e-GRO Alert

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Avoiding Ammonium Toxicity is Easy!

Pansies are selling, so why talk about a production issue that is frequently observed during the winter and early spring? It's never too late to buy a different fertilizer blend for crops that are prone to ammonium toxicity before you forget.

This spring, several greenhouses reported chlorosis in their pansy crops. As well as a few other crops. Given that pansies are generally considered to require low fertility of 100 to 150 ppm nitrogen and a pH and EC range (PourThru) from 5.5 to 5.8 and 1.3 to 2.0 mS/cm, respectively, we did not believe it was a nitrogen deficiency as the grower was providing 115 ppm nitrogen at every irrigation. As pansies can develop both low and high substrate pH disorders, our first thought was that the substrate pH might be high given that they can develop interveinal chlorosis when the substrate pH is above 6.2 as iron becomes unavailable (Fig. 1). An in-house substrate analysis determined that that the pH and EC were 6.0 and 1.98 mS/cm, respectively, which are not too far outside of the

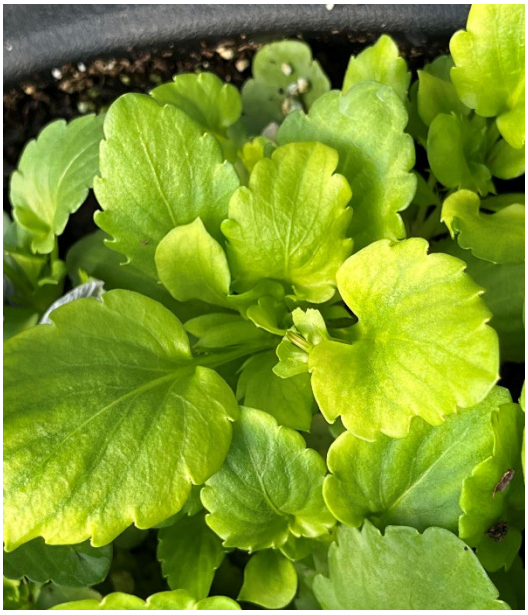

Figure 1. When the substrate pH is above 6.2, iron becomes unavailable, and pansy develops interveinal chlorosis.

recommended ranges. We then collected tissue samples from newly expanded leaves, triple rinsed with distilled water and submitted the samples to a lab to analyze nutrient levels. The analysis indicated that nitrogen was 7.3%, which is above the recommended range for pansy (2.5 to 4.5%) and iron was 103 ppm, which is within the recommended range of 60 to 300 ppm. The next step was to ask the grower what type of fertilizer they were using as 115 ppm N at every irrigation should not lead to such high N concentrations in the tissue. The grower indicated that they were utilizing a 20-10-20 fertilizer which contains a high percentage of ammoniacal nitrogen.

Ammonium toxicity occurs when too much ammonium is available in the substrate, and plants take it up excessively. Water-soluble fertilizers may contain more than one form of nitrogen such as nitrate (NO_3^-), ammonium (NH_4^+), and urea [$CO(NH_2)_2$]. Ammonium and urea (urea converts to NH_4^+) can result in ammonium toxicity during the winter and early spring when light levels and temperatures are low, and substrates are saturated, oxygen deprived, and below 65 ºF. Additionally, bacteria that usually help convert ammonium to nitrate are not as active in cold substrates.

Figure 2. This ranunculus crop was fertigated with 150 ppm nitrogen from a 20-10-20 fertilizer and grown very cool in the greenhouse. Within a few weeks, the leaves began to curl and develop yellow and necrotic lesions.

Figure 3. Excess accumulation of ammonium in regal geranium can cause leaf curl and necrotic tissue in between veins.

Figure 4. This pansy crop was kept excessively wet and was fertilized with 115 ppm nitrogen. Pale green foliage is a symptom of ammonium toxicity in pansy.

Figure 5. Plants that are exhibiting symptom of ammonium toxicity are stunted. In most instances, those cells were overwatered, and roots are underdeveloped.

Figure 6. Potted basil exhibiting symptoms of ammonium toxicity when irrigated with 150 ppm N from a blend of 20-5-20 and 18-3-18.

While plant cells can store high levels of nitrate nitrogen without any harm, accumulating ammonium can damage cells (Figs. 2 and 3).

Therefore, acidic fertilizers such as 20-10-20 containing a high percentage of ammoniacal nitrogen should be avoided during cold and cloudy weather, especially in Northern latitudes. Instead, nitrate-based fertilizers such as 15-0-15 should be used from November to March. Additionally, ensure that plants are receiving adequate amounts of potassium, as it helps convert NH_4^+ to proteins, which lowers the foliar ammonium levels. Certain crops such as basil (Fig. 6), coleus, cosmos, eggplant, geranium, lettuce, pansy (Fig 5.), pepper, ranunculus, salvia, tomato, and zinnia are especially sensitive to too much ammonium.

To avoid ammonium toxicity, growers need to monitor the ammonium levels and use fertilizers with a balanced ratio of ammonium and nitrate. Adjust the pH of the substrate to help convert ammonium to nitrate and use amendments to reduce ammonium levels. Following these steps can prevent ammonium toxicity and promote growth. Visual symptoms of ammonium toxicity begin as interveinal or marginal leaf chlorosis, chlorotic blotches, or pale lime green foliage that mimic an iron deficiency (Figs. 3, 4 and 5). In mature plants, either upward or downward curling of leaf margins and even the floral buds can occur (Figs. 2 and 3). Roots may also be affected with fewer roots forming and tips becoming necrotic with an orange-brown color. As the toxicity progresses, necrosis follows chlorosis on older leaves (Figs. 2 and 3). Seed germination and establishment can be delayed as young leaves are more susceptible to ammonium toxicity and typically develop interveinal chlorosis.

Similar to older plants, the margins of leaves will curl up or down depending on the species.

Correcting ammonium toxicity:

• Increase substrate temperature by raising the air temperature or moving the crop to a heated bench or floor.

• Switch to a fertilizer with no ammoniacal nitrogen or a calcium-magnesium fertilizer.

• Leach the substrate with clear water, but make sure to allow it to dry down between irrigations.

To facilitate leaching in severe cases of ammonium toxicity, growers can apply gypsum. Cornell University recommends an application of one tablespoon of gypsum top-dressed to a 6-inch pot and irrigated with clear water. Follow up two hours later with 50 ppm of calcium nitrate. For more details, check out this article.

Preventing ammonium toxicity:

Growers typically report ammonium toxicity during the winter and early spring growing season. Take active steps to prevent ammonium toxicity in sensitive crops from November to late March. Use fertilizers with combined ammonium and urea, making up less than 40% of the total nitrogen. In extremely cold and cloudy conditions, this percentage should be further reduced.

• Keep substrate pH at the higher end of the crop recommendations by monitoring regularly and taking steps to adjust as needed.

• Maintain greenhouse temperatures above 60 °F (15 °C) if possible.

• Do not allow nitrogen to build up in the substrate by over-fertilizing.

• Avoid keeping the substrate too wet.

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