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# Phosphorus Has 2 Ps:

## The case of two distinctive deficiency symptoms

*When phosphorus is deficient, the classical symptom we all learn is lower leaf purpling, especially during cold or wet growing conditions. With warmer growing temperatures, a totally different symptomology occurs as lower leaf olive-green spotting on pale leaves. Knowing both types of symptoms will help diagnose a phosphorus deficiency.*

Anyone who has taken a plant nutrition class has been taught when it comes to diagnosing a phosphorus (P) deficiency, one needs to look for lower leaf purpling. This is the classic symptom that occurs in plants. The purpling is due to an increase in anthocyanin production that accumulates when P is limited. During cold and wet springs, it is hard to miss all the purple cornfields as the plants struggle to grow and take up P. This type of symptomology is commonly observed with geraniums, garden mums, and numerous bedding plants (Figs. 1&2). In addition, the mimics of lower leaf bronzing due to sub-optimal substrate pH levels (Fig. 3) and a nitrogen (N) deficiency occurring on a red leaf plant (Fig. 4) can cause confusion.



Figure 1. Typical lower leaf purpling occurs when phosphorus uptake is limited. (Photo: Brian Whipker)

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At NC State University, we have been inducing nutrient deficiencies over the past 10 years on a wide assortment of plants. When it came to P deficiency symptoms, in most cases with our warmer growing temperatures, we failed to induce lower leaf purpling (Fig. 5). Instead, lower leaves developed an overall pale yellow coloration and an olive-green spotting pattern (Figs. 6&7). Ultimately the leaves turn necrotic and abscised. We have observed this on over 40 species. This type of symptomology has not been described for many species.

Interestingly enough, when Dr. Josh Henry, currently a member of the Ball Technical Team, was working on his Master's degree at NC State, he investigated optimizing phosphorus rates and inducing deficiencies. In work supported by the Fred C. Gloeckner Foundation, he determined that when P was marginally low and there was a large demand (sink) due to flowering or fruit load, the symptoms of a P deficiency changed location. Symptoms appeared in the upper foliage just below the flowers in chrysanthemums or fruit in the case of peppers. To have symptoms develop at the top of the plant is a new condition that growers need to be aware of when diagnosing phosphorus deficiencies.

Phosphorus deficiency symptoms can be multifaceted and go beyond the typical lower leaf purpling. Knowing how symptoms can vary will aid in your diagnostic ability.



Figure 2. Pronounced purple discoloration due to a phosphorus uptake issue caused by root rot. (Photo: Brian Whipker)



Figure 3. Lower leaf purpling in pentas caused by a low substrate pH (<5.0) and not a phosphorus deficiency. (Photo: Brian Whipker)



Figure 4. Red leaved plants can develop an orange to purple coloration when nitrogen is limited. This can be confused with typical symptoms of a phosphorus deficiency. (Photo: Brian Whipker)



Figure 5. Typical reported lower leaf purpling as the result of a phosphorus deficiency. (Photo: Brian Whipker)



Figure 7. A collection of leaf symptoms when phosphorus is deficient. (Photo: Brian Whipker)



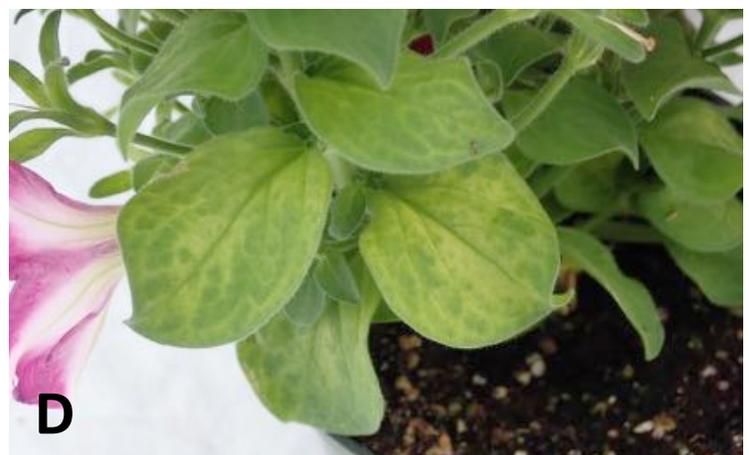
**A**



**B**



**C**



**D**

Figure 6. During warmer growing, a phosphorus deficiency begins as a faint yellow discoloration of the lower leaves (A), followed by overall leaf yellow and the development of olive-green blotches (B-D). (Photo: Brian Whipker)

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