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Fertigation Management - General Considerations[1]

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Fertilizers applied in irrigation water (fertigation) may be purchased dry, as suspensions, or as solutions. Suspension fertilizers contain undissolved constituents, whereas the constituents of solution fertilizers are completely dissolved. Dry or suspension fertilizers are mixed with enough irrigation water prior to application that the fertilizer material dissolves completely and forms a solution (no undissolved constituents).

Fertilizers purchased as solutions, not suspension, are presently used mostly in agronomic crop production, yet interest in the use of these fertilizers for woody ornamental production has increased recently. This interest is probably related to the smaller labor requirement necessary for the application of fertilizer solutions compared with dissolving dry fertilizers or fertilizing individual containers with dry fertilizer materials. Many nursery operations with more than 12 to 15 acres (5 to 6 ha) are currently purchasing fertilizers as solutions. However, these fertilizers can just as well be used efficiently and economically with drip irrigation systems on smaller acreage. The practice will probably become more widely used because fertilizers purchased as solutions are generally less expensive per pound of nutrient than nursery fertilizers purchased dry. At present, solution fertilizers are not used extensively in the ornamental industry because special equipment is needed to inject the fertilizer into the irrigation water and because more intense management is required for fertigation systems.

Solution fertilizers may be purchased containing various ratios of nitrogen, phosphorus pentoxide and potassium oxide (N-P_2O_5-K_2O), although a 3-1-2 or 4-1-2 ratio (Dickey et al., 1978) is recommended. Urea is often the ammoniacal nitrogen carrier although ammonium nitrate or ammonium thiosulfate are also used. Sulfur is supplied by ammonium thiosulfate while nitrate nitrogen is supplied by ammonium nitrate and potassium nitrate. Potassium nitrate and potassium chloride (muriate of potash) are the primary potassium carriers. Potassium sulfate is also used as a potassium carrier if additional sulfur is needed. Ammonium polyphosphate is used to supply ammoniacal nitrogen and phosphorus, while phosphoric acid is used to supply phosphorus.

Nursery operators could purchase concentrated suspension fertilizers or the common fertilizer carriers such as ammonium nitrate, potassium chloride and magnesium sulfate as dry formulations and dissolve either with water prior to injection. However, dissolving fertilizer at the nursery is a time-consuming, laborious task and is not recommended unless a specific plant nutrient problem exists, such as severe magnesium deficiency. If the nursery operator could not purchase magnesium as a concentrated solution, magnesium sulfate or chelate could be dissolved and then injected into the irrigation water. A consideration when dissolving fertilizers is the salt index or the relative degree to which a fertilizer compound will contribute to the growth

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medium soluble salts compared to an equal weight of sodium nitrate. For example, a similar amount of monoammonium phosphate and calcium nitrate are required to supply an equivalent amount of nitrogen, yet calcium nitrate would contribute more to the growing medium soluble salts than monoammonium phosphate.

Fertilizers purchased as solutions may contain magnesium, usually as magnesium sulfate or chelate, while many formulations do not contain calcium because calcium often forms insoluble compounds with phosphorus. Calcium and magnesium are usually provided for plants by amending potting media with dolomitic limestone. The irrigation water in some areas of the state contains concentrations of calcium and magnesium (30 - 40 ppm) adequate for plant growth (Starr and Wright, 1984), thus additional calcium and/or magnesium may not be required.

Solution fertilizers may be purchased that contain macronutrients and/or micronutrients. If the micronutrients needed for plant growth are supplied by amending the potting media, then micronutrients are not usually supplied by fertigation unless a corrective nutrient application is needed. For example, iron chelate may be applied to correct iron deficiency. Sulfate, citrate and/or chelate forms of the micronutrients manganese, iron, copper, and zinc are used in solution fertilizers, and under most growing conditions these forms are acceptable. Molybdenum and boron are usually supplied as sodium molybdate and sodium borate, although other carriers such as molybdic acid and boric acid may be used.

Nitrogen (N), phosphorus (P) and potassium (K) are the most common plant nutrients applied with fertigation systems when producing woody ornamentals. Other essential plant nutrients are usually supplied as pre-plant container medium amendments. Consequently, the following discussion will deal with the management of a fertigation system that is used to supply N, P, and/or K to container-grown woody ornamentals.

One approach to management of fertigation is to maintain the desired concentration of nutrients in the growth medium solution. For example, a nursery operator may want to maintain 60 to 90 parts per million (ppm) N, 10 to 15 ppm P, and 25 to 40 ppm K (Wright, 1983b) in the container medium as determined by a saturated paste extraction method. Using a 15-5-10 that contains 1.5, 0.2, and 0.8 pounds of N, P, and K (681, 91, and 363 g), respectively, per gallon (3.8 L) of fertilizer or 179,739 ppm N, 25,763 ppm P, and 99,456 ppm K; 1 gallon of concentrated fertilizer should be diluted with 2,499 gallons (9,460 L) of water so 72, 10, and 40 ppm N, P, and K,, respectively, would be applied. Regardless if 1 inch (2.5 cm) or one-half inch of irrigation water were applied per application, the approximate concentration of N, P, and K that is to be maintained in the media solution should be applied at each watering. However, this does not ensure these levels will be maintained, and media nutritional levels must be monitored.

COLLECTION OF MEDIA SAMPLES

Diagram the nursery growing beds and divide the nursery into blocks or groups of beds according to those plants that are treated similarly and grown under similar conditions. For example, plants of the same genera or species, growing in the same media and irrigated similarly, may comprise one block, while plants of the same species and receiving less irrigation water or growing in a different medium or container size would comprise another block. The idea is to separate blocks of plants that would result in different media test results.

The number of beds per block will vary, but for discussion assume 6 beds for each of 4 blocks. One of the beds of plants in a block, for example bed 1, should be sampled each sampling time. This is a check or reference bed. Future test results from plants of bed 1 are compared with previous test results of bed 1, to detect errors in sampling or the extraction procedure. One core of media is removed with a soil probe from each of 5 to 20 containers of bed 1 in order to obtain a pint sample of media. At each sampling time, also remove media from 5 to 20 containers from 2 or 3 other growing beds in the block, and at the next sampling time, sample the check bed and 2 or 3 beds not sampled last time.

MEDIA TEST RESULTS AND INTERPRETATION

Once media samples are obtained, the saturated paste or 2:1 dilution procedure may be used to obtain the liquid extract needed for analysis (See "ENH Commercial Circular 556" for extraction details). If the reason for sampling was to obtain growth medium soluble salts levels, then it is recommended the extraction procedure be performed at the nursery, since extract soluble salts can be determined rapidly, and this indicates the relative fertility status of the container medium needed for quick management decisions. Optimum growth medium soluble

salts levels for most plants excluding azaleas and salt sensitive plants range from 1,000 to 1,200 ppm for the saturated paste extraction and from 600 to 700 for the 2:1 dilution procedure (Smith, 1983). Optimum soluble salts for azaleas and salt sensitive plants are about 400 to 600 ppm for the saturated paste and 250 to 350 for the 2:1 dilution (Smith, 1983).

A soluble salts level below optimum indicates the concentration of fertilizer in the irrigation water should be increased. The magnitude of increase and number of irrigations with water of increased nutrient concentrations needed to increase soluble salts levels of the growing medium to optimum levels varies; therefore, soluble salts should be monitored at least weekly during the growing season.

Many N fertilizers contain urea and are hydrolyzed to ammonium carbonate by the enzyme urease. Urea does not increase soluble salts (conductivity) until hydrolyzed, so soluble salts levels of media fertilized with urea could be less than that of media fertilized with the same N concentration from ammonium nitrate. Urease is commonly found in the environment and hydrolysis of urea occurs naturally. Recent research (Wright, 1983a) indicated about 70% of urea is hydrolyzed in 24 hours in a pine bark growing medium.

Soluble salts levels represent the electrical conductance of ions in solution and do not indicate a deficiency or excess of a nutrient or ion in the growth medium. Thus, N, P, and K of the growth medium should be monitored at least monthly to ensure desired levels are maintained. Sample the container medium as described previously and send media samples to the University of Florida Extension Soil Testing Laboratory or a private laboratory for analyses and interpretations. Detailed nutritional records should be maintained so future nutritional management decisions can be based on the past.

REFERENCES

Dickey, R. D., E. W. McElwee, C. A. Conover, and J. N. Joiner. 1978. *Container growing of woody ornamental nursery plants in Florida*. University of Florida Extension Bulletin 793.

Smith, G. 1983. *An easy method of determining when to fertilize container plants*. Georgia Nursery Notes, July-August, University of Georgia.

Starr, K. D. and R. D. Wright. 1984. *Calcium and magnesium requirements of Ilex crenata 'Helleri'*. J. Amer. Soc. Hort. Sci. 109: 857-860.

Wright, R. D. 1983a. *Hydrolysis of urea in a pine bark growing medium*. Proc. So. Nurserymen Assoc. Res. Conf., 28: 76 - 77.

Wright, R. D. 1983b. "Study indicates need for changes in nutrition programs for plants in containers." *American Nurseryman* 157: 109 - 111.