

## Calcium deficiency/disorder

Calcium deficiency symptoms on vegetables express themselves in different ways. Most calcium deficiencies that we observe on vegetables in California are generally not related to the quantity of calcium in the soil. Hartz et al (2007) found in a survey of 15 Salinas Valley soils that all but one of the soils had a concentration of calcium in the soil solution of greater than 200 ppm. By comparison, the concentration of calcium used in hydroponic solutions generally ranges from 150 – 250 ppm. In the same study, the incidence of tipburn on romaine lettuce was not related to soil calcium levels but was related to the amount of transpiration that occurred in the final two weeks prior to harvest. Calcium deficiency is enhanced by environmental conditions that promote rapid growth that limit transpirational flow of water through the plant that transports calcium to sensitive tissue. Calcium deficiency on many vegetables is therefore more often a disorder than a deficiency caused by low levels of calcium in the soil.

Calcium moves in the xylem with the flow of water created by transpiration. As a result, during the day, if there is high humidity (e.g. cool, foggy weather) and water is not moving efficiently through the leaf, calcium deficiency can occur along the edges of the developing leaf resulting in a localized deficiency of calcium known as tipburn (Photos 1 and 2). Likewise, high nighttime temperatures which stimulate rapid growth, when no transpiration is occurring, can also result in tipburn. Calcium disorders have different names in different types of vegetables; for instance, in tomatoes and peppers it is called blossom end rot and in celery black heart, but all are caused by the same phenomena, localized calcium deficiency. Varieties of different vegetable types can vary in their susceptibility. For instance, in head lettuce varieties differ greatly in susceptibility to tipburn from susceptible to highly resistant varieties. Tipburn resistant varieties were developed by careful selection by plant breeders. Some types of vegetables, such as romaine lettuce, have not received the same amount of attention by breeders to develop tipburn resistance, and at present, it romaine tends to be more susceptible than head lettuce.

The following are photos of localized calcium deficiency in various vegetables



1. Tipburn on head lettuce



2. Tipburn on romaine lettuce



3. Tipburn on cabbage



4. Close up of tipburn on cabbage



5. Tipburn on Nappa cabbage



6. Tipburn on spinach



7. Tipburn on Brussels sprouts



8. Close up of tipburn on Brussels sprouts



9. Tipburn on Cauliflower



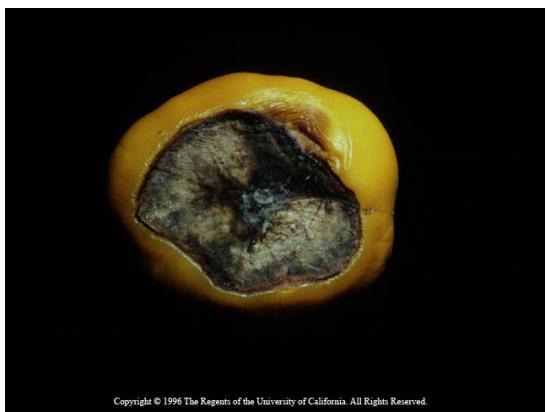
10. Tipburn on radicchio



11. Blackheart of celery



12. Blackheart of fennel



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13. Blossom end rot of tomato



14. Blossom end rot of pepper



15. Tipburn of artichoke

Reference: Hartz, T.K., P.R. Johnstone, R.F. Smith and M.D. Cahn. 2007. Soil calcium status unrelated to tipburn of romaine lettuce. *HortScience* 42(7): 1681-1684.