the most serious disease affecting broccoli. Black rot is often introduced to a field by planting infected transplants or seeds. In some areas of the country, the disease is of minor importance. However, under Georgia conditions, the disease becomes serious and growers may sustain severe economic loss. In some cases the crop may be a total loss.

The disease is easily recognized in the field by the presence of large yellow to yellow-orange V-shaped areas extending inward from the margin of the leaf.

**Black leg**, caused by the fungus *Phoma lingam*, is another disease that can cause serious loss of broccoli. Plants are usually infected in seed beds. The first symptom is an oval depressed light brown canker near the base of the stem. The canker enlarges until the stem is girdled.

**Wirestem**, caused by the fungus *Rhizoctonia*, is normally more serious in transplant beds. However, it can be a serious problem after plants are transplanted to the field. Broccoli planted in early fall is more vulnerable to *Rhizoctonia* injury. Wirestem infected plants are first infected at about soil level. The initial infection site may be as small as a pin point or extend an inch up the stem. The area shows a reddish-brown discoloration and is very constricted. The plant may be bent or twisted without breaking, hence the name wirestem.

**Alternaria leafspot**, caused by *Alternaria brassicae*, may cause severe damage if uncontrolled. The first symptom is a small dark spot on the leaf surface. As the spot enlarges, concentric rings, which are common to this disease, develop. Blight spots enlarge progressively and can defoliate a plant if uncontrolled.

**Downy mildew**, caused by the fungus *Pernospora parasitica*, can be brought in from the transplant bed; however, it also can be introduced to new field plantings by wind blown spores. Plants can be infected at any time during their growing period. Young plants infected early show white mildew mostly on the underside of the leaf. Later, however, a slight yellowing shows up on the corresponding upper surface. The young leaf, when yellow, may drop off. Older leaves usually persist and the infected areas enlarge as they turn tan in color and papery in texture.

## DISEASE CONTROL PRACTICES

**Disease-free transplants:** Purchase only transplants or seed certified free of black rot or black leg. **THESE DISEASES CANNOT BE CONTROLLED WITH PESTICIDES.**

**Crop Rotation:** Never grow broccoli on land where cabbage, collards, kale, or other leafy greens have been grown in the past three years. These diseases may persist on the debris of these crops.

**Chemical Sprays:** Fungicide sprays are effective in controlling some broccoli diseases, provided they are properly timed and thorough plant coverage is obtained.

For specific disease recommendations, see your county agent.

## HARVESTING



**Figure 1.** Broccoli develops a central head that should be harvested before it begins to flower.

Harvest broccoli when the central head reaches a diameter of 3 to 6 inches. The buds that make up the central head, however, must be tightly closed with no sign of flower development. Over maturity reduces or destroys the commercial value of broccoli; therefore, cut it before the flower

heads have opened enough to show the yellow petals. Over maturity also tends to cause a woodiness of the outer tissues of the stem, which is very undesirable. When the heads have reached the proper stage, cut them with 8 to 10 inches of stem. Continue harvesting at two- to three-day intervals. Depending on variety, you may continue this schedule for two to three weeks.

If marketed as bunches, each bunch should weigh about 1½ pounds (usually three to four heads) with stems neatly cut at the base and 8 to 10 inches total head length.

Cool the broccoli as soon as possible after cutting. The most feasible method of precooling in a small operation is to place the cut broccoli in ice water. After trimming and bunching, pack broccoli in bunches using 12 to 15 bunches per waxed carton. Ice the broccoli down and store at 33° to 35°F.

### ***ATTENTION:***

#### **PESTICIDE PRECAUTIONS**

1. Observe all restrictions and precautions on pesticide labels.
2. Store all pesticides behind locked doors in original containers with labels intact.
3. Use pesticides at correct dosage and interval to avoid excessive residues and injury to plants and animals.
4. Apply pesticides carefully to avoid drift.
5. Bury surplus pesticides and destroy used containers so that contamination of water and other hazards will not result.

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