HOW TO AVOID AMMONIUM TOXICITY AND SAVE MONEY ON FERTILIZER

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The Problem

One of the most common greenhouse problems that occurs in northern states is amonium toxicity. Ammonium levels tend to build up in the soil when 1) fertilizers containing ammonium are used and 2) growing conditions tend to be cool and cloudy. Symptoms of ammonium toxicity include yellowing of leaf edges and lower leaf drop. Ammonium toxicity is often a problem in the winter and spring when ammonium levels often build up to toxic levels and temperatures increase. Although any plant is susceptable to ammonium toxicity, Easter lilies, geranium stock plants, and ivy geraniums have shown ammonium toxicity most often this year in Minnesota.

The Solution

If ammonium toxicity is present, you should leach the crop to remove as much ammonium as possible from the soil. In addition, you should switch to fertilizers that do not contain ammonium. Remember, when toxicity symptoms are evident, often a considerable amount of damage has already been done to the crop. Therefore, a crop may show ammonium toxicity symptoms for a period of time even after corrective measures have been taken.

Avoiding the Problem

The easiest way to avoid ammonium toxicity is to use fertilizers which do not contain ammonium from November to March, i.e. during the cooler, cloudier months of the year. It has been my experience that growers who have ammonium toxicity problems are often using commercial premixed fertilizers. Twenty to thirty percent of the nitrogen in most premixed fertilizers is in the ammonium form, i.e. ammonium nitrate. If you have a premixed fertilizer that does not contain ammonium nitrate you do not have to worry. However, you may wish to mix your own fertilizer for the reasons described below anyway.

Mixing your own fertilizer has 2 distinct advantages beyond eliminating ammonium toxicity problems: 1) you have more flexibility to alter your mix according to the crop and the time of year, and 2) you save money. For instance, the typical price per pound of a fertilizer premix is 84 cents. In contrast, the cost per pound of a comparable fertilizer mixed from 'scratch' is 21 cents. This translates into 1/4 the fertilizer cost!

The reason more growers do not mix their own fertilizer seems to be rooted in the misconception that fertilizer calculations are difficult and laborious. In fact, the calculations can be quite simple. To demonstrate this an example calculation for a 200-0-200 ppm fertilizer solution is shown below.

Standard formulas

Nitrogen: (1)

$$\frac{\text{(desired ppm fertilizer)} \times \text{(gal. in stock tank)} \times \text{(injector ratio)}}{\text{(nitrogen in fertilizer)} \times (1200)} = \text{pounds fertilizer}$$

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Potassium: (2)

$$\frac{(\text{desired ppm fertilizer}) \times (\text{gal. in stock tank}) \times (\text{injector ratio})}{(\%\ \text{potassium in fertilizer}) \times (1000)} = \text{pounds fertilizer}$$

The 1200 and 1000 are constants in the equations. A 1200 should be used whenever doing calculations related to nitrogen and 1000 should be used to do calculations with potassium.

Example Calculation:

The example below is a typical 200-0-200 ppm (parts per million) pot plant fertilizer mix using calcium nitrate and potassium nitrate. For our example we will use a 15 gallon stock tank and a 1:100 injector ratio. Calcium nitrate is 16% nitrogen by weight. Potassium nitrate is 13% nitrogen and 36.6% potassium by weight.

Potassium nitrate and calcium nitrate both contain nitrate (nitrogen). First we will calculate how much potassium nitrate we need to make a solution containing 200 ppm of potassium. Then we will calculate how much nitrogen we are getting from the potassium nitrate. Last we will calculate how much calcium nitrate we will need to supplement this mix to make a solution containing 200 ppm total nitrogen.

If we plug in the necessary information into the formula (2) to calculate the amount of potassium nitrate needed to get 200 ppm of potassium we get the following equation:

$$\frac{(200\ \text{ppm}) \times (15\ \text{gal. stock tank}) \times (100\ \text{injector ratio})}{(36.6\ \%\ \text{potassium})\ (1000)} = 8.2\ \text{lbs potassium nitrate}$$

As I mentioned before, potassium nitrate contains both potassium and nitrogen. So how much nitrogen (in ppm) will 8.2 pounds of potassium nitrate contain? We can calculate that with the following formula:

$$\frac{(\%\ \text{nitrogen in fertilizer}) \times (\text{lbs fertilizer}) \times (1200)}{(\text{gallons in stock tank}) \times (\text{injector ratio})} = \text{ppm nitrogen}$$

In our example we get the following equation:

$$\frac{(13\%\ \text{nitrogen}) \times (8.2\ \text{pounds}) \times (1200)}{(15\ \text{gallons}) \times (100\ \text{injector ratio})} = 85.3\ \text{ppm nitrogen}$$

This means that we need to add enough calcium nitrate to our mix to make up 114.7 ppm nitrogen (200 ppm - 85.3 ppm).

Therefore, we substitute in the necessary information into our equation (1) to calculate how much calcium nitrate we must add:

$$\frac{(114.7\ \text{ppm}) \times (15\ \text{gal.}) \times (100\ \text{injector ratio})}{(16\%\ \text{nitrogen}) \times (1200)} = 9.0\ \text{pounds calcium nitrate}$$

Solution:

To make a 200-0-200 ppm fertilizer solution you should add 8.2 pounds of potassium nitrate and 9.0 pounds of calcium nitrate to a 15 gallon stock tank with a 1:100 injection system.

Let's calculate a second example. This time let's calculate how much potassium nitrate and calculate nitrate are needed to produce a 200-0-

200 ppm solution using a hozon and a 5 gallon stock tank. A hozon typically has a 1:15 injector ratio.

$$\frac{(200\ \text{ppm}) \times (5\ \text{gal. stock tank}) \times (15\ \text{injector ratio})}{(36.6\ \%\ \text{potassium}) \times (1000)}$$

= .41 lbs. (6.6 oz) potassium nitrate

$$\frac{(13\%\ \text{nitrogen}) \times (.41\ \text{pounds}) \times (1200)}{(5\ \text{gal. stock tank}) \times (15\ \text{injector ratio})}$$

= 85.3 ppm

$$\frac{(114.7\ \text{ppm}) \times (5\ \text{gal. stock tank}) \times (15\ \text{injector ratio})}{(15\%\ \text{nitrogen}) \times (1200)}$$

= .45 lbs. (7.2 oz) calcium nitrate

In addition to nitrogen and potassium, it is important to add phosphorus to a medium. After transplanting or potting, a couple of applications of a fertilizer high in phosphorus, i.e. a commercial starter fertilizer (9-45-15), will give a media an adequate phosphorus charge. Continued supplemental phosphorus is often not necessary as it does not leach from the soil as readily as nitrogen and potassium. In addition, many growers are adding phosphorus to their soil continuously when they add phosphoric acid to their water to alter pH. Adding additional phosphorus to your medium through a commercial 20-20-20 mix is just wasting money!

It is often necessary to add both magnesium and micronutrients to the medium. Because both magnesium and micronutrients leach from the soil, you may want to supplement the fertilizer solution continuously or apply a single dose of each once a month. Magnesium should be added in the form of magnesium sulfate (epsom salts). Care should be taken not to add magnesium sulfate and calcium nitrate at the same time as these materials may react and precipitate out of the fertilizer solution. Once a month applications of both magnesium and micronutrients is often adequate.

Once a month applications of Epsom salts should be added at the rate of 8 ounces/100 gallons final solution. Micronutrients can be added at the same time as magnesium. Apply micronutrients at 1/2 the rate recommended for continuous application when applying once a month. Both epsom salts and micronutrients should be added as a soil drench.

One final note. I encourage all growers to purchase a pH and soluble salts meter. These instruments are essential, as a pH and soluble salts meter allow you to monitor your crops continuously to make necessary changes to your fertilizer regime. Ultimately, having these instruments will benefit you with higher quality crops and/or reduced soil testing costs.

This is not to say that soil tests are not necessary. Full soil tests should be routinely done. However, your own instruments can be helpful to insure that crops are grown with the correct pH and soluble salts levels between soil tests.