

Crop Production Guide Cabbage, Broccoli, Cauliflower... (Brassica oleracea)



Introduction

The species *Brassica oleracea* has given rise to several familiar vegetable crops referred to as cole crops, or simply Brassicas. The species has been extensively modified from its original form as a biennial, rosette-forming herb found in coastal Europe, to the many forms and multitudes of varieties that exist today.

Different forms occurred due to efforts to enhance various characteristics of the plant. Broccoli and cauliflower have been modified to produce a large, flowering head. Collard greens, kale and cabbage have all been modified to produce large, fleshy leaves, while Brussels sprout and kohlrabi have been modified to increase stem tissues. Management practices required for the different crop varieties derived from *Brassica oleracea* are similar, and many are susceptible to damage from the same insects and disease pests. The oil crop canola is also derived from *Brassica oleracea* and is known to share pests and pathogens with cole crops.

Growth Requirements

Brassica crops are well adapted to cool-season growing conditions. Most Brassicas display optimum growth rates at temperatures between 15-20°C, but will grow at lower temperatures. Prolonged periods of temperatures around 10°C can cause some Brassica crops to hasten their maturity or induce premature flowering in a process called “bolting.” Premature flowering negatively impacts the quality of crops produced for stem or leaf tissues, and can lead to reduced yield in crops produced for flowering heads. Generally, Brassica crops show moderate frost tolerance; however, there are differences between the cultivars. Cabbage, kale and collard greens are fairly hardy crops and can withstand temperatures of -10°C for short periods of time. Broccoli and cauliflower are less hardy and can be damaged when temperatures drop below -5°C.

Cole crops have very low drought tolerance, and insufficient water at any point in the growing season may result in reductions in yield and/or quality. Insufficient water may also make the plant more susceptible to physiological disorders, such as tipburn.

Vegetable cultivars suggested in this production guide are based on available season length, tolerance to disease, and suitability for current production practices prevalent in the Province of Newfoundland and Labrador.

Broccoli: Arcadia, Diplomat, Emerald Pride, Everest, **Brussels Sprout:** Jade Cross, Capitola, Nautic Organic
Cabbage: Artose, Expect, Bronco, Red Dynasty (Red), **Cauliflower:** Bishop, White Sails, Fremont
Collard Greens: Champion, Top Bunch, **Kale:** Winterbor, Red Russian, **Kohlrabi:** Grand Duke, Kossak

Brussels Sprout



Kale



Broccoli



Nutritional Value

Broccoli: Vitamin A, Vitamin C, Potassium, calcium and phosphorus, folate

Brussels Sprout: Vitamin A, Vitamin C, Potassium, Folate

Cauliflower: Vitamin C, Folate and Potassium

Cabbage: High in Vitamin C, some Vitamin B, potassium, calcium

Crop Establishment

Seed Germination

Seeds of Brassica crops will germinate at temperatures as low as 5°C; however, best germination and development occurs if seeds are germinated at temperatures between 20-25°C. Due to the growing conditions in Newfoundland and Labrador – which include low temperatures in early spring – direct seeding of Brassica crops may be difficult due to the number of days some crops require to mature. Transplants, which establish quickly and provide vigorous and uniform growth, are often used.



Seeding/Planting

Brassica transplants can be seeded in a greenhouse and then transplanted into the field after five to six weeks, or when plants have obtained four to five true leaves. Transplants should grow at temperatures above 15°C, as lower temperatures can lead to premature bolting in the field. Field spacing of the different crops is as follows:

Broccoli: 60-90 cm row spacing, 30-45 cm plant spacing within the row.

Brussels Sprout and Cauliflower: 75-90 cm row spacing, 45-60 cm plant spacing within the row.

Cabbage: 60-90 cm row spacing, 30-60 cm plant spacing within the row (for early production use lesser spacing, and for late production use greater spacing).

Collard Greens and Kale: 70-80 cm row spacing, 30 cm plant spacing within the row (plants may need to be thinned).

Kohlrabi: 70-80 cm row spacing, 10 cm plant spacing within the row (plants may need to be thinned).



Crop Management

Although total annual rainfall on the Island of Newfoundland is generally considered adequate to meet the total moisture requirements of most Brassica crops in a given year, rainfall events can be sporadic and soil moisture amounts suboptimal at certain points during the season. Brassica crops are very sensitive to dry and drought conditions, and will stop growth when soil moisture levels become low. Rainfall amounts in the mainland portions of the province are such that irrigation will be required for maximum production. Periodic irrigation may be required in dry periods to achieve maximum yields of Brassica crops. However, care must be taken as some physiological disorders of Brassica crops can be exacerbated when dry periods are followed by heavy rain or irrigation.

Nutrition

All soil fertility and limestone applications require soil analysis at the provincial Soil, Plant and Feed Laboratory. Test soil before undertaking any agricultural activities. Consult your crop or soil fertility specialist for production recommendations.

Nitrogen: Brassica crops are high nitrogen users. Cabbage, broccoli, cauliflower and Brussels sprout require 220 kg/ha of nitrogen over the course of the season. Kale, collard greens and kohlrabi have a lower nitrogen requirement at 135 kg/ha. In all cases, total nitrogen should be applied in at least two applications – one before transplant and one approximately three to four weeks after transplant. For leafy crops such as kale or collard greens, it may be beneficial to fertilize with nitrogen after the first harvest.

Phosphorus: Brassica crops are unlikely to respond to additional phosphorus application if soil test values are above 375 mg/L. For organic soil, please consult your crop or soil fertility specialist.

Potassium: Brassica crops are unlikely to respond to additional potassium applications if soil test values are above 300 mg/L. For organic soil, please consult your crop or soil fertility specialist.



Micronutrients:

Calcium: Calcium deficiency can cause a disorder called tipburn, characterized by a breakdown of tissues within heads of cabbage, sprouts of Brussels sprout, and inner leaves of cauliflower.

Boron: Boron deficiency can increase the likelihood of a disorder called hollow stem in broccoli, which causes small gaps in the stem tissues that enlarge over time to cause a large hollow spot in the stems. Plant spacing and nitrogen fertilization also impact the likelihood of this disorder.

Molybdenum: Molybdenum deficiency can cause a disorder called whiptail in broccoli, cauliflower and Brussels sprout that manifests as a malformation and stunting of the leaf surface so the leaf is reduced down to mainly the mid-rib, giving it a whip-like appearance.

If deficiency symptoms are suspected, contact your crop or soil fertility specialist for diagnostic services (soil or plant tissue analysis may be needed).

Application

Applications of balanced fertilizer N-P-K should be broadcast and disked in before planting. This application should contain one-third to one-half of the total nitrogen fertility required for the year. The remaining nitrogen application should be side-dressed in either one or two subsequent applications.

If applying raw manure, it must be applied at least 120 days before harvest.

Growers should either:

- Use properly composted or otherwise sterilized manure for application during the current growing season, or
- Apply raw manure in the fall before crops are planted the next spring.

Climatic Limitations

When some Brassica varieties are exposed to cool temperatures (5-10°C) for prolonged periods (10 days) early in their development, they may undergo early flowering or bolting, which causes plants to flower well



before they have reached a vegetative size capable of producing a marketable flowering head. Care must be taken when hardening transplants for the field, as bolting may be induced by both insufficient hardening and rapid reductions in temperature.

Brassica crops are subject to a number of disorders caused by micronutrient deficiencies including calcium, magnesium, boron and molybdenum. These issues may be overcome with proper focus on nutrient management and diligence in scouting.

Pests and Diseases

Disease: Black Rot (*Xanthomonas campestris*)

Characteristics: Black rot is a serious disease of Brassica crops. The causal organism can infect plants of any age. Infection on young plants will cause young leaves and cotyledons to turn black and fall off. In more mature plants, early infection tends to manifest as yellowing of the leaf margins. Black rot will often infect leaves and then move throughout the plant via the vascular system. As the pathogen moves through the plant, a darkening of the crown, stem and roots may be observed.

Control: Sanitation is the key to control of this pathogen. New infection may come from infected seeds, transplants or weed species residing in the field. The pathogen is able to survive on residues of Brassica crops for up to two years, and is able to survive in the soil for



up to two months. The pathogen prefers hot (25-30°C) wet weather, as movement within the field is facilitated by rain splash. Use of certified disease-free seeds or a seed treatment may reduce infection. Furthermore, proper crop rotation with a two- to three-year period between Brassica crops will also reduce populations of black rot pathogens in the field. There are currently no chemical control methods available in Canada.



Disease: Clubroot (*Plasmodiophora brassicae*)

Characteristics: Clubroot is a major pathogen of all Brassica crops, including rutabaga and turnip, grown in Atlantic Canada. The pathogen is soil borne and enters plants through the root tissues. Symptoms of the disease include swelling/malformation of root tissues, which leads to wilting and eventually death of the plant. The pathogen is more problematic in wet, cool, acidic soils.

Control: Proper crop rotation is incredibly important to control the populations of this pathogen in the soil. A proper crop rotation should have a minimum of three years between the cultivation of Brassica species. Spores of this pathogen may survive in soil for up to seven years and may infect any member of the Brassicas species grown as crops in Newfoundland and Labrador. If an outbreak occurs, cultivation of Brassica species

in the same field may result in major or complete crop failure. Sanitation is of key importance, as spores of this pathogen are released into the soil when plant tissues infected with the pathogen begin to breakdown and decay in the field. If an outbreak occurs, infected material must be removed and destroyed before the spores enter the soil. In addition, weeds in the Brassica family may harbor infections and create a source of new spores. There are very few chemical controls for clubroot, and those that do exist provide inconsistent control.

Disease: *Alternaria* Leaf Spot

Characteristics: Both *Alternaria brassicae* and *Alternaria brassicola* may cause leaf spot on cabbage and broccoli. These diseases are more prevalent in fall for broccoli, and in spring for cabbage.

Control: One major source of this disease is contaminated seed. Seed should be treated with hot water, or a fungicide treatment. Proper crop rotation and sanitation of the field will also greatly help reduce pathogen populations.

Insects: Cabbage maggot (*Delia radicum*)

Characteristics: The larvae of *Delia radicum* feed on the root tissues of Brassica crops, including rutabaga and turnip. They tunnel into and feed along the surface of the root, causing major damage that often leads to wilting and death. In addition, the root feeding site acts as an entry point for soil-borne pathogens to enter root tissues and begin infection.

Control: Proper crop rotation is important to control this insect as larva do not feed on non-Brassica crops. Proper incorporation of plant residues to depths greater than five cm will also help reduce pest populations. For large-scale Brassica cultivation, crop monitoring is of great importance as a model based on growing degree days (base 6°C) has been developed to predict emergence of adult flies. This model predicts averages of 356, 904 and 1,525 growing degree days for the first, second and third emergence of adult flies.



Harvest and Handling

Broccoli: Broccoli heads should be cut while still green and compact. Terminal heads are generally cut to include 15-20 cm of the stem. Lateral shoots will develop from the axis of the leaves after the terminal head is cut, and lateral heads will continue to develop for one to two weeks and may provide additional marketable yield.

Brussels Sprout: Brussels sprout should be harvested when the sprouts are well formed and firm. Sprouts lower on the stem will develop first and should be harvested once they are ready to encourage sprouts higher on the stem to develop. If a single harvest is desired, plants should be topped to prevent further vertical growth and encourage development of sprouts on the upper stem.

Cabbage: Cabbage heads should be cut when the outer leaves still have a light-green appearance, before they begin to yellow. Slightly immature cabbage heads will maintain their green color longer in storage than mature heads.

Cauliflower: Cauliflower heads may develop an undesirable yellow color when exposed to sunlight, which will occur more quickly in hot conditions. To avoid yellowing, tie the outer leaves of the cauliflower over the head. Cultivars are available where the head is covered by inner leaves to prevent sun exposure.

Collard Greens and Kale: For multiple harvests, cut leaves five to 15 cm above the ground to allow the crown to regrow. For one-time harvest, cut leaves just above ground level.

Kohlrabi: Cut stems when they have reached maturity.



Storage Conditions

All Brassica oleracea crops should be cooled immediately after harvest. Store at 0°C and at 95-100 per cent relative humidity.

For more information about crop production and soil fertility services contact:

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