

Cabbage, Cauliflower, Brussels Sprouts, Broccoli

Cultivars

Contact Manitoba Agriculture and Food's Vegetable Specialist for variety recommendations.

Seed Treatment

Treat seed for control of damping off, seed decay, and seedling blight before seeding.

Using a large cheesecloth bag, fill half full of seed and place in a large container of warm water. Stir the seed bags and water to maintain uniform temperature, measure temperature with an accurate thermometer. Soak seed for 25 minutes (cauliflower for 15 min.) in 50^o C water. Spread seed out to dry.

Seeding

About 4 oz seed provides sufficient transplants for each acre. For direct seeding, use 2 lb/acre and thin to the desired population. Direct seeded crops should be sown 1/2 to 3/4 inch (12 to 19 mm) deep. Direct field seeding is not currently practiced in Manitoba. The common practice is to use transplants greenhouse grown in plug trays.

Spacing

Cabbage: Early crop transplants are set in the field in early May. Late cabbage is seeded directly about a week later (May 10 to 15). In Manitoba, growers normally transplant all plantings of cabbage.

- *Early* - Rows 2.5 ft (76 cm) apart, plant 1 to 1.5 ft (30 to 45 cm) apart.
- *Mid Season* - Rows 2-1/2 to 3 ft (76 to 90 cm) apart, plants 1 to 1.5 ft (30 to 45 cm) apart.
- *Late* - Rows 2-1/2 to 3 ft (76 to 90 cm) apart, plants 1 to 1.5 ft (45 to 60 cm) apart.

Cauliflower: Normally set transplants out into the field after the danger of frost is over. Mid-season and late crops can be direct seeded.

- *Early* - Rows 2 to 2.5 ft (60 to 75 cm) apart, plants 1 to 1.5 ft (30 to 45 cm) apart
- *Late* - Rows 2 to 2.5 ft (75 – 90 cm) apart, plants 1 to 1.5 ft (45 to 60 cm) apart.

Brussels sprouts: Grown only from transplants which are set out into the field about May 20 to 25. The entire season is required for crop to reach maturity. Rows 3 ft (90 cm) apart, plant spacing 21 inch (53 cm) apart.

Broccoli: Grown from transplants or seed. Early crops are set out as transplants, while late crops are direct seeded. Rows 2 ft (60 cm) apart, plants 6 to 7 inch (15 to 18 cm).

Fertilizer

Refer to Tables 1 through 9 for this crop. For general recommendations in the absence of a soil test, refer to Table 10 in the fertility section.

Transplants – Starter Solution

As cole crops respond favourably to a liberal application of nitrogen and phosphorus, use of a starter solution such as 20-20-20 is recommended. Mix at the rate of 1 lb/10 gal. (454 g/45 L) of water and apply 10 ounces (284 mL) per plant.

Caution

Do not use emulsifiable formulations in the planting water.

Do not add fertilizer to planting water containing an insecticide unless recommended by the manufacturer or until experience has proven the mixture to be safe.

Note: If necessary, additional nitrogen at the rate of 25 to 35 lb/acre may be applied between the rows, or applied through the irrigation system about a month after seeding or transplanting.

Boron

Boron should be used with care. There is a fine line between adequate and toxic levels.

Boron deficiencies often occur during dry weather. However, the response to boron is often inconsistent. As a result, it has not been possible to develop a reliable soil test. Visual symptoms and tissue analysis are useful for predicting boron requirements in plants.

Broccoli and cauliflower show leaf rolling, deformed buds, hollow stems and brown heads. Cabbage develops internal dead spots and hollow stems.

Application of boron to mineral soils has not been universally successful. Foliar sprays generally give faster and more effective results. Spray when the young plants are about 3 inch (8 cm) high. A second application may be required.

If the soils are known to be deficient in boron, apply 20 lb/acre borax. It may be broadcast over the field and disced in before planting. If a foliar spray is used during the growing season, reduce the rate to 4 lb/acre borax.

Pest Management

Diseases

Clubroot

Clubroot is an occasional problem in Manitoba but may become more frequent in occurrence if crop rotation is not followed. The fungus causes swollen roots and wilting plants. Follow a four-year crop rotation and avoid all cole crops including canola (rapeseed) and mustard in the same rotation. Thoroughly clean all planting and harvesting equipment between fields. Use a pressurized washer and follow with a disinfectant.

The resting spores of the fungus can persist in soil for at least seven years. The organism can move in the soil water, spreading infection within and between fields. Avoid wet, poorly drained soils. Grow seedlings or transplants in soil free of disease.

Damping Off, Wirestem

Delay planting as long as possible to avoid cold,

moist soils that favour disease development. Grow transplants in fumigated soil. Space seedlings in seed beds to allow air circulation around the plants. Treat seed before planting.

Blackleg, Black Rot, Bacterial Leaf Spot, Grey Leaf spot

To minimize disease spread, avoid working in field when plants are wet. Follow a three-year crop rotation.

Seed can be hot water treated to reduce fungal and bacterial pathogens associated with Blackleg, Black Rot and Bacterial Leaf Spot.

Note: Some cultivars are more susceptible to black rot than others. Check the seed packet to be sure that the incidence of black rot is not greater than 1 in 30,000 and check with seed company representatives about cultivars tolerant to black rot.

Bacterial Soft Rot and Watery Soft Rot

Avoid injury to plants in cultivation or at harvest and use plant spacing that allows for good air circulation. Control root maggots, slugs and other chewing insects. Disinfect storage bin with 2% copper sulphate solution or other disinfectant before storing the crop. Follow a three year crop rotation and avoid other cole crops, beans, peas, lentils, parsnips, sunflowers, lettuce, carrots and celery. Rotate with cereals, corn, onions and beets.

Brown Heart

Brown heart deficiency can cause leaf rolling, deformed buds, hollow stem and internal dead spots in cole crops.

Fusarium Yellows

Fusarium yellows is an occasional problem in Manitoba but once the disease is established in a field it can cause complete crop loss of susceptible cabbage varieties. Long rotations of three or more years are required to reduce the incidence of Fusarium fungus in the soil. There are varieties available that have good resistance to Fusarium yellows and these are indicated in seed catalogues.

Downy Mildew

Cultural control in broccoli and cauliflower heads include practices of incorporating crop remains as soon as harvest is completed and avoid over-watering, especially in late afternoon.

Black Leaf Spot

This disease may be damaging in warm, wet seasons. Spray with one of the materials listed in fungicide tables.

Note: it is important to control downy mildew and black leaf spot on storage cabbage. Prevent the development of resistance by rotating between recommended products.

Insects

Root Maggot

Root maggot management is primarily preventative by means of seed treatment or foliar insecticide, however, high soil temperatures, low soil moisture, natural predators, crop rotation and field sanitation are also important. Later plantings are less likely to require protection.

Flea Beetles

In Manitoba, flea beetles can remain a concern all year-round. Populations are variable from year-to-year. Typically, flea beetles are a problem as adults in the early spring and then later in August, but some adults may be present all year-round.

Thrips

Thrips damage can occur on all cole crops. However, cabbage appears to be the most susceptible. Evidence also suggests that late plantings suffer less damage than earlier ones. Spraying for thrips should start once cupping of cabbage occurs. Thrips can also damage the curds of cauliflower, leaving them unmarketable.

Cutworms

Cutworms can be a serious problem in cole crops primarily during the month of June. Most cutworms hide in the soil during the day and emerge to feed at night. Chemical controls are

most effective if applied to moist soil in the early evening.

Cabbageworm, Cabbage Looper, Diamondback Moth Caterpillar

Infestations of cabbageworm and diamondback moth caterpillar may begin early in the season. Cabbage loopers usually appear after mid-July.

Insecticides are less effective against large larvae. Begin application of insecticides when young larvae are found and continue at 5 to 10 day intervals, or as necessary for adequate protection of the crop. Scouting is an excellent way to assess the population of cole-crop caterpillars.

To limit the development of resistance, insecticides from different groups/families should be used alternately. Pyrethroid insecticides are more effective under cool conditions (temperatures less than 26°C).

Note: Many insecticides are not consistently effective against cabbage looper and diamondback moth larvae. Spray small areas first to check if the product is working in your area. Also note that the repeated use of synthetic pyrethroids in cole crop fields may lead to aphid resurgence.

Aphids

Good coverage (bottom of leaves) is essential for aphid control. Drop nozzles and increased water volumes are necessary.

Swede Midge

Swede midge is not known to occur in Manitoba. Growers should be cautious about importation of transplants from infested areas (Europe, Ontario).

The following information applies to Ontario:

The Swede midge is a new pest to vegetable production areas in Ontario. Swede midge damage can occur on all cole crops. Clusters of eggs are laid on the youngest part of the plant, both on the flower buds and the central leaves. The developing insect larvae, if present, are tiny and difficult to detect.

Damage symptoms and severity depend upon the number of larvae present and the growth stage of the plant attacked. Damaged seedlings often

appear twisted and have a noticeable brown scar at the growing point. If damage occurs before the plant reaches the button stage, then heads will not be produced. If damage occurs once head formation has already begun, the resulting heads will be twisted and distorted. Brown scars are typically found within the head and along leaf stalks, making the head unmarketable. Feeding by larvae can also promote the entry of pathogenic bacteria and fungi, resulting in rotting. These symptoms are often mistaken for symptoms of poor seed quality, heat stress or nutrient deficiencies.

Tarnished Plant Bug

Both the adults and nymphs of this insect can damage the heads of broccoli and cauliflower. Brown beading of broccoli and brown streaking of cauliflower may be caused by tarnished plant bug feeding.

Physiological Disorders

Cabbage Splitting

Well developed heads may split if heavy rains follow a prolonged dry spell. The splitting is caused by rapid growth promoted by improved growing conditions.

Maintaining uniform growth with proper irrigation may partially prevent this. Deep cultivation may also break up roots preventing excessive growth.

Cauliflower Buttoning

Buttoning is the premature formation of a cauliflower curd. As the curd forms very early in the plant's life, the leaves are not large enough to nourish the curd to a marketable size. Buttoning usually occurs shortly after planting in the field.

Losses are usually most severe in the early-planted crop during cold, wet seasons, when vegetative growth is reduced. Conditions that reduce the vigour of the plant and retard vegetative growth appear to encourage buttoning. Some cultivars, particularly early ones, are more susceptible to buttoning. Conditions that may cause buttoning include:

- too-rapid hardening-off treatment of young plants raised under protection
- insufficient hardening-off treatment of young plants before being planted in the field
- unbalanced soil fertility in the field (particularly low nitrogen)
- low soil moisture
- cold weather (e.g., 4°– 10°C for 10 days or more) especially in combination with excess moisture
- certain diseases, insects and trace-element deficiencies, such as club root, rootmaggot and molybdenum deficiency (whiptail).

An application of 35 lb/acre of 34-0-0, through the irrigation system may assist in rectifying the problem. Application should be made as soon as possible after stress conditions occur.

Bolting

Low temperatures early in the growing season may cause premature seedstalk development. The earlier the seed is sown, the greater the bolting tendency. Bolting may also be caused by extreme changes in temperature, poor soil conditions or low nutrient levels. Some cultivars, particularly early ones, are more susceptible to bolting.

Tipburn of Cauliflower and Cabbage

Tipburn can occasionally cause severe economic losses in cabbage and cauliflower. Tipburn is a breakdown of plant tissue near the centre of the head in cabbage and on the inner wrapper leaves of cauliflower. It is a physiological disorder associated with an inadequate supply of calcium in the affected leaf margins causing a collapse of the tissue and death of the cells.

High temperatures and fluctuating soil moisture conditions hinder the movement of calcium into the leaves, leading to tipburn.

Secondary rot organisms such as soft rot bacteria *Erwinia* can follow tipburn. Many varieties of cabbage and cauliflower have been noted to be resistant to tipburn problems.

Weeds

Competition from weeds can reduce yield and also make harvesting more difficult. For recommended herbicides refer to the *Guide to Vegetable Crop Protection 2003*.

Harvest and Storage

Cabbage and Brussels Sprouts: Cabbage heads are harvested after they have become firm. Brussels sprouts are harvested when sprouts are 1 to 2 inch inches (2.5 to 5 cm) diameter. Sprouts are best stored on the stock for longer storage life. Sprout development is improved and made more uniform by pinching the growing point of the plants when the lower to middle sprouts are about 1/2 to 3/4 inch (12 to 19 mm) in diameter.

Both crops store well at a temperature of 0°C and a relative humidity of 100%. To retain the rich green colour, field heat must be removed immediately after entering storage. Most green colouring will disappear unless the temperature is reduced within the first week of storage.

Cauliflower: Harvest heads when they are 6 inches (15 cm) or more in diameter and before the curd begins to separate and "rice". Tying up the leaves to enclose the head is usually necessary to produce a bright white curd.

Broccoli: Heads should be harvested when the flower bud clusters are well formed, but before yellow flowers appear. The terminal bud is the largest and forms first, followed by the laterals. Broccoli heads should be trimmed to a length of about 6 inches (15 cm).

Cauliflower and broccoli will store for short periods of time if the field heat is removed immediately after harvest.

For broccoli, storage quality is maintained at a much higher level if the product is covered with a layer of crushed ice (slush) after it is packed in the container ready for shipment or 0°C at 95 - 100% relative humidity. This helps prevent dehydration while it is moving through the distributive trade.