

Review on Major Physiological Disorders of Cole Crops

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Brassica or cole crops are one of the world's most significant vegetable crops. The Brassicas offer the widest range of products that can be produced from a single genus. They produce vegetables such as leaves, flowers, stems, and roots that can be eaten raw or cooked [4]. *Brassica oleracea* (Cole or cabbage group) and Oriental types (Chinese cabbage and its relatives), which contain vitamins and cancer-preventing compounds, are of vital importance for human nutrition. The wild species found along the Mediterranean shoreline, whose progenitor was an annual herb gave rise to the species *Brassica oleracea* (with the exception of rape = *Brassica napus*), which was developed in Central and Western Europe [13]. Broccoli, cabbage, cauliflower, and Brussels sprouts are examples of varieties of the *Brassica oleracea* species that belong to the Brassicaceae family. Most cole crops grow best at temperatures between 60 and 65 °F [15]. The fact that these plants are related and have comparable climatic needs as well as common pests and diseases should be kept in mind. Although they are similar, they are not the same. Between broccoli varieties, there could be more variation than between broccoli and cauliflower. Each group has had many varieties created, varying in terms of pest susceptibility, temperature tolerance, shape, color, and growing season. To find out which varieties are suitable, speak to other farmers in your community or your Extension agent. Regardless of the season in which the crops are grown, they are susceptible to a number of diseases and physiological problems that lower the quality of the produce. The majority of physiological disorders are frequently brought on by mineral deficiencies, usually micronutrients, as well as environmental stress brought on by erratic and uncontrollable weather conditions [16]. The absence of physiological disorders in Brassica crops is crucial, not only for aesthetic reasons but also because they may

have an impact on other qualities like nutritional value and shelf life.

Physiological disorders of Cole Crops

Buttoning

In broccoli and cauliflower, buttoning is an early form of heading. Foliar growth stops, and small heads (1 to 4 inches in diameter) form. The heads are of poor quality, though they may continue to grow. There aren't enough leaves on the cauliflower to blanch the curds. Buttoning can happen at any time from seeding until the plants are almost fully grown, but it usually happens within a month of field transplantation. Young plants are under stress due to low or high temperatures, moisture stress, transplant shock, or nutrient deficiencies, which leads to this issue. By cultivating varieties that are well suited for that climate and taking good care of the plants in the greenhouse and field, the seedlings to be transplanted should not be more than six weeks [17].

Whiptail

Whiptail is a physiological disorder of cole crops, such as cauliflower, broccoli, cabbage, and Brussels sprouts. It is caused by a molybdenum deficiency in the soil. Molybdenum is an essential micronutrient for plant growth and development. It is involved in the metabolism of nitrogen and phosphorus, which are essential macronutrients for plants. The main symptom of whiptail is the narrowing of the leaf blades. The leaves become strap-like and the midrib becomes prominent. The growing point of the plant may also be deformed, resulting in a lack of head formation in cauliflower and broccoli. Leaf margin chlorosis can cause the entire leaf to turn white. The leaf blades don't grow out correctly [6]. Molybdenum deficiency typically happens in acidic soils when the pH is under 5. To control this condition, it is helpful to apply 0.5–1.0 kg of sodium or ammonium molybdate per hectare, or 0.1-0.3%

ammonium molybdate with 0.1% teepol as a sticker. To increase the pH to 6.5, add lime to the soil.

Browning (brown rot or red rot)

Cauliflower turns brown when it lacks boron. Typically, after curd formation, plants show external signs of boron deficiency. On the stem and curd, the water-soaked areas first appear early in the stage. As the plant matures, the stem becomes hollow, and tissue soaked in water coats the interior walls of the cavity [18]. At an advanced stage, the curd surface exhibits brown or pink surfaces. It can be managed by adding borax. The quantity of borax varies depending on the type of soil, pH, and degree of deficiency. While alkaline soil may need large amounts of borax, acid soil only needs 10–15 kg/ha.

Bolting

When young plants of biennial vegetables, such as cabbage and cauliflower, are exposed to low temperatures for an extended period of time, between 50 and 55 degrees Fahrenheit, bolting (early flowering) is likely to occur later in the season [11]. Plants that are bolted have no market value. When plants are about four weeks old, plant them in the field. Bolting can be reduced by adhering to the same temperature recommendations that were provided above for the prevention of buttoning. To prevent and manage bolting in cole crops, following measures can be adopted-

- Choose varieties that are resistant to bolting.
- Plant at the appropriate time of year- Planting too early or too late can make plants more susceptible to bolting.
- Provide adequate spacing between plants- This will allow for good air circulation and help to reduce stress on plants.
- Maintain adequate soil moisture and fertility- This will help to reduce stress on plants and ensure that they have the nutrients they need to produce a healthy head or curd.
- Avoid over fertilizing with nitrogen-Too much nitrogen can promote bolting.

Hollow stem

Tissues become discolored and exhibit the appearance of being wet. The affected stem is completely clear and white and shows no signs of deterioration. It is caused by boron excess or deficiency [12]. Closure spacing, the best use of nitrogenous fertilizers, and borax at 0.3-0.4% can all help to correct it.

Riceyness

The term "riceyness" describes the early appearance of flower bud initials on the curd surface of cauliflower, which is regarded as unfavorable for the market [19]. Cauliflower which is too ricey makes the curds uneven and fuzzy, which lowers their marketability. This disorder is caused by warm temperatures (> 68° F) during curd development. At 68 to 80°F, some more recent hybrids can start to grow heads. The ability to develop mature floral structures is momentarily inhibited during the curd development stage [4,5], whereas the iterative proliferation of apical meristems of branches causes a rapid increase in curd size. When the curd reaches the post-maturity stage, some pedicels begin bolting along with the differentiation of floral meristems, and the plant then starts to bloom [3,6].

Fuzziness

The lengthening of the leafy floral bracts of the bud or flower causes fuzziness, giving the curd's surface a velvety or hairy appearance. Before appearing elsewhere, it frequently first appears around the curd's edges [1].

Hollow Stem

Insufficient boron or high nitrogen levels are the main causes of this. The stem exhibits the symptoms. The stem's thick, fleshy center splits, creating a cavity. This cavity creates openings to the outside environment at both ends. It can be controlled by using close spacing, the necessary amount of nitrogen, or by spraying 0.25 to 0.50% borax [8].

Blindness

Blindness in cauliflower is a physiological disorder that prevents the formation of the head (curd). The plant may produce leaves, but the curd does not develop. By storing carbohydrates, the leaves grow larger, thicker, darker greener, and leatherier while the plant remains vegetative stage [9]. Cutworms and the low temperature are to blame for this [10]. Insecticides that kill the insects, protect the buds from damage, and prevent exposure to low temperatures can be used to control this.

Pinking

The curd shows a pink tinge because of exposure of the curds to high light intensities. anthocyanin pigment develops which imparts pink color to curd. Blanching is the best way to control pinking.

Splitting or Cracking

Early cabbage often experiences splitting when moisture stress is followed by heavy rain. Splitting can occur as a result of rapid growth brought on by rain, high temperatures, and high fertility. Splitting might be avoided with appropriate irrigation and deep cultivation [2]. The susceptibility of various cultivars to this issue varies significantly.

Tip Burn

Tip burn is the term used to describe the browning of the internal leaf edges or tips found within the heads of cauliflower, broccoli, and cabbage [14]. During storage or transportation, these brown spots frequently disintegrate, allowing secondary organisms to decompose the product. Rapid growth brought on by too much nitrogen, a high temperature, water stress, and a calcium deficiency is the issue [7]. Although calcium can be found in the soil, it can only move a small amount to the plant before it becomes unavailable to support rapid growth. Applications of additional nitrogen should be timed to prevent rapid growth in the plant's later stages of development.

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