Grower 101:

Diagnosing Bedding Plant Nutrient Deficiencies

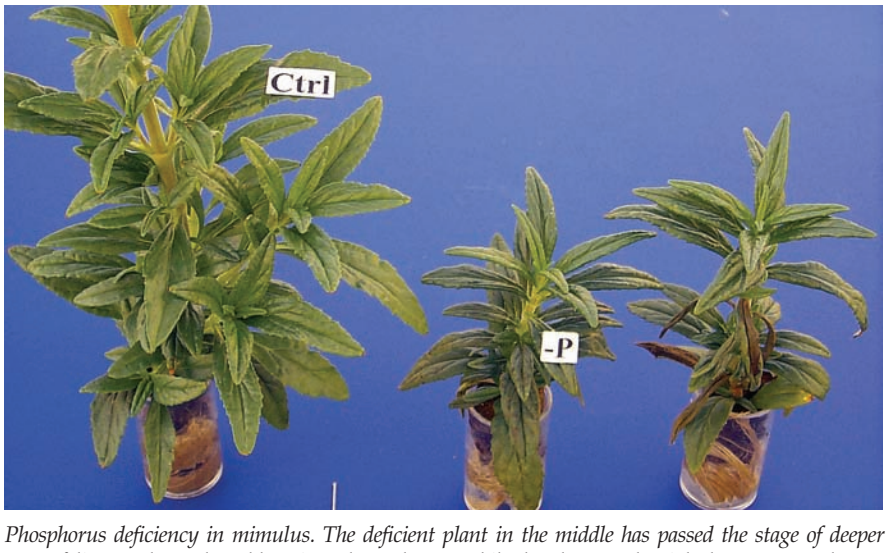
This nitrogen-deficient sunflower with chlorosis on lower leaves is beginning to give way to necrosis. (Photos: NCSU Floriculture Group)

The different nutrient deficiencies in bedding plants exhibit a range of symptoms. Learn the common symptoms of a number of deficiencies, such as nitrogen, copper, boron and more, to aid in diagnosis.

By Paul Nelson, Brian Whipker, John Dole, Dharmalingam Pitchay, James Gibson, Amy Rhodes and Brenda Cleveland

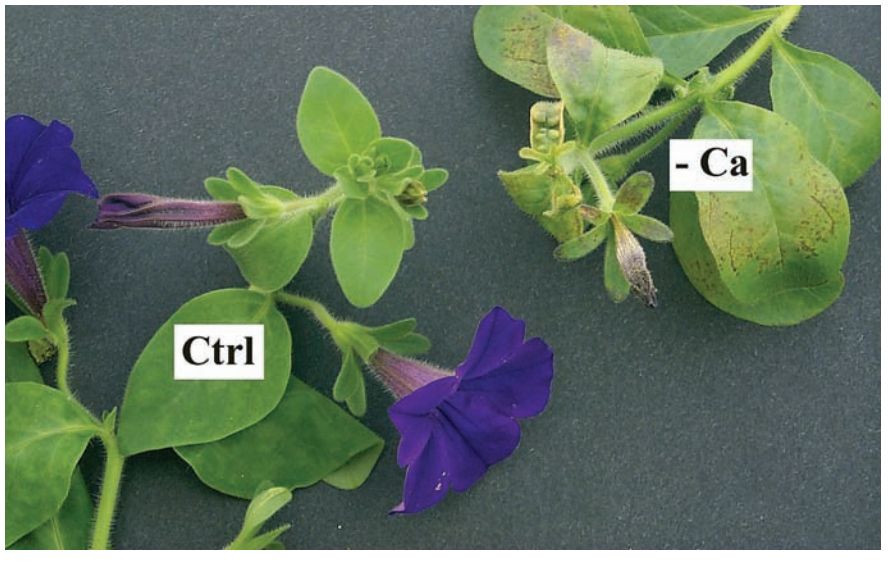
Bedding plants are afflicted by a number of nutrient deficiencies. There are three diagnostic tests that can be used to assess these deficiencies — soil testing, foliar analysis and visual diagnosis. Soil testing and foliar analysis should be practiced on a routine schedule to avert nutritional disorders; hopefully, one will not need to resort to visual diagnosis, because the presence of symptoms is evidence that a preventable problem has occurred. Worse yet, not all symptoms may be reversible when corrective action is taken. However, when nutritional errors do occur, visual diagnosis is a powerful tool for rapid identification of the problem and verification of soil or foliar test results.

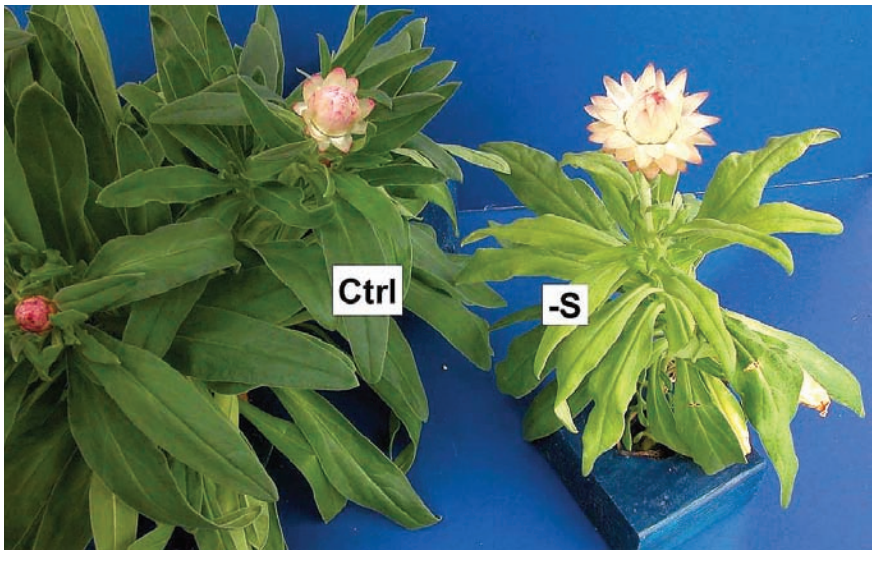
When using visual diagnosis, one must first account for all other factors that could cause similar symptoms. A number of nutritional disorder symptoms also can be the symptoms of other causal agents, such as air pollution, pesticide damage, herbicides in or near the crop area, plant growth regulators and pathogenic diseases, par-

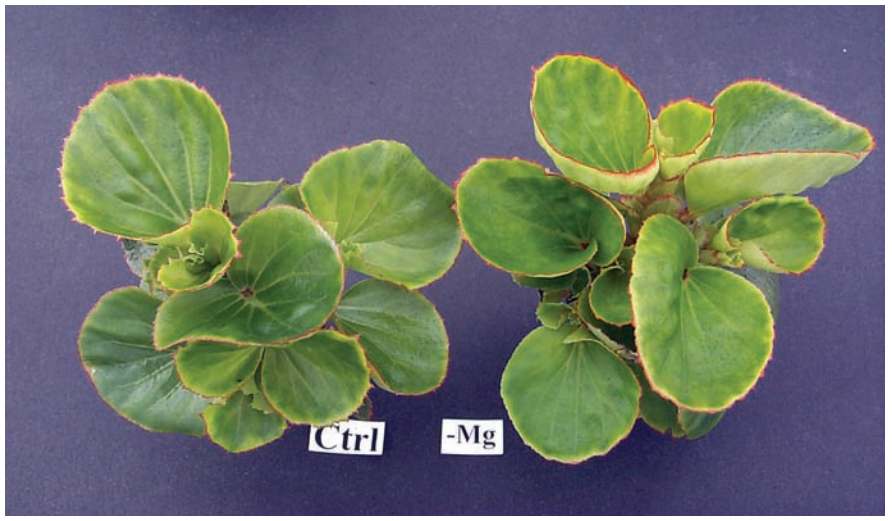


Phosphorus deficiency in mimulus. The deficient plant in the middle has passed the stage of deeper green foliage and now has chlorosis on lower leaves, while the plant on the right has progressed on to necrosis of lower foliage.

Potassium deficiency in salvia. The plant is smaller, foliage is darker and necrosis has formed on lower foliage margins.







Top: *Calcium deficiency in petunia. Young tissue becomes distorted and necrotic with a modest amount of chlorosis.* ***Bottom:*** *Magnesium deficiency in begonia expressed as interveinal chlorosis in mature leaves.*

Top: *Sulfur deficiency in bracteantha expressed as uniform chlorosis over the entire plant.* ***Bottom:*** *Iron deficiency in petunia. A progression can be seen in leaves where interveinal chlorosis is giving way to total loss of pigment, as seen in the white leaves, and finally to necrosis.*

ticularly viruses and environmental extremes such as frost, desiccation or temperature extremes. A valuable asset for sorting out these other causal agents is a crop production record. Further help can be found in production and pest control manuals for the crop at hand.

Diagnosing Symptoms

When it is evident that the symptoms are those of a nutritional problem, the diagnostic approach becomes important. Where are the symptoms on the plant? Symptoms of mobile nutrient deficiencies, including nitrogen, phosphorus, potassium and magnesium, appear in older tissue at the base of the plant. Symptoms of non-mobile nutrient deficiencies — including calcium, iron, manganese, zinc, copper and boron — generally appear first at the top of the plant in young tissue. Symptoms of the semi-mobile nutrient sulfur appear across the whole plant, in this case, as a uniform chlorosis of all leaves.

Is distorted growth of young tissue an early symptom? This would implicate calcium or boron deficiency. Is unusually deep-green foliage coupled with heavy stunting an early symptom? This points to phosphorus deficiency. Common symptoms for each deficiency are given in the next section.

Typical Nutrient Deficiency Symptoms

Nitrogen deficiency. Plants become noticeably smaller, leaves may be more upright and the plant as a whole may become light green. The oldest leaves will be the most chlorotic, and this chlorosis spreads uniformly across these leaves. After considerable time, older leaves become necrotic and drop off if abscission is possible for the species in question. Red to purple-red discoloration may develop in petioles, stems and leaves in many species including begonia, celosia, marigold, ornamental kale, pansy, salvia and snapdragon.

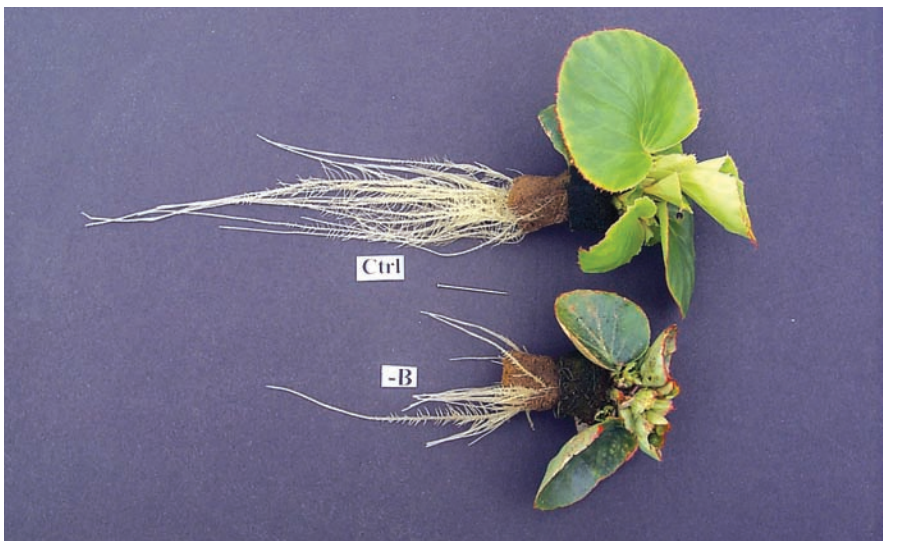
Phosphorus deficiency. The plant becomes severely stunted, and at the same time, the foliage becomes deeper green than normal. In some species, the older leaves develop purple coloration. Then older leaves develop chlorosis followed by necrosis. In young plants, necrosis may occur along with chlorosis or without prior chlorosis. Roots grow longer than normal but are fewer in number when the deficiency is moderate.

Potassium deficiency. The margins of older leaves become necrotic. Chlorosis may briefly precede this necrosis. Alternatively, necrotic spots may form across the blades of older leaves but more toward the margin. Soon the older leaves become totally necrotic. Seedlings and young bedding plants, prior to the formation of chlorosis and necrosis on older foliage, are more compact and deeper green than normal.

Calcium deficiency. Symptoms are expressed at the top of the plant. Young leaves may develop variable patterns of chlorosis and distortion such as dwarfing, strap-like shape or crinkling. The edges of immature leaves become necrotic; this is often the first noticeable symptom. Shoots stop growing. Petals or flower stems may collapse. The edges of poinsettia bracts may burn. Roots are short, thickened and noticeably branched.

Magnesium deficiency. Older leaves develop interveinal chlorosis. Often, chlorosis will start along the terminal margins of leaves and then move inward between veins, forming an interveinal pattern. In seedlings of several species, chlorosis may begin in leaves at the mid or slightly lower region of the plant. In several species, pink, red or purple pigmentation will develop in the older leaves following the onset of chlorosis.

Sulfur deficiency. Foliage over the entire plant becomes chlorotic, with chlorosis on any given leaf being quite uniformly distributed. ➧



Top: *Manganese deficiency in pansy. Chlorosis of young leaves tending toward an interveinal pattern followed by tan necrosis.* ***Bottom:*** *Zinc deficiency in zinnia seen as chlorosis of young leaves followed by rapid necrosis of recently mature leaves.*

Top: *Boron deficiency in begonia. Young tissue is distorted, internodes are short, buds are aborting, plant is highly branched and roots are short.* ***Bottom:*** *Copper deficiency in New Guinea impatiens manifested as interveinal chlorosis and marginal rolling in young leaves followed by sudden and rapid necrosis in recently mature leaves.*

Symptoms tend to be more pronounced toward the top of the plant in some species or at the base of the plant in very few species. While symptoms on the individual leaf look like those of nitrogen deficiency, it is easy to distinguish sulfur deficiency from nitrogen deficiency because the latter begins in the lowest leaves rather than over the whole plant.

Iron deficiency. Young leaves become chlorotic. Chlorosis can start in an interveinal or uniform pattern in young leaves but more often ends up interveinal. In late stages, the leaf blade may lose all pigment, passing through stages of increasingly lighter green to clear yellow and finally white. Necrosis occurs at the yellow or white stages.

Manganese deficiency. Young leaves become chlorotic. As in iron deficiency, chlorosis may be general across the leaf blade or interveinal. In young plants, chlorosis may affect the entire plant but will be a little more pronounced in the young leaves. In advanced deficiency, tan necrotic spots form in the chlorotic areas between the veins.

Zinc deficiency. One or more of various symptoms develop on young leaves. These include a little chlorosis in varying patterns but tend toward interveinal, abnormally small leaves; short internodes that give the stem a rosette appearance; and distortion of leaves in the forms of leaf curl, rolling of margins and spoon shapes. Following the young leaf symptoms, seedlings develop necrosis often on older, immature or recently mature leaves. In kalanchoe, zinc deficiency can express itself as a fasciation (a flattened, highly branched stem).

Copper deficiency. Pigment across the plant becomes darker, giving it a blackish- or bluish-green hue. Young and recently mature leaves commonly curl along their lengths or at the terminal end. A modest amount of chlorosis may or may not develop in young leaves, and it may be uniform or tend toward interveinal. Tips and lobes of these leaves may retain green pigment longer than the rest of the leaf. Necrosis suddenly appears on recently mature leaves and spreads rapidly, often resembling desiccation. Petioles and stems associated with recently mature leaves of snapdragon may also become necrotic and collapse.

Boron deficiency. Flower symptoms can include incomplete formation of flower parts, such as fewer petals; small petals; sudden wilting or collapse of petals; notches of tissue missing in flower stems, leaf petioles or stems; collapse of flower stems; and abortion. Death of the flower bud gives rise to branching, which is followed by death of the new buds, eventually leading to a proliferation of shoots termed a "witch's broom." Vegetative tissue symptoms can include short internodes; crinkling of young leaves; corking of young leaves, stems and buds; thickening of young leaves; and chlorosis of young leaves, but not in any definite pattern. Roots become short and thick with eventual death of root tips.

Molybdenum deficiency. As far as we know, molybdenum deficiency has not been a problem with bedding plants. Poinsettia is the only greenhouse floral crop it is known to effect. The margins of leaves at the middle of poinsettia plants become chlorotic, presenting a silhouette appearance, and then quickly necrotic. Symptoms spread up and down the plant. These leaves may also become misshaped, resembling a half-moon pattern with some crinkling. GPN

Paul Nelson, Brian Whipker, John Dole are from North Carolina State University; Dharmalingam Pitchay is from Rakers and Sons Inc.; James Gibson is from West Florida Research and Education Center, University of Florida; Amy Rhodes is from Wicomico County Extension Office; and Brenda Cleveland is from North Carolina Dept. Agriculture & Consumer Services. Contact Nelson at paul_nelson@ncsu.edu or (919) 515-1191.

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