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Using Conductivity Meters for Nitrogen Management in Float Systems

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Many tobacco producers are using the DiST 4 pocket conductivity meter to monitor the fertilizer level in their float beds. The DiST 4 is a very useful management tool, but it is important to understand what the meter is measuring and the limitations of such measurements.

DiST is an acronym for Dissolved Solids Tester, and the number 4 indicates a particular model of the meter. Old DiST 4s measure in hundreds of microSiemens. Newer DiST 4s measure milliSiemens, the industry standard units for measuring electrical conductivity, and read one decimal point off compared to the older model (a reading of 9 becomes 0.9, for example). Meters other than the DiST 4 are fine, but may read in different units. A quick check in plain water should reveal whether units on these meters are in whole numbers or tenths.

Salt Content Measured

In float plant production, the measurements taken are often expressed as parts per million (ppm) of nitrogen. In reality, the meters measure a solution's total salt content and thus its ability to conduct an electric current. The higher the solution's salt content, the greater its ability to conduct current and the higher the DiST 4 reading.

The conductivity reading is merely an estimate of the fertility level of the water and does not measure any specific nutrient. However, an educated estimate is much better than a guess.

How can the DiST 4 be used to estimate the nitrogen content of a float bed? When you add a fertilizer to water, you know what proportion of the solution is nitrogen. Because you assume that the proportion of nitrogen in the solution remains constant, you assume that if the salt content goes down by half, the nitrogen level does the same. But one of the limitations to using the meter is that if the uptake of nitrogen is faster or slower than that of the other salts, the proportion of nitrogen is not constant. This shift in the proportion of nitrogen may introduce some error into the measurement (although generally this error is not significant).

Calibration Is First Step

In order to obtain a reliable reading, it is important to use the meter correctly. The first step is calibration, although calibration may be impossible on damaged meters or those with weak batteries.

To calibrate the meter, immerse it in a solution with a known conductivity level and adjust the meter until that value appears. Your county Extension agent should be able to help with calibration and may have calibration solution available. Dealers who sell the meter should also stock a calibration solution.

Before adding fertilizer, you need to know the source water's conductivity reading. This background reading is important when evaluating the readings from the fertilized solution. You also need to know or determine the conductivity reading for a fertilizer increase. Some fertilizer manufacturers provide conductivity charts for their products. Charts for a common type of fertilizer used in float systems are provided in this publication (see Figures 1 and 2).

How to Determine Fertilizer Needs

1. Determine electrical conductivity (EC) of the fertilizer to be used. Most fertilizers should have an EC value listed on the bag, so the EC of most common fertilizers is known. Typically, if listed as a single value, the EC will be for 50 ppm. Some manufacturers list values over a range of ppm levels. For example, 20-10-20 may list 50 ppm = an EC of .33, 100 = .66, 150 = .99, etc. Values are usually in standard units of milliSiemens.
2. Determine water volume in float beds. The following formula is a quick method to approximate water volume: Number of trays x 1.64 x depth of water (inches) = gallons of water (Note: 1.64 is the number of gallons of water covered by a typical tray to a depth of 1 inch).
3. To determine the amount of fertilizer to achieve 100 ppm nitrogen in 1000 gallons of water from any analysis of fertilizer, use the following formulas:

1000 gallons of water weighs 8340 lb
(A gallon of water weighs 8.34 lb).

100 ppm = 0.834 lb N/8340 lb water (1000 gal).

The first number on a fertilizer bag indicates percent N (example: 20-10-20 = 20% N). Actual fertilizer needed per 1000 gallons of water can be determined by dividing 0.834 by the decimal equivalent (20% N becomes 0.2 N). For example, calculations for 20-10-20 would be 0.834/.2 = 4.17 lb, or 4.2 lb; for 15-5-15 would be 0.834/.15 = 5.56 lb; and for 21-9-20 would be 0.834/.21 = 4 lb.

These values are constant for any brand of fertilizer of the same analysis and need no recalculation after initial calculation.

Example

To calculate the needs for a float bed that holds 40 trays and 5 inches of water with an initial conductivity reading of 3 and 20-10-20 as the fertilizer source, use the following formula:

40 x 1.64 x 5 = 328 gal (see explanation above.)

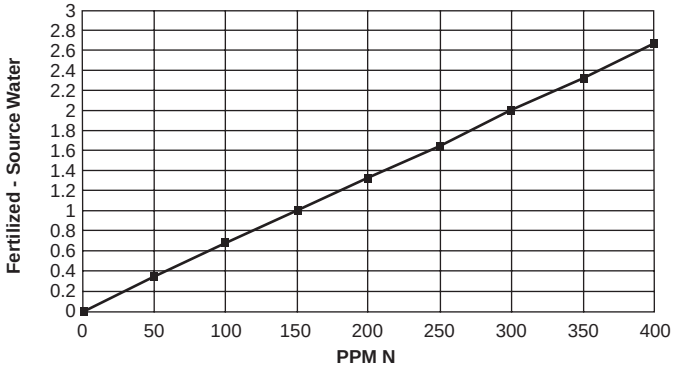
Measure the conductivity reading of the water with a DiST 4 or other suitable conductivity meter before adding any fertilizer or other product that might influence conductivity. For this bed you would need 4.2 lb of 20-10-20 or (4.2 lb/1000 gal x 328 gal) = .0042 lb/gal x 328 gal= 1.4 lb of 20-10-20. After adding the fertilizer, mix the bed thoroughly and let it sit at least overnight before taking a conductivity reading.

For this example, a reading of 10 after fertilization is an increase of 7 (10 [second reading] minus 3 [initial reading]) for a level of 100 ppm N. In this example you would want to maintain a reading between 8 and 11 (75 to 125 ppm). Note that this is not a general rule but is based on the specific information in this example. Target levels will differ depending on the water source and type of fertilizer used.

Regularly monitor the conductivity reading of beds. If readings are higher than the target level, add water to the bed. If they are lower, add fertilizer. DiST 4 meters and other conductivity meters measure all salts in the water. Therefore, any treatments (like acid) added to the water will influence the reading. Add these amendments before adding the fertilizer and take a reading so they become part of the background reading.

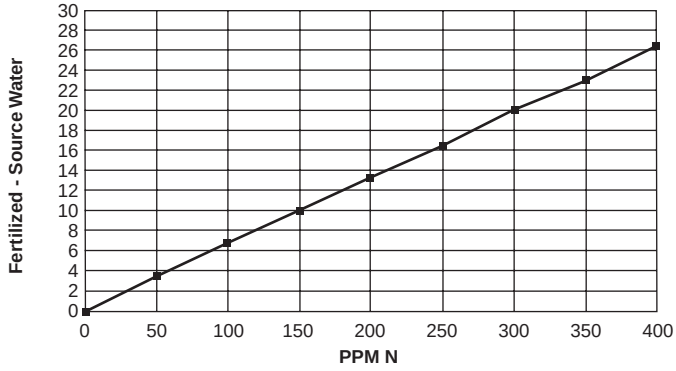
Rainwater, which has an EC reading of 0, will dilute the background reading and lower the target level in outdoor beds. This effect is difficult to reconcile, so it may be necessary to estimate the new target level.

Figure 1. Conductivity Readings—Standards chart for 20-10-20, 1 mS (New DiST 4 meters).



1. Take water source reading (plain water).
2. Take fertilized water reading.
3. Subtract water source from fertilized.
Example: If plain water = .4 and fertilized water = 1.4, 1.4 - .4 = 1.0, PPM N = 150.

Figure 2. Conductivity Readings—Standards chart for 20-10-20, 100 μS (Old DiST 4 meters).



1. Take water source reading (plain water).
2. Take fertilized water reading.
3. Subtract water source from fertilized.
Example: If plain water = 4 and fertilized water = 14, 14 - 4 = 10, PPM N = 150.