



AGRONOMIC SPOTLIGHT



MANAGING BROWN BEAD AND HOLLOW STEM IN BROCCOLI

- » Brown bead is a disorder of broccoli in which the flower buds turn yellow and then brown.
- » The incidence of brown bead is associated with several environmental factors.
- » Providing even and adequate moisture and nutrients will help reduce levels of brown bead.

BROWN BEAD SYMPTOMS

Brown bead (also known as brown bud, orange bead, and yellow bead) is an abiotic disorder of broccoli that reduces the quality and marketability of the heads.¹ In Canada, brown bead accounts for up to one-third of all rejections of heads in the field.²

Symptoms of brown bead start as a yellowing of unopened floral buds (Figure 1). The buds can turn tan or copper colored as the heads approach market maturity (Figure 2). Affected buds become necrotic, die, and dry up, and these flower buds easily detach from the head. The condition spreads throughout the head. Under wet conditions, the necrotic tissues can become an infection court for colonization by soft rot bacteria, leading to a rotting of the



Figure 1. Yellowing floral buds are the initial symptoms of brown bead.



Figure 2. As the condition develops, the buds turn brown.

head.^{1,3} Some forms of insect damage can look similar to symptoms of brown bead.

FAVORABLE CONDITIONS

Brown bead occurs most commonly during the warm summer months. The optimum temperature for the growth of broccoli is between 60 and 65°F, and brown bead becomes more common as temperatures rise above 75°F.² Temperatures during the five days before harvest are especially important. In California, there is an increased incidence of brown bead when plants are rapidly growing and temperatures are above 77°F. Rapid growth may be stimulated by heavy rainfall or irrigation events.⁴ High humidity has been associated with a lower incidence of brown bead in some studies,² while others report that brown bead is more likely to occur when humidity is high or at times when humidity levels vary significantly.

There appears to be an association of brown bead with levels of certain nutrients. Affected tissues have been shown to have low levels of calcium (Ca) and high levels of magnesium (Mg) and potassium (K). Ca is a relatively immobile element in plants. It is taken up by the roots and is translocated to the upper parts of the plant through the xylem. When plants are transpiring rapidly, due to warm temperatures, water and Ca are primarily translocated to the leaves rather than to the developing flower buds, so Ca levels in bud tissues are low under these conditions.² Ca is used in cell wall formation, and it is thought that low Ca levels result in poorly formed cell walls, leading to cell death. Even if there are adequate levels of Ca in the soil, localized Ca deficiencies can develop in growing bud tissues. Mg and K compete with Ca for absorption into the cell, so elevated levels of either of these two elements would further lower the level of Ca in the cell. High levels of sodium (Na) in the soil can also compete with Ca for uptake by the roots, resulting in higher levels of brown bead.

A study in Ontario found that direct seeded broccoli and transplanted broccoli plants responded differently to the

(Continued on page 2)





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(Continued from page 1)

effects of environment and soil conditions in the development of brown bead. Transplants tend to have smaller root systems than direct seeded plants, and their roots tend to grow primarily in the upper levels of the soil. As a result, transplants were found to be more sensitive to soil conditions. However, transplanted broccoli is usually planted early in the season, avoiding the period of high temperatures, so levels of brown bead with these early season plantings are typically low. With early planted transplants, warmer conditions that allowed plants to grow and recover from transplant shock more quickly were correlated with a lower incidence of brown bead.² For direct seeded plants, the amount of solar radiation (sunlight), soil moisture, and the levels of nutrients in the soil and tissues were found to be most important in brown bead incidence. High levels of sunlight means that water is transpiring from the leaves and Ca is not moving into the flower buds as quickly, resulting in more brown bead symptoms. With both direct seeded and transplanted broccoli, even levels of water availability and nutrients resulted in lower levels of brown bead. Anything that interrupts plant development, including insufficient water or nutrients or unfavorable temperatures, results in higher levels of brown bead.

MANAGEMENT OF BROWN BEAD

Broccoli varieties vary in their susceptibility to brown bead⁴, so selecting a variety that is less susceptible can help reduce the problem, especially for plantings that will be nearing market maturity during the warm part of the season. Maintain an even and regular water supply. Higher nitrogen (N) application rates have been shown to reduce levels of brown bead in some studies², but this does not seem to be true in all situations. Supplying adequate levels of N and moderate levels of K and Mg should help lower the incidence of this problem. Because the incidence of brown bead can be affected by the temperatures in the days just before harvest, planting a mix of varieties with different rates of maturation will spread out head formation and reduce the chances that all plants will be affected by brown bead.³

HOLLOW STEM

Symptoms of hollow stem start as small cracks in the internal stem tissue. As the stems grow, the cracks expand and cavities form. The cavities may extend up into the head (Figure 3). The hollow areas in the stem and head can lead to colonization by secondary pathogens, resulting in rotting of the tissues.

The occurrence of hollow stem is affected by soil moisture levels, N levels, and warm weather. For hollow stem,



Figure 3. Broccoli heads showing symptoms of hollow stem.

anything that promotes rapid plant growth increases the incidence of this disorder. For example, high levels of N can increase the incidence of hollow stem, especially during periods of warm weather.^{5,6} Wide plant spacings and rapidly growing cultivars are also associated with higher levels of hollow stem. Closer plant spacing and lower fertilization levels, especially N, will lower the incidence level of hollow stem. A brown discoloration of the internal hollow stem tissue may be associated with a boron deficiency. Some recently developed varieties are resistant to hollow stem.

Sources:

- ¹Jenni, S., Dutilleul, P., Yamasaki, S., and Tremblay, N. 2001. Brown bead of broccoli. I. Response of the physiological disorder to management practices. *HortScience* 36(7):1224-1227.
- ²Jenni, S., Dutilleul, P., Yamasaki, S., and Tremblay, N. 2001. Brown bead of broccoli. II. Relationships of the physiological disorder with nutritional and meteorological variables. *HortScience* 36(7):1228-1234.
- ³Dicklow, B. and McKeag, L. (eds.) 2016. Physiological disorders: Head rot and brown beading (broccoli). *New England Vegetable Management Guide*.
- ⁴2009. Brown bead of broccoli. Ontario Crop IPM. <http://cropipm.creativecommons.org/english/brassicac/diseases-and-disorders/brown-bead.html>
- ⁵Rimmer, S., Shattuck, V., and Buchwaldt, L. 2007. *Compendium of Brassica Diseases*. American Phytopathological Society, St. Paul, MN.
- ⁶Fritz, V., Rosen, C., Grabowski, M., Hutchison, W., Becker, R., Tong, C., Wright, J., and Nennich, T. *Growing broccoli, cabbage and cauliflower in Minnesota: Fertility requirements*.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development & Agronomy by Monsanto.

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