Nursery Runoff and Fertilization Practices Impact on Pollution Potential

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Nature of Work:

Liquid fertilizers applied by overhead irrigation are not very efficient in providing nutrients to container crops. Many nutrients are lost with surface runoff, increasing the possibilities of surface and/or ground water pollution. Controlled release fertilizers provide a more efficient application method of supplying needed nutrients with less pollution potential. However, supplementing crop nutritional needs with controlled release fertilizers requires a labor intensive re-application of the granular fertilizer to the crop.

The Best Management Practices Guide for Producing Container-Grown Plants published by SNA in 1997 states "CAUTION: when fertilizer is injected in the overhead irrigation system you will need to take steps to address the nutrient loading of the water leaving your property, because much of the water from overhead irrigation systems falls between containers." Nearly 3/4 of the applied water with fertilizer runs off the nursery beds into ponds or streams.

A Georgia nursery which relies on supplemental overhead fertilization wanted to monitor its runoff and determining the potential for contamination of waters below the nursery. A spring provides water directly to the nursery and is used for irrigation. A portion of the spring water source is diverted through the nursery for irrigation and the runoff water (with and without fertilizer) mixes back into the spring water before leaving the nursery and joins the initial water source.

Two beds were being monitored during the production season. Bed 1 contains plants in a pine bark mix that has been amended with Perk (a minor element booster) 1#/yd^3, potassium nitrate (13-0-44) 0.5#/yd^3, dolomitic lime 2.5#/yd^3, gypsum 2#/yd^3, urea (46-0-0) 2.5#/yd^3, super phosphate (0-46-0) 2#/yd^3, Polyon (8-5-10) at 4.5#/yd^3 and Talstar at 2.5#/yd^3. Supplemental liquid feed is applied to the plants through the irrigation system. Ammonium nitrate, soluble potash, magnesium sulfate and chelated iron were dissolved and injected through the irrigation system every two weeks at about 300 ppm nitrogen. Bed 2 contains plants where the potting mix was amended with dolomitic lime at 2.5#/yd^3, gypsum at 2#/yd^3, Talstar 2.5#/yd^3 and Osmocote Plus 15-9-12 (8 to 9 month) at 14#/yd^3. No supplemental fertilization was applied.

Water was sampled at six locations at this nursery. Sample 1 is taken from the water source above the nursery. Sample 2 came from down stream below the nursery after the runoff had mixed with the source water. Sample 3 and 4 are the two discharge locations exiting the nursery. Sample 3 mixes with the spring water running through the nursery. Sample 5 is directly from Bed 1 (the liquid feed area) and Sample 6 is from Bed 2 (the controlled release fertilizer area). Sample 5 came from the bed runoff which had mixed with the fresh spring water except for the 8/23/01 sample. This sample was directly from the beds with no fresh water dilution.

Samples were taken about two hours after the liquid fertilization was completed on 6/18/01, 7/11/01 and 8/23/01. and again one week after the liquid fertilization on 7/2/01 and 9/25/01. Liquid fertilization was discontinued at the end of September 2001. The sample on 11/28/01 was taken after all liquid fertilization was suspended and a winter controlled release fertilizer (12-6-6) was applied to winterized plants.

Results:

The results of the water analysis have been organized with all sampling dates together for each of the sampling sites. The six sampling sites were Sample 1 - Water Source, Sample 2 - Water Down Stream, Sample 3 - Discharge 1, Sample 4 - Discharge 2, Sample 5 - Liquid Feed Bed and Sample 6 - CRF (Controlled Released Fertilizer) Bed. Sample 3 - Discharge 1 for 11/28/01 was lost, so no data is recorded for the pH or nutrients. Table 1 gives all the data collected.

Ten parts per million nitrate nitrogen is the benchmark level for drinking water. The water source and down stream nitrate levels did not exceed 3 ppm in any of the sample dates. The discharge is high (42 ppm) only on one date, 8/23/01 from Discharge 1. The next highest discharge was 5.3 ppm on 6/6/01 from Discharge 2. The nitrate nitrogen levels from the Bed 2, the liquid feed bed were very high on 6/18/01m 7/11/01 and 8/23/01. These were the samples taken two hours after applying the liquid fertilizer (Figure 5). Levels ranged from 129 ppm to 51 ppm nitrate nitrogen. The highest nitrate level from Bed 2, the CRF, was 3.4 ppm (Figure 6).

The amount of nitrate nitrogen detected above and below the nursery after the runoff had mixed with the source water was not significantly different. There appears to be no effect from the nursery runoff in raising the nitrate levels of the source water. The levels from Discharge 1 on 8/23/01 show the concentration of the nitrogen in the runoff from the liquid fertilization beds. The nitrate levels from the liquid fertilization beds were high enough to present a potential pollution source. However, there was no indication that it was affecting the down stream water quality. The CRF bed showed little potential for pollution since the nitrate levels were low all season long.

In the water source and water down stream the ammonium levels are near zero. In the discharge, there is a small amount of ammonium nitrogen particularly on 8/23/01 from Discharge 1. The source of the ammonium nitrogen is being supplied by the liquid fertilization on 6/1/01, 7/11/01 and 8/23/01. There is a insignificant amount coming from the controlled release fertilizer bed. The ammonium nitrogen is only being released from the liquid feed bed.

All phosphorous levels were exceptionally low except for the runoff directly from the liquid feed bed. Phosphorous entering and leaving the nursery present no pollution threat.

The water source potassium and water down stream are all below 2 ppm. The potassium level from Discharge 1 are high, 40 ppm, on 8/23/01. Levels from Bed 1, the liquid feed bed, are relatively high.

Levels from Bed 2, are relatively low and gradually decline with time. Potassium does not appear to be a pollution threat.

The natural calcium levels in the water source and water down stream are 25 to 30 ppm. The levels in the discharge are within this range except for Discharge 1 on 8/23/01. The levels from the bed samples are all elevated above this range. The lime and gypsum are the potential source since they are being added to the individual potting mixes used for plant production.

The natural magnesium levels in the water source and water down stream are 15 to 16 ppm. The levels in the discharge are within this range except for Discharge 1 on 8/23/01. The levels from the bed samples are elevated above this range. The liquid feed bed levels are elevated more than the controlled release fertilizer bed. Sources for the magnesium include the water supply and the dolomitic lime in the potting mix.

The natural pH of the water source and water down stream are 7.3 to 7.7. There is little change during the year. The discharge levels range from 7.0 to 7.6. The controlled release fertilizer bed has an elevated pH, ranges from 7.6 to 8.8. The increase in the pH results from the addition of dolomitic lime to the mix and the fertilizer source. The fertilizer source and rate can effect the pH and has not reduced it as much as expected.

Summary:

The nutrients leaving the nursery are exceptionally low. The nitrogen and phosphorous levels are not showing up down stream as elevating existing levels. There is an indication that some nitrogen, potassium, calcium, and magnesium are leaving the nursery occasionally. The increased levels appear to be a direct result of the runoff from the liquid fertilization practices. The runoff from the controlled release bed had much lower levels of nutrients than the liquid fertilization bed. The pH showed little variation except for the elevation on the controlled release bed. However, all levels would be consider high with the controlled release bed considered very high.

Table 1. Water Analysis Data in ppm for All Nutrients, pH and Dates.						
Sample -1	**6-18-01**	**7-2-01**	**7-11-01**	**8-23-01**	**9-25-01**	**11-28-01**
pH	7.4	7.4	7.3	7.7	7.4	7.5
NO_3	0.4	3.2	0.3	0	0.4	0.3
NH4	0	0	0	0	0	0
P	0	0.1	0	0	0.2	0
K	0.8	1.4	0.8	0.9	0.9	1.3
Ca	26.6	26.9	25.8	28.9	27.4	27.9
Mg	15.0	15.6	14.7	15.3	14.7	16.1
Sample - 2						
pH	7.6	7.6	7.5	7.6	7.4	7.6
NO3	1.9	0.3	0.9	0	0.4	0.3
NH4	0.3	0	0	0	0	0
P	0	0	0	0.1	0.1	0
K	1.5	1.0	1.5	1.2	0.9	1.0
Ca	26.9	27.5	26.8	29.5	27.5	29.0
Mg	15.2	15.7	14.8	15.4	14.7	16.4
Sample - 3						
pH	7.4	7.3	7.4	7.0	7.6	7.3
NO3	7.2	0.7	2.2	41.7	0.4	0.4
NH4	1.8	0	0.5	7.6	0	0
P	0.1	0	0.1	1.1	0.1	0
K	4.0	1.1	3.6	39.2	0.9	0.9
Ca	29.7	27.7	27.7	58.0	28.1	27.6
Mg	15.9	15.7	15.0	23.4	14.9	15.8

Table 1. Water Analysis Data in ppm for All Nutrients, pH and Dates (Continued)

Sample -4	6-18-01	7-2-01	7-11-01	8-23-01	9-25-01	11-28-01
pH	7.5	7.5	7.4	7.5	7.6	7.6
NO3	5.3	0.9	1.9	0.2	0.6	1.5
NH4	1.3	0	0.4	0	0	0
P	0.1	0	0	0	0	1.9
K	3.1	1.2	2.8	2.1	1.0	2.4
Ca	28.6	27.0	27.6	30.5	28.3	32.7
Mg	15.8	15.3	15.1	15.6	15.1	16.3
Sample - 5						
pH	7.1	7.4	7.8	7.0	7.7	7.6
NO3	129.0	9.5	55.0	51.1	6.1	4.6
NH4	27.8	0	31.8	41.1	0	0
P	2.2	4.5	3.7	1.6	1.1	1.8
K	60.8	21.8	78.1	57.5	9.6	8.5
Ca	95.1	54.8	65.7	61.6	38.4	42.0
Mg	33.2	21.0	31.9	28.5	13.0	18.4
Sample - 6						
pH	8.8	8.3	8.3	7.6	7.9	7.9
NO3	3.4	1.9	0	1.9	0	0
NH4	0.6	0.2	0	1.0	0	0
P	0.3	0.4	0.4	0.3	0.2	0.1
K	10.9	5.3	4.5	5.9	2.7	1.7
Ca	41.6	47.1	47.4	38.4	38.9	28.3
Mg	13.9	21.1	20.1	13.5	17.1	15.6