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Understanding Plant Nutrition: Diagnosing Problems

In this new series, Argo, Fisher and Santos pour over the details to systematically identify and correct common nutritional problems found in greenhouses and nurseries.

By Bill Argo and Paul Fisher and Kate Santos
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You are walking through your greenhouse and notice a group of plants that don't look right. You think the problem is nutritional, but you're not quite sure. Now what? Do you throw the "kitchen sink" at the problem hoping it will get fixed, or do you take time to figure out what the problem is and how to fix it?

In this new series, we will discuss ways to systematically identify and correct common nutritional problems found in greenhouses and nurseries. In this first article, we will discuss information that proves useful for diagnosing nutritional problems.

Identifying nutritional problems in container grown plants is not an exact science. Instead, you try to gather information from multiple sources that can lead you to determine the cause of the problem. Listed below is information that is useful for diagnosing nutritional problems.

Location Of The Affected Tissue

The location of the symptom or symptoms on the plant can give a good indication about the type of problem you are dealing with (Table 1). For example, deficiency symptoms of mobile nutrients (i.e. nitrogen or magnesium) will occur in the lower part of the plant. As mobile nutrients become limited, they can be redistributed from the older growth and into the new growth.

In comparison, deficiency symptoms of immobile nutrients (i.e. calcium or iron) will tend to show up on the new growth. Since immobile nutrients cannot be redistributed by the plant, a limitation in their supply will show up on the young growth first.

The pattern is also important. For example, the limitation of an immobile nutrient associated with photosynthesis (i.e. iron) will cause yellowing (chlorosis) in the growing tip. The limitation of an immobile nutrient associated with cell structure (i.e. calcium) will cause distortion in the growing tip.

It is risky to only use visual symptoms to diagnose nutritional problems. Sometimes the symptoms produced in the crop are due to multiple problems occurring at once. Other times yellowing, discolored or distorted foliage, or tissue death are not caused by nutritional problems at all. Further soil and tissue testing is required to fully determine what problem is affecting the crop and how to fix it.

Media pH & EC Results

Media pH and EC can give critical information for diagnosing nutritional problems. Plant roots can only take up nutrients that are soluble. Media pH directly affects the solubility of several nutrients, including phosphorus (P) and micronutrients iron (Fe), manganese (Mn), zinc (Zn) and boron (B). In general, the higher the media pH, the lower the solubility of those nutrients.

Media EC is a generic measurement. That means it measures the concentration of all the salts contained in the medium, not just the fertilizer salts. As long as the salt levels in the irrigation water are within manageable ranges and you know the ratio of nutrients being supplied by the fertilizer (and the water), then you can get a rough correlation between media EC and nutrient concentrations in the media.

Be aware that media EC does not give an indication of the concentration or ratio of any nutrients. The only way to determine exactly which ions make up the EC is to use a more extensive commercial laboratory analysis.

	2:1 method	SME method	Pour-thru method	Squeeze method
No fertility	0 to 0.25	0 to 0.75	0 to 1.0	0 to 1.0
Low fertility	0.30 to 0.75	1.0 to 2.0	1.0 to 2.5	1.0 to 2.5
Acceptable range	0.30 to 1.50	1.0 to 3.5	1.0 to 6.0	1.0 to 5.0
High fertility	0.75 to 1.50	2.5 to 3.5	4.0 to 6.0	2.5 to 5.0
Potential root damage	>2.50	> 5.0	> 8.0	> 8.0

The units of measure for EC can be mMho/cm, dS/m, mS/cm, µM/cm, or mMho x 10-5/cm. The relationship is 1 mMho/cm=1 dS/m=1 mS/cm=1000 µS/cm=100 mMho x 10-5/cm.

There are a number of different methods for measuring media pH and EC, including the 1:2 method, the saturated media extract (SME) method, the pour-thru method and the squeeze method. In general, you will get a similar media pH with all methods. However, there will be a significant difference in the acceptable EC range with the different methods (Table 2). Whenever you use media EC data to diagnose a nutritional problem, make sure you know which testing method is being used in order to use the correct acceptable range for that particular test.

Tissue Tests

Whereas soil testing gives you information on the nutritional status at one moment in time, tissue testing provides information on the long-term nutritional status of the plant.

When taking tissue samples, it is commonly recommended to take the newest fully expanded leaves as the sample. If you are testing small plants (like plugs or liners), then the entire plant can be used. However, the results would reflect an average value for the entire plant and therefore localized deficiencies or toxicities may not show up in the results. If tissue is sent for analysis showing specific problems, such as older leaves showing interveinal chlorosis, then send in a second test containing tissue from the same crop that is unaffected by the problem. The difference in levels between "good" and "bad" plants may allow you to figure out what the problem is.

Guidelines for the interpretation of tissue tests.

		Adequate range	Deficient levels	Toxic levels
Nitrogen	N	2.5 to 6%	< 2%	-
Phosphorus	P	0.30 to 1.0%	< 0.25%	-
Potassium	K	2.5 to 6%	< 2%	-
Calcium	Ca	0.6 to 2%	< 0.6%	-
Magnesium	Mg	0.3 to 1.0%	< 0.3%	-
Sulfur	S	0.30 to 1.0%	< 0.1%	-
Iron	Fe	75 to 200 ppm	< 60 ppm	>250 pp
Manganese	Mn	50 to 200 ppm	< 50 ppm	>250 pp
Zinc	Zn	25 to 100 ppm	< 20 ppm	> 200 p
Copper	Cu	5 to 20 ppm	< 2 ppm	> 25 pp
Boron	B	30 to 120 ppm	< 30 ppm	> 120
Molybdenum	Mo	1 to 5 ppm	< 0.5 ppm	-

Macronutrients and molybdenum do not typically reach toxic levels in the tissue. However, extremely hig more nutrients probably represents an imbalance in the nutritional program for that crop. In addition, ex of one nutrient can cause a suppression in uptake of another nutrient.

to determine the concentration and balance of individual nutrients. Important concentrations to know are total alkalinity, EC, calcium, magnesium, sodium, chloride, boron and fluoride.

Test The Injector

Checking that the injectors are working properly goes hand-in-hand with soil testing. The EC of a fertilizer solution should be used to measure the nutrient concentration coming out of the hose. The relationship between EC and concentration from blended fertilizer can be obtained from fertilizer manufacturers. In addition, testing the EC of the solution can be used to test the calibration of in-line EC sensors. If you are injecting acid into irrigation water for alkalinity control, then the alkalinity concentration and water pH should also be tested regularly.

Other Things To Notice

Don't forget to look at your plants! When taking weekly pH and EC tests, it is also an opportunity to check the color and vigor of foliage, and also the health of roots. If the plant has a major Pythium or fungus gnat infestation in roots, or it is growing in waterlogged media, even though a tissue analysis may show nutrient deficiency, the issue may be one of pest or water management rather than fertilizer type and concentration. All the test data in the world is no replacement for common plant sense.

Conclusion

Many growers think it takes too much time to diagnose nutritional problems. Some of the information is often readily available because the testing (water, media, injectors) is being done on a regular basis, whether there is a problem or not. Even if this information is not readily available, it will take less than an hour to collect. Others, like noticing the location of the symptoms on the plant or looking at the roots, only take a few minutes. Taking a few minutes to collect as much information as possible will allow you to make the correct diagnosis.

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