ARE YOUR NUTRIENTS COMPETING?

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Plants tend to take in a constant amount of cations over time. Which cations are taken up is influenced by the availability of those cations in the media. One of the determinants of availability of a specific nutrient is the concentration of an ion in the media, and/or are more available, will tend to enter the plant more easily than those at low concentrations in the media.

Every so often a problem arises in a local greenhouse where we see magnesium deficiency even though the levels of magnesium in a soil test are within the recommended range. Typically, this is a result of excessive calcium levels in the medium which competes with the magnesium for entry into the plant and, therefore, decreases magnesium uptake by the plant. This is perhaps the most common example of nutrient competition which we come across in Minnesota. Therefore, even though the level of a specific nutrient may show a nutrient deficiency because a significant amount of competition for entry into the plant is occurring among ions.

Table 1 shows which nutrients may become deficient in plant tissues when levels of specific nutrients are above recommended levels.

What is obvious is that we need to consider the relationship between 2 nutrients as well as the actual levels of nutrients when evaluating a soil test. Often the relationship between 2 nutrients can best be presented as a ratio. A number of ratios have been developed for a variety of nutrients which tend to compete. For example, the ratio of N to K should be approximately 2-3:1. If the ration of N:K is greater than 3:1, K deficiencies can occur. Similarly, Ca:Mg ratios should be maintained between 2-3:1. Ca levels in excess of this ratio frequently result in Mg deficiency symptoms. Common ratios used to evaluate soil tests are shown in Table 2.

Of course, it is important to realize that each species will respond differently. However, since we grow a variety of crops, the ratios are a good 'rule of thumb' to follow. Another important point to remember is that higher levels of other competing nutrients can aggravate the problem. For instance, Mg deficiency symptoms may be worst when you have high levels of Na in combination with high Ca levels.

It is also very important to realize that pH has a very significant impact on the availability of every nutrient important for plant growth within a medium. Even though the levels of a specific nutrient may be within recommended range, a nutrient deficiency can occur because that nutrient is 'tied up' within the medium and not available to the plant. Because of this it is critical to have your pH within the accepted range. The ratios and relationships shown in Table 2 are contingent on this.

References:

Marschner, H. 1986. Mineral nutrition of higher plants. Academic Press, New York, NY. Chapters 8-12.

Tisdale, S. L., W. L. Nelson and J. D. Deaton. 1985. Soil fertility and fertilizers. 4th ed., MacMillan Pub., New York. Chapter 12.

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Table 1. Which nutrients compete. Excessive levels of an ion in a media can result in deficiency symptoms developing in the plant of a competing ion. The nutrient deficiency which can occur in a plant resulting from excessive levels of competing ion are shown below.

Ion in Excess	Element which may be Deficient in Tissue
NO_{3-}	K^+, PO_4^{3-}
K^+	NO_3, Ca^{2+}, Mg^{2+}
PO_4^{3-}	Cu^+ or $^{2+}$, Fe^{2+} or $^{3+}$, Zn^{2+}
Ca^{2+}	Mg^{2+}, B
Mg^{2+}	Ca^{2+}, K^+
Na^+	K^+, Ca^{2+}, Mg^{2+}
Mn^{2+}	Fe^{2+} or $^{3+}$, Mo
Fe^{2+} or $^{3+}$	Mn^{2+}
Zn^{2+}	Mn^{2+}, Fe^{2+} or $^{3+}$
Cu^+ or $^{2+}$	Mn^{2+}, Fe^{2+} or 3+, Mo
Mo	Cu^+ or $^{2+}$
NH_{4+}	Ca^{2+}, Cu^+ or 2+, Mg^{2+}

Abbreviations: NO_{3-} (nitrates); K^+ (potassium); PO_4^{3-} (phosphorus); Ca^{2+} (calcium); Mg^{2+} (magnesium); Cu^+ (copper); Fe^{2+} (iron); Zn^{2+} (zinc); B (boron); Na^+ (sodium); Mn^{2+} (manganese); Mo (molybdenum); and NH_4^+ (ammonium).

Table 2. The suggested ratios of various nutrients.

Chemical Relationship	Suggested Ratio
N/P	10:1
N/K	1.5-3:1
K/P	7:1]
N/S	15:1
Ca/Mg	3:1
Ca^+Mg/K	4:1

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