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Managing Containerized Nurseries for Pollution Prevention

Introduction

Research shows that rainfall runoff and irrigation return flows from containerized nurseries can contain pollutants such as nitrogen, phosphorus, bacteria, certain pesticides, various salts, and trace metals. When these runoff-carried chemicals enter a stream, lake, or wetland, changes in the water's biological and chemical balance may create nuisance algal blooms, low oxygen levels, increased salinity, and pH fluctuations — changes that can alter the types and amounts of fish, amphibians, reptiles, and aquatic insects in the aquatic environment. When fish and other organisms that live in or near the water ingest certain pesticides, the resulting residue can accumulate in the food chain, which makes the area's larger fish unfit to eat. Bacterial levels above state water quality standards can make water unsafe for recreation or drinking, while nitrate levels over 10 mg/L can cause serious human health risks, especially to babies.

Several commercial nurseries have developed and installed cost-effective pollution control structures and initiated management methods to more fully protect local water resources. Using information collected from their operations and data gathered by state and federal agencies, these nurseries determined the environmental improvements needed at their specific locations. The nurseries have demonstrated that much of this type of pollution can be prevented through proper planning and changes in nursery management. Most remaining pollution can be controlled by installing structural best management practices (BMPs).

Drip irrigation system at Turkey Creek Farms near Houston, Texas.

Planning and Managing for Pollution Prevention

When planning a new operation or expanding an existing one, you as a nursery manager must choose a site carefully to avoid environmental risks and design the total drainage system properly. For example, locating your nursery within a quarter mile of a stream or lake is rarely a good choice if you want to prevent water pollution economically because close proximity to a waterbody increases the chances that nursery runoff will discharge directly to a stream or lake. Designing a drainage system for growing beds, lath houses, and propagating facilities or greenhouses so that no untreated drainage leaves the property will save you thousands of dollars over redesigning and retrofitting an existing system for pollution control.

If you have an established nursery, you probably do not have the luxury of starting over to minimize the potential for environmental harm. Instead, you can prevent and control pollution by retrofitting your operation and changing management practices. Some effective BMPs you should consider:

- Add a field border around your operation with permanent upright grass to slow velocity and rapidly growing trees to remove nutrients from runoff. (Research has shown that poplars have some of the highest nutrient uptake rates.)

- Establish vegetation on the upslope edge of the property to slow outside water from flowing across your operation.

- Evaluate your fertilization schedules and methods. Use soil and tissue testing to ensure optimum — but not excessive — growth. Consider changing to a more precise application method, such as microfertigation (injecting fertilizers through the irrigation system) or mechanical incorporation. Evaluate the fertilizer in use: is a form available that is less environmentally mobile, such as a slow release formula? Install a backflow preventer if fertigation is used.

- Evaluate the growing habits and requirements of different plant materials and species. Match pesticide and fertilizer amounts to each plant's specific need so species that need less receive less.

- Rearrange your stock on growing beds so varieties that need the most fertilization and irrigation are located farthest from a waterbody or a drainage channel that discharges near or into a waterbody.

- Develop and implement an integrated pest management (IPM) program that uses pest scouting to identify and treat infestations before they become severe. Select the least mobile and persistent chemical. Explore the use of biological controls.

- Use a soil or growing medium that holds water better than your nursery's present mix (but still provides sufficient aeration and drainage) to decrease irrigation frequency and amount.

- Assess your irrigation methods and schedules. Avoid methods that use large-volume overhead sprinklers (almost two-thirds of this water runs off carrying excess fertilizers, pesticides, and other pollutants). Try precision application with drip irrigation. Maximize the efficiency of existing systems by irrigating when wind velocities are lowest.

- Select varieties for production that require the least intensive growing methods. Native plants often require much less fertilizer and water and are much less prone to disease and pest damage than introduced varieties. Aggressively market these environmentally friendly plants.

- Practice source reduction in your weed control program by mowing the perimeter of your nursery to prevent weeds from going to seed; similarly, establish a regular (daily) hand weeding schedule for the same reason.

Turkey Creek uses several high efficiency filters (ranging from 20 to 80 microns) in its water treatment system to remove solids; the water intake pipe is also screened. Both the water intake and filters use a back-pressure system to eliminate clogging. To prevent algae accumulation, 3 ppm of chlorine is added to the water as it enters the treatment system.

After mechanical filtration, the water is treated in a carbon tank filter system to remove herbicide and pesticide residues — an important step toward protecting plant and water quality. These residues can become increasingly concentrated as irrigation return water or rainfall runoff water is reused again and again.

The final treatment involves an ultraviolet light system that destroys fungi, bacteria, and any other waterborne spores. This step prevents the spread of disease to nursery stock and the discharge of bacteria-laden water from the nursery. The treatment system water and any discharge water (if the system is bypassed in an unusually intense storm) is tested at an approved lab for pH, nitrate, nitrite, total phosphorus, fecal coliform, and certain metals.

Turkey Creek has to contend with some unique problems that could be avoided in a newer nursery. For example, it must manage a channelized highway runoff drain (off-site water) that flows across the property. The site has little natural drainage and much of the irrigation return water must be pumped into detention ponds and through the rest of the system (including treatment and re-irrigation) because little gravity flow is available. All blocks, now properly crowned and graded to drain to the concrete ditches, originally had to be stabilized (as did the roads) because the site is located on high shrink-swell clay soil.

Turkey Creek recommends that nurseries planning to install a pollution control system plan in advance (especially in site selection) and devote the needed time, effort, and expense to design and build the most effective pollution control system possible — one that can be expanded as the nursery grows.

Case Study: Hines Nursery

With almost 250 employees, Hines Nursery (also located near Houston) is one of the largest containerized wholesale growers in Texas. Hines' recycle/reuse system includes retention of irrigation return flows and the first half inch of rainfall, water filtration and reuse, and various management methods that maximize production while minimizing input.

Hines has a system of gates, pump stations, concrete channels, and ditches to carry (using gravity flow) irrigation return water to two holding ponds. After filtration, the water is recycled back through the irrigation system, which consists mostly of overhead sprinklers. Before Hines installed its recycle/reuse system, an estimated 70 to 80 percent of the irrigation water was discharged and lost.

Sand filters for water treatment at Hines Nursery near Houston, Texas.

Case Study: Turkey Creek Farms

Turkey Creek Farms, a wholesale nursery north of Houston, Texas, uses a combination of structural and management BMPs to prevent and control runoff, irrigation discharge, and associated pollution.

Turkey Creek uses an almost totally closed irrigation recycle/reuse system to manage the more than one million gallons of water per day needed for its 120-acre facility. The system includes concrete-lined irrigation return and rainfall runoff collection ditches that drain to two clay-lined detention ponds. Water is pumped from these ponds to a central holding basin and then goes through a treatment process that removes solids, organics, pesticides, and bacteria. The treated water is discharged into a large, high-density, polyethylene-lined holding tank. From here, the treated water is either used for irrigation or pumped to the nursery's original water supply pond where it is mixed with well water.

This system will cost Turkey Creek about $400,000 when fully completed. Maintenance costs (including replacement of treatment system components) are expected to be about $30,000 annually — a considerable investment in a short time. However, the nursery, which previously used four 6" wells almost continuously, lowered its pumping costs considerably by installing the water recycle/reuse system and expects a significant cost savings over the next few years. Turkey Creek recommends that you install retention ponds first and follow up with a water treatment system within a year.

Management BMPs, usually the least expensive part of the system, can often be modified right away. The nursery uses a mixture of preventive or good housekeeping procedures (e.g., proper disposal of clippings and silt fences around bark storage and potting-up areas) to keep organic materials out of irrigation and runoff return water. This practice also decreases treatment costs and prevents plant damage from mold and fungus. Most plants are fertilized with a controlled-release fertilizer to save time (the slow-release formulas are designed to last 10 to 12 months without re-application), decrease fertilizer cost (less fertilizer is lost through leaching), and keep excess nutrients out of the discharge water.

As part of its integrated pest management program, Turkey Creek uses the least residual pesticide and is experimenting with a preventative pest control program that incorporates pesticide-free oils to coat and smother insect pests. The key to this program appears to be a regular spray schedule that is coordinated with the insect's growth/reproductive cycle.

Drip irrigation is now used on about one-third of the plants grown at Turkey Creek; overhead sprinklers are still used on the remainder. The nursery is evaluating the sprinklers' water use requirements and converting to the drip system as expenses allow. To conserve space and use the drip system optimally, the nursery has interspaced deciduous trees on racks with smaller, low-growing evergreens. Successful use of a drip or trickle irrigation system depends on clean water because the tiny emitters clog easily.

Retention pond for irrigation return flow and runoff at Turkey Creek Farms near Houston, Texas.

Structural BMPs

How can a nursery keep all runoff or irrigation return water on its property? Detention ponds, tailwater pits, and catchment basins — coupled with water recycling — can help your nursery get close to that goal. Although these systems include an initial design, engineering, and construction cost, they often create a significant cost savings because less water is pumped. While researchers cannot fully predict environmental cost savings from using these detention ponds and water reuse systems, they have found that proper design, installation (lined to prevent groundwater contamination), and management can reduce nutrient discharge concentrations up to 80 percent.

Success does not depend as much on the detention pond (normally about 20 percent effective in removing nutrients) as the recycle/reuse system that diminishes discharge. Since they act like settling basins by allowing the heavier particles to drop out, detention ponds effectively remove suspended solids and any pollutants that are adsorbed to sediment particles. However, using a pond alone is not a particularly effective method to remove dissolved pollutants, especially pesticides and some forms of nitrogen.

Reusing your irrigation water can cause problems with salinity, nutrient, algae, and bacteria buildup. Recycled/reused irrigation water may need treatment to protect nursery stock from waterborne diseases and frequent testing so the nutrient concentration can be factored into your fertilization program. Testing will help you avoid over-fertilization (and its associated scorch or weedy growth) or nuisance algae growth in ponds. Investing in a simple testing lab safeguards your nursery's investment in container stock.

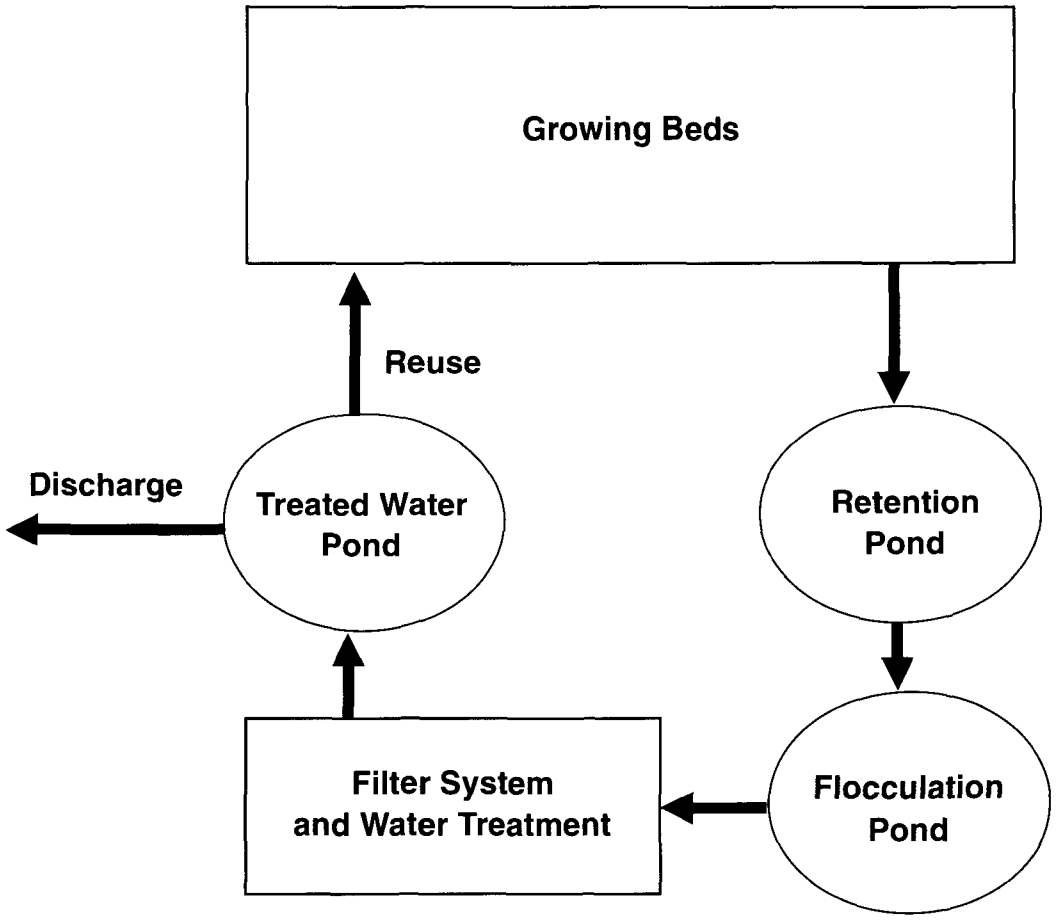

Diagram of irrigation water management and reuse system for containerized nurseries.

Situated in an area with an average rainfall of 50 to 60 inches annually, the nursery contains 200 acres of graveled growing beds on both sides of a creek. Because of the average high rainfall, Hines was concerned about the large water volume its system would have to accommodate, so the nursery installed several new drainage channels to divert the flow from direct discharge into the creek.

The low maintenance system cost Hines about $800,000; upkeep on the water recycling system is estimated to be $25,000 per year. The nursery expects to save substantially on annual costs because of lower pumping expenses.

One of only a few nurseries in Texas with an individual state discharge permit issued by the Texas Water Commission (Turkey Creek is another), Hines collects water samples and sends them to an independent laboratory for analysis. Hines uses data from these analyses to improve production and decrease expenses by modifying their fertility management program. The nursery uses both fertigation and controlled-release fertilizers to grow their products.

Hines personnel believe the recycle/reuse system has made them better managers. Although Hines spent a considerable amount of money over the past four years to research, design, engineer, and install its system, the nursery has maintained a profitable business.

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