Six State Survey of Container Nursery Nitrate Nitrogen Runoff[1]

T. Yeager[2], R. Wright[3], D. Fare[4], C. Gilliam[4], J. Johnson[5], T. Bilderback[6], and R. Zondag[7]
Environmental Horticulture Department
University of Florida, IFAS, Gainesville, FL 32611

Abstract

Container nursery bed runoff, reservoirs or ponds that contained runoff, wells, and surface water discharged from the property or at the property border were sampled at approximately 6-week intervals during April–October 1990 in Alabama, Florida, New Jersey, North Carolina, Ohio, and Virginia. Runoff from container beds averaged 8 and 20 ppm NO_3-N, respectively, for nurseries using controlled-release fertilizers (CRF) and controlled-release fertilizers supplemented with solution fertilizers (CRFSS). Average NO_3-N levels for runoff collection ponds, property borders, and wells were each less than 10 ppm, the drinking water limit, regardless of fertilizers used. However, ppm NO_3-N for some samples exceeded the drinking water standard. In general, these data indicate reason for concern and nursery operators need to implement best management practices.

Index words: controlled-release fertilizer, slow-release fertilizer, ground water, irrigation effluent.

Significance to the Nursery Industry

Data obtained from this study indicate that nursery operators can expect lower levels of NO_3-N in production bed runoff using controlled-release fertilizers rather than a combination of controlled-release and solution fertilizers. Production bed runoff NO_3-N levels ranged from 0.5 to 33 ppm for nurseries using controlled-release fertilizers and 0.1 to 135 ppm for nurseries using controlled-release supplemented with solution fertilizers, but averaged 8 and 20 ppm, respectively, for the 6 states in this study. Average NO_3-N levels for collection ponds or reservoirs were 2-3 times lower than production bed runoff levels. This decrease was possibly due to rain water dilution or filtration through grass in surface waterways, however, nurseries must ensure that NO_3-N does not percolate to the ground water, regardless of fertilization regime or runoff collection system. The average NO_3-N level of well water and water discharged from the property ranged from 5 to 7 ppm.

Introduction

The environmental consciousness of society and concern for safe drinking water makes it necessary for the nursery industry to understand impacts of management practices and fertilization programs on water resources. Some public sectors perceive that agriculture is the villain that contaminates ground water, however, perception alone should not be used as a basis for regulation. Data are needed to determine agriculture's influences on the environment. Currently, the federal drinking water NO_3-N limit is 10 ppm (1), but relationships between N application in the nursery and NO_3-N in surface and ground water have not been established. Fertilizer used in the container nursery industry and subsequent nutrient runoff is a potential source of ground and surface water pollution. In order to determine the impact of nursery crop production on ground and surface water NO_3-N levels, the following study was conducted in 1990 to survey NO_3-N levels in container bed runoff, wells, collection ponds or reservoirs and surface water discharged from container nurseries.

Materials and Methods

Samples were collected during the 1990 growing season from container nurseries utilizing either controlled-release fertilizers (CRF) or controlled-release fertilizers supplemented with solution fertilizers (CRFSS) applied in irrigation water. Sample collection was initiated in April and continued through October at approximately 6-week intervals for container nurseries in Alabama (4 CRF and 3 CRFSS), Florida (1 CRF and 3 CRFSS), New Jersey (2 CRF and 3 CRFSS), North Carolina (5 CRF and 1 CRFSS), Ohio (1 CRF and 1 CRFSS), and Virginia (3 CRF and 2 CRFSS). Samples were collected from: a) container production bed runoff, b) reservoirs or ponds that received runoff, c) wells, and d) where surface water was discharged from the property or property border. Runoff samples were obtained from the same collection points for each subsequent sampling.

To minimize the direct influence of bed runoff on pond NO_3-N levels, pond samples were collected at a location not directly receiving inflow water. Well water samples were taken from spigots on the property and samples were taken from streams at the property border. For each sampling location at the nursery, 2 or 3 samples (ca 100 ml, 3 oz) were collected in plastic bottles. Samples were cooled or acidified immediately, filtered, and frozen (if not acidified) until NO_3-N was determined by accepted analytical procedures.

A wide range of controlled-release and solution fertilizers were used at the nurseries. Application rate and frequency also varied from nursery to nursery. Due to the large variation in production practices from nursery to nursery, no

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[2]Environmental Horticulture Department, IFAS, University of Florida, Gainesville, FL 32611

[3]Department of Horticulture, Virginia Tech, Blacksburg, VA 24061

[4]Department of Horticulture, Auburn University, AL 36849

[5]Rutgers Cooperative Extension, Millville, NJ 08332

[6]Horticulture Department, North Carolina State University, Raleigh, NC 27695

[7]Lake County Cooperative Extension Service, Painesville, OH 44077

attempt should be made to relate NO_3-N levels to specific production practices and nursery layout or location.

Results and Discussion

Data were averaged over each sampling location for all collection times and these data were averaged over the states (Table 1).

Runoff from production beds for nurseries using CRF averaged 8 ppm and ranged from 0.5 to 33 ppm NO_3-N. Samples obtained early in the season following spring fertilizer application usually contained higher NO_3-N levels than samples obtained later in growing season (Fig. 1). As noted in Fig. 1, runoff NO_3-N levels exceeded the 10 ppm federal drinking water standard for 2 months indicating that time of sampling relative to fertilizer application is an important consideration in interpreting results for production bed runoff. Nursery operators should consider extending the time frame in which CRF are applied or stagger applications (2, 3) so that a large quantity of fertilizer is not applied at one time. For example, the commonly employed practice of fertilizing all plants within a few weeks in the spring could result in high runoff NO_3-N levels during the next 1-2 months.

Table 1. Average NO_3-N levels (ppm) for container nurseries that applied controlled-release fertilizers (CRF) or controlled-release fertilizers supplemented with solution fertilizers (CRFSS) during 1990 in Alabama, Florida, New Jersey, North Carolina, Ohio and Virginia.[z]

Location	Controlled-release			Controlled-release and solution		
	min.	mean	max.	min.	mean	max.
Beds	0.5	8	33	0.1	20	135
Ponds	0	4	20	0	6	23
Borders	0	5	30	0.5	5	20
Wells	0	5	17	0.2	7	55

[z]Samples were collected from production bed runoff, ponds or runoff water reservoirs, where water was discharged from the property or border, and wells.

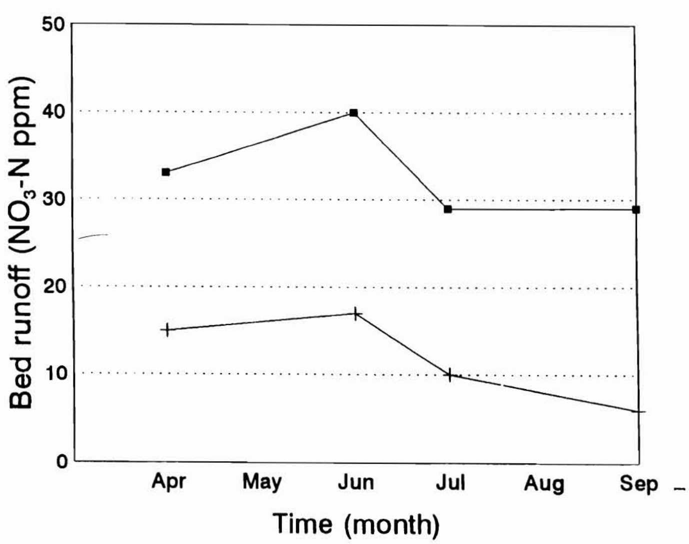

Fig. 1. Runoff NO_3-N from a nursery that fertilized with a controlled-release fertilizer (CRF = +) or nursery that fertilized with a CRF supplemented with a solution fertilizer (CRFSS = ■).

Bed runoff water averaged 20 ppm NO_3-N (Table 1) for nurseries using CRFSS and was higher than for nurseries using CRF only. The maximum level obtained was 135 ppm and the minimum of 0.1 ppm. Runoff NO_3-N levels from a nursery using CRF and one using CRFSS are given in Fig. 1. Not only did we find differences in bed runoff NO_3-N for the CRF and CRFSS but, our data indicate a wide range in NO_3-N bed runoff levels for two different nurseries using the same CRF (Fig. 2). This unexplainable difference could be due to environmental conditions, fertilizer application rate, and irrigation practices. These data reveal that regardless of fertilizer system, CRF or CRFSS, runoff levels vary considerably and indicate that nursery operators will need to implement management practices to minimize NO_3-N runoff. Nitrate N levels in collection ponds averaged 4 and 6 ppm for CRF and CRFSS, respectively. However, some ponds were as high as 20 to 23 ppm regardless of fertilizer type. Data were similar for borders and wells.

In general, this survey indicates that NO_3-N in nurseries may exceed the 10 ppm drinking water standard for bed runoff, wells, irrigation ponds, and at points where water leaves the nursery property. However, we observed nurseries that had levels below 10 ppm for most of the growing season. One fact not taken into consideration was the relative growth rate or nutritional status of the plants. Additional controlled experiments are needed to ascertain the relationships between production practices such as timing of reapplications and nutrient runoff.

While NO_3-N runoff from nursery beds was lower for nurseries using CRF than CRFSS, plant growth may be reduced unless supplemental fertilizers are added, either by reapplying CRF or supplementing with solution fertilizers in the irrigation water (unpublished data, Wright). Until CRF are developed that provide nutrient release patterns commensurate with plant uptake requirements, reapplication is advised. Rathier and Frink (3) also indicated that CRF should be reapplied, but to minimize NO_3-N runoff by reducing the quantity of fertilizer applied per application.

Based on the results of our study, we encourage nursery operators to implement sampling schedules in strategic loca-

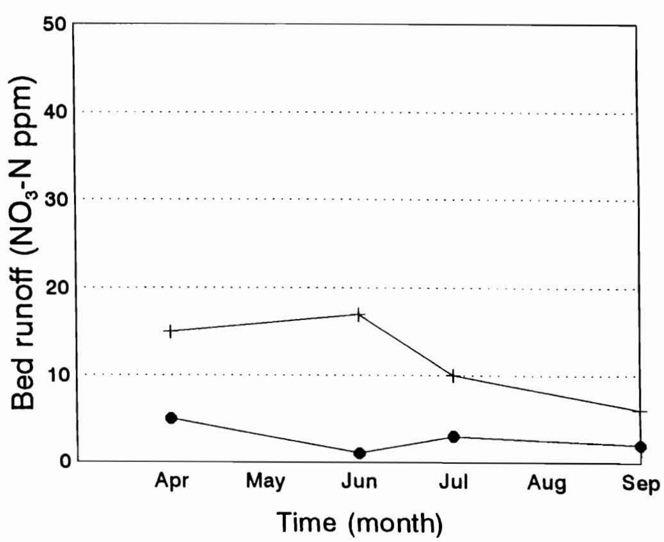

Fig. 2. Runoff NO_3-N for two nurseries (symbols + and ●) that used the same controlled-release fertilizer (CRF). Nurseries were located in the same state.

tions in the nursery. Data from those samples are needed to assess the potential environmental impact of the nursery fertilization program and thus to implement responsible changes if needed. Responsible actions rather than reactions will help ensure that the nursery industry is a steward of the environment (4). We have provided a list of management practices for nursery operators to consider.

1. Monitor NO_3-N levels in the container medium, production bed runoff, well water, runoff water in collection reservoirs and water discharged from the property. Maintain records and develop a data base of information to justify making changes needed in the fertility program.

2. Some controlled-release fertilizers can cause excessive NO_3-N levels in water runoff immediately following fertilizer application. If this occurs at your nursery, consider changing the type of controlled release fertilizer used, and apply controlled-release fertilizers to beds or crops within a runoff area sequentially over an extended period of time.

3. Check the calibration of spreaders and other fertilizer application equipment.

4. Monitor the irrigation duration, since excessive irrigation contributes to NO_3-N runoff.

5. Determine the efficiency of irrigation systems and modify systems as needed to improve efficiency.

6. Establish grass filter strips in surface waterways.

7. Reservoirs may be used to impound runoff and rain water; however, reservoirs and ditches may need liners to ensure groundwater contamination does not occur. Several connected reservoirs will facilitate more biological degradation than a single reservoir.

8. Tanks containing concentrated solutions of fertilizer should be placed on and surrounded by secondary containment barriers that will contain spills. Check state regulations for specifics regarding construction details.

9. Berm property border to prevent surface water from flowing onto or off of property.

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