GROWERTALKS

Features

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Plant Physiology for Growers

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The field of plant physiology is intricate and complex. It encompasses biochemistry, plant nutrition and physiological ecology. For example, most plants take up very little water at night. In general, about 3% of moisture is absorbed during the night hours. Most absorption begins early in the morning when the sun comes up. We were all taught that plants absorb carbon dioxide and give off oxygen. This, however, is only true in the daylight hours. At night, most plants take in oxygen and give off carbon dioxide, just like we do.

In the daytime, most plants absorb carbon from the atmosphere, and hydrogen and oxygen from the roots. They combine these building blocks into simple sugars such as glucose, amino acids such as tryptophan and nucleic acids such as adenine. At night, plants completely switch around their activities. They assemble the chemical building blocks they made in the daytime into large molecules, such as carbohydrates, proteins, enzymes and genetic material. They use major and minor nutrients absorbed from the soil to help with these processes.

Iron deficiency

Iron deficiency is a common problem in many ornamental plants; however, iron deficiency is almost never a lack of iron in soil. It's a lack of iron availability. In addition to high pH, iron absorption can be interfered with by high phosphate, high manganese and high zinc. Soils that are too wet, too compacted or poorly drained will tend to lead to iron deficiencies.

There are primarily two kinds of iron in soils: the ferrous (or +2) ion and the ferric (or +3) ion. Plants can absorb both, but only the +2 ferrous ion is physiologically active. Plants don't think in the human sense. They don't have anything to think with. However, they "know" via their metabolic pathways when they're deficient in something like iron.

In such situations, many plants will try to acidify the root zone by proton extrusion. They secrete protons into the rhizosphere, lowering the pH around the roots to make iron more available. Some plants will secrete organic acids such as citric or malic acid to help both acidify the root zone and act as chelating agents for the iron.

Pictured clockwise from top left: Iron deficiency in dracaena. • Nandina with excess fertilizer. • Sodium toxicity in hibiscus. • Sunshine Ligustrum with high soluble salts.

Because of all this, you can't necessarily count on the iron in a tissue analysis being available. Plants, especially monocots, can take up iron in unavailable forms. When I was in the laboratory business, many times growers would compare tissue levels in both normal and chlorotic plants. Oftentimes, there would be more iron in the chlorotic plants than in the green plants. They would say I got the samples mixed up, but I didn't. Chlorotic plants are working in their own way to correct their nutrient deficiencies.

Plants can also direct ions in the transpiration stream. This is a fancy way of saying that when a plant absorbs a nutrient or even a non-nutrient, the plant can pretty well put the substance where it wants. If a plant needs boron for flowering or fruiting, it can direct boron to the flowering sites. They may direct silicon to leaves that are being set upon by aphids or mites in order to make themselves less palatable.

If a plant is getting too much of something, it'll also direct the excess elements into the older leaves with the idea that the plant can shed those leaves later and help avoid the toxicity that way. This is why potentially toxic nutrient levels (boron and manganese for example) generally show up in older leaves.

Fluoride

Fluoride is a non-nutrient potential toxin. Plants in the lily family and varieties with long, tapered leaves tend to be sensitive to fluoride. Plants don't want fluoride and they don't need fluoride. It simply comes in with the transpiration stream as plants move water through themselves. Plants tend to put the undesirable fluoride into the tips and margins of the older leaves.

Fluoride primarily exists in leaf tips as fluoroacetic acid. This acid prevents the stomates from closing. During times of high temperature, low humidity or moisture stress, the plant can't "close the window" and leaf tips and margins can burn very quickly. Fluoride can come from phosphate fertilizers and unleached perlite. City water sources are often fluoridated with four times the amount of fluoride that can be toxic to sensitive plant varieties.

Imagine for a moment that your fingers are plant roots. In a normal horticultural situation, the salt levels in the root cells are higher than the surrounding soil moisture. Moisture enters the root cells rather effortlessly by osmosis. The plant doesn't have to work very hard to take in water. Because water molecules are sort of bent and curved, they have a little charge to them. Water molecules will stick to each other as they pass through the xylem in stems and ultimately out of the leaves through the stomates. This is how water passes through plants, even in the case of 200-ft.-tall trees.

However, what if a grower puts excessive salts around the root zone? These can be fertilizer salts, or sodium and chloride salts from sea water, which happened in recent hurricanes. Straight sea water contains 15,500 ppm sodium and 19,000 ppm chloride. It has an EC of 53. We call sodium and chloride in irrigation water high above 70 ppm, and very high above 300 ppm. It only takes about 2% salt intrusion to make irrigation water too salty to use.

If a grower applies too much fertilizer to the root zones of plants, the osmotic advantage of the root cells being saltier than the surrounding soil is lost. Now plants need to extend effort to absorb moisture. If the salts in the root zone become high enough, moisture is pulled out of the root and back into the soil by reverse osmosis.

This is how fertilizer burns. It's not that the plant is taking in too much of something and somehow injures itself. In fact, many plants with high soluble salts show nutrient deficiencies, especially of nitrogen. This is also why plants with high salts may show significant wilt symptoms, even if the soil or media is quite moist. They can't absorb the water because of the salt gradient. The soil is moist, yet the plant wilts.

Leaching with good quality irrigation water is, of course, one way to lower soluble salts. However, sometimes leaching can be difficult to impossible. Some soils just don't percolate very well. Some plants will easily develop root rot if kept too wet. Imagine an interior landscaper with a large container ficus tree growing in a bank or office building. Leaching would get water all over the floor and probably get them fired.

There's a trick for reducing soluble salts in situations where leaching is awkward. You can drench with molasses or with 5 lbs. of sugar per 100 gallons. The carbon in the sugars will stimulate beneficial soil microbe populations. The microbes will consume the fertilizer salts.

I've been doing this in certain situations for years and it works. You can generally cut the EC in half in about two weeks. **GT**

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