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Nutritional Monitoring Series: Element Edition

Phosphorus (P)

Function: Involved in energy transfer (ADP) and formation of nucleic acids, oils, sugars, starches, and membrane structure. It also plays an important role in root and floral development and stimulates rapid plant growth.



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Figure 1. Lower leaf purple discoloration denotes a phosphorus deficiency in pansy. Photo by: Brian Whipker.

Elemental Parameters

Mobile Element:

Deficiency symptoms appear on older growth

Function:

Energy transfer, root and floral development

Target Fertilizer Range:

10 to 25 ppm P

Phosphorus

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Figure 2. Lower leaf purplish-red coloration denoting a phosphorus deficiency in (a) garden mum and (b) potted sunflowers. Photos by: Brian Whipker.

Deficiency: First expressed as extensive stunting with the leaves turning dark green. Under advanced P deficiency conditions, the lower leaves will chlorotic (yellow), then become reddish-purple, chlorotic, and ultimately necrotic (Figs. 1-2). For some species grown with warmer conditions, the reddish-purple coloration will not develop, and instead olive-green spotting can occur and as symptoms advance, the entire leaf becomes chlorotic (Figs. 3-4). It is important to correct P deficiency when symptoms first appear because lower leaf chlorosis and necrosis cannot be reversed. Phosphorus is a mobile element within the plant; therefore, deficiency symptoms will first appear on the lower, older leaves.

Excess: Excessive levels of P will reduce plant growth and can induce deficiencies of iron (Fe), copper (Cu), manganese (Mn), and zinc (Zn). In poinsettia, excessive levels can reduce bract size.

Misdiagnosis With:

a. Poor root health due to root disease, injured roots, insect and nematode feeding, poor drainage or compact substrate can result in a purple cast and red venation. Inspect the root system.

b. Cold substrate temperatures can inhibit the uptake of P. Measure the root-zone temperature.

c. Wet substrate conditions can inhibit the uptake of P. Inspect the substrate for waterlogged conditions.

Confirm your actual P levels by conducting a routine root substrate (medium) test and/or a plant tissue analysis.

Monitoring and Management Strategy for Phosphorus

Fertilization Rate: 10 to 25 ppm. (Remember 20-10-20 applied at the rate of 200 ppm N will supply 44 ppm P.)

Tissue Concentration: The normal P range is between 0.2 to 0.5% for all species. Phosphorus levels below 0.2% are considered deficient and P levels greater than 0.9% are categorized as excessive in many species. If made available, greenhouse plants will take up luxurious amounts of P and concentrations can exceed 1.0%.

Options:

Preplant: Incorporation of super phosphate or treble-super phosphate in the root substrate (medium) for a starter charge.

Continual Fertilization:

1. Use a fertilizer that provides P. Examples 20-10-20, 15-5-25, 13-2-13 Cal-Mag, 15-5-15 Cal-Mag and others.
2. If using 20-10-20 or 20-20-20, remember to supply Ca and Mg to the plants.



Figure 3. During warm growing conditions, olive-green leaf spots can appear on the lower foliage instead of the purplish-red coloration, as seen here with garden mums. Photo by: Brian Whipker.

3. If using calcium nitrate [$\text{Ca}(\text{NO}_3)_2$] with potassium nitrate (KNO_3), remember to supply P, Mg, and micro-nutrients to the plants.

4. If injecting phosphoric acid for alkalinity control, remember to adjust your P fertilization rate.

5. Remember when calculating P fertilization rates, the numbers on the fertilizer bag are expressed as percent of P_2O_5 . Therefore, multiply the bag number by 0.437 for the percentage of P. Example: 20-10-20 fertilizer would be calculated as $10 \times 0.437 = 4.37\%$ P.

Corrective Fertilization:

1. Applications of 20-10-20 at the rate of 200 ppm N will supply 44 ppm of P. A corrective P fertilization will return the lower leaves to the normal green color within 1 to 2 weeks. Do not over apply. It is important to correct P deficiency when symptoms first appear because lower leaf necrosis cannot be reversed.



Figure 4. Advanced symptoms of olive-green leaf spots and foliage chlorosis which appears on the lower foliage of garden mums. These symptoms appear instead of the typical purplish-red coloration during warm growing conditions. Photo by: Brian Whipker.

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