Agro Services International Inc.

Tissue Analysis- When it can be misleading

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Plant tissue analysis for nutrient content is a popular tool for assessing the nutrient status of plants and the fertility of soils. Tissue analysis can provide valuable information when used as part of a nutrient management program. However, using tissue analysis as the sole source of information often leads to wrong conclusions as to what needs to be done to ensure optimum plant nutrition.

It is not unusual to find low nutrient levels in plants growing on fertile soils. Changes in the nutrient content of plant tissue can be caused by many factors such as temperature, time and method of sampling, pests, diseases, moisture problems, soil compaction, nutrient imbalances and soil acidity. When nutrient uptake is being reduced by these factors, tissue analysis may encourage the grower to apply fertilizers that are not necessary.

Consider this actual example. A citrus grower was not satisfied with his production and used only tissue analysis to select fertilizers. The analysis identified low phosphorus levels as being the main problem, so he applied large amounts but got no response. He finally decided to also get the soil tested.

PLANT TISSUE ANALYSIS

ELEMENTS		PLANT ANALYSIS LabNo. R4 P7 - 4		INTERPRETATION GUIDE (Very Low / Low / Average / High / Very High)
		%	ppm	
Calcium	CA	3.07		Ca
Magnesium	Mg	0.42		Mg
Potassium	K	1.81		K
Sodium	Na	0		
Nitrogen	N	3.51		N
Phosphorus	P	0.09		P
Sulfur	S	0.66		S
Boron	B		93	B
Copper	Cu		11.4	Cu
Iron	Fe		174	Fe
Manganese	Mn		109	Mn
Zinc	Zn		101	Zn

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SOIL ANALYSIS

Act. C.E.C. 7.4 meq/100 cm3; Base Satn. 79 %; Acid. Satn 21 %; pH 4.2 ; O.M. 2.6 %;

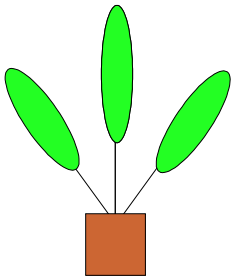
ELEMENTS		SOIL ANALYSIS Lab No. B9 120 - 4 meq/100cm3	lbs/acre		INTERPRETATION GUIDE (Below / Optimum / Above)
Act. Acidity	A.A.	1.6			
Calcium	Ca	4.4	1584		Ca
Magnesium	Mg	0.41	89		Mg
Potassium	K	0.99	833	K_2O	K
Sodium	Na				
Ca/Mg Ratio	Ca/Mg	10.7			Ca/Mg
Mg/K Ratio	Mg/K	4			Mg/K
		ug/cm3			
Nitrogen	N	13	23		N
Phosphorus	P	625	2562	P_2O_5	
Sulfur	S	53	95		S
Boron	B	0.65	1.2		B
Copper	Cu	10.3	18.5		Cu
Iron	Fe	815	1466		
Manganese	Mn	7.1	12.8		Mn
Zinc	Zn	4.2	7.6		Zn
Other					

The soil analysis clearly shows that the phosphorus level is excessive but uptake is being hampered by the soil acidity (pH=4.2). Also note that the soil magnesium level is very low but the tissue analysis does not show it. Once the main problem (the acidity) is solved, this level of soil phosphorus will certainly induce zinc deficiency and the tissue levels of magnesium will also fall due to “dilution”.

Dilution Effect

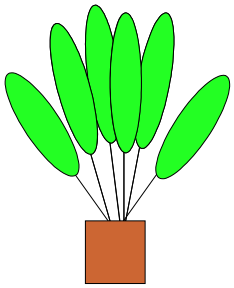
Very often, tissue analysis may identify one nutrient deficiency but when that nutrient is applied, another nutrient suddenly becomes deficient. Why does this happen?

To illustrate, we will examine the levels of three nutrients in a plant, phosphorus, potassium and magnesium. We will assume that the tissue level of each nutrient must be at least 2% for good growth (although this is not a typical value).



Total plant weight = 100g
Total P=1 g, tissue level = 1%
Total K=2 g, tissue level = 2%
Total Mg=2 g tissue level = 2%

This is our plant before fertilization. The tissue phosphorus level is 1%, therefore this is the limiting nutrient, it needs to be added. Potassium and magnesium levels are 2%, they apparently do not need to be added. We will now add only phosphorus and re-check the tissue nutrient levels.



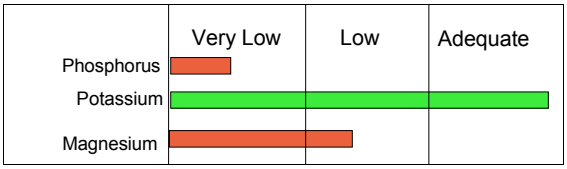
Total plant weight = 200g
Total P=4 g, tissue level = 2%
Total K=4 g, tissue level = 2%
Total Mg=3 g tissue level = 1.5%

This is our plant after fertilization. The phosphorus problem has been solved and the potassium level has not changed but the magnesium level is now deficient. What happened?

When we applied the phosphorus, the plant growth increased from 100 g to 200 g. As the plant doubled in size, it also took up double the amount of potassium so the percentage in the tissue remained the same. The plant also needed to take up double the amount of magnesium, but the soil was not able to supply this amount therefore the percentage in the tissue fell. The soil contained enough magnesium to supply a plant stunted by phosphorus deficiency but not enough for healthy growth.

Under field conditions, it is common to find multiple nutrient problems occurring at the same time. Tissue analysis can identify the worst deficiency, the one which is causing growth problems at the time of sampling. It does not tell which of other nutrients will become deficient when the main problem is solved.

Soil analysis gives a better assessment of the nutrient supply. A soil report for the three nutrients in the example above would look like this:



The soil analysis would have identified phosphorus as the main problem limiting plant growth. It would also show that magnesium will become a problem once phosphorus is applied but there is no need for potassium applications.

The combination of soil and plant tissue analysis usually provides the most useful information. When soil analysis is used as the primary tool for correcting soil fertility problems, plant analysis can be used to monitor the effectiveness of the fertility program.

Soil analysis can be used to identify and prevent nutrient problems before the cropping season whereas plant tissue analysis can only detect nutrient problems after the plant has already suffered yield loss.

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