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Managing Water Quality On-Farm

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Summary

Water availability and quality contribute to crop health and impact the profitability of crop production. Water security is likely the next big challenge for ornamental producers worldwide. Enhancing on-farm water storage (e.g., reservoirs) capacity may be one of the savviest investments currently that can be made. Grower use of poorer-quality water will likely increase in the coming years. Managing water quality on-farm can be achieved by strategically integrating chemical or biologically-based treatment technologies within production areas or water-management systems.

INTRODUCTION - WATER CHALLENGES AND CONCERNS

Water Availability. Water sources used for irrigation include municipal (potable or reclaimed), ground, surface, and captured stormwater. Geographic and economic variables regulate water availability. In the eastern US, riparian water rights govern reasonable water uses, while in the western US, prior-appropriation, water rights give rights to a certain volume of water to the first person/business who used it. Thus, depending upon operation location, the capacity to gain access to surface waters for irrigation may be simple or difficult. Any one of these sources can serve as either primary source or a backup source.

It is critical to understand how much water is used for irrigation per day at peak application times to truly be able to plan for scenarios when water availability might be limited due to drought. Figure out how much water you apply per day. Multiply that volume by the number of days you want your water to last if an alternate backup water source is not available. Then develop a plan to invest in on-farm infrastructure (over time, all at once) to have enough water available to meet your production goals.

Water Quality. Water quality influences plant growth rates and quality. Meeting plant production goals requires understanding your water quality and managing it so plant growth outcomes are attained. Do you have pathogens in your water that infest crops and cause inventory shrinkage? Consider sanitizing your water (e.g., chlorine, peroxides, etc.) to kill the pathogen before it can infest your crops. Do you have issues with clogged emitters? Consider adding disc/media filters that can remove debris from water that contributes to clogging. Are your plants growing slower than you think they should? Check your water pH and alkalinity. Sometimes, water can be too pure – and nutrients are less available than they should be because water pH is too low. In this instance, you may need to add additional buffer to the substrate (e.g., lime) or irrigation water (e.g., flowable lime) to moderate pH to enhance nutrient availability.

WATER QUALITY MANAGEMENT SOLUTIONS

Water quality management is not about one single solution that solves all your problems. It's about a concerted, strategic effort to combine treatment options to attain water quality outcomes specific to your operation.

Reservoirs. Reservoirs are typically considered water storage structures. Reservoirs are also called tailwater recovery ponds or containment ponds (Sahoo et al., 2021). But in recent years, we have come to realize that reservoirs add benefits beyond simple water storage (Yazdi et al., 2021). Reservoirs should be designed to intercept operational water before it leaves your operation (**Fig. 1)** but can also be used to store "clean" water.

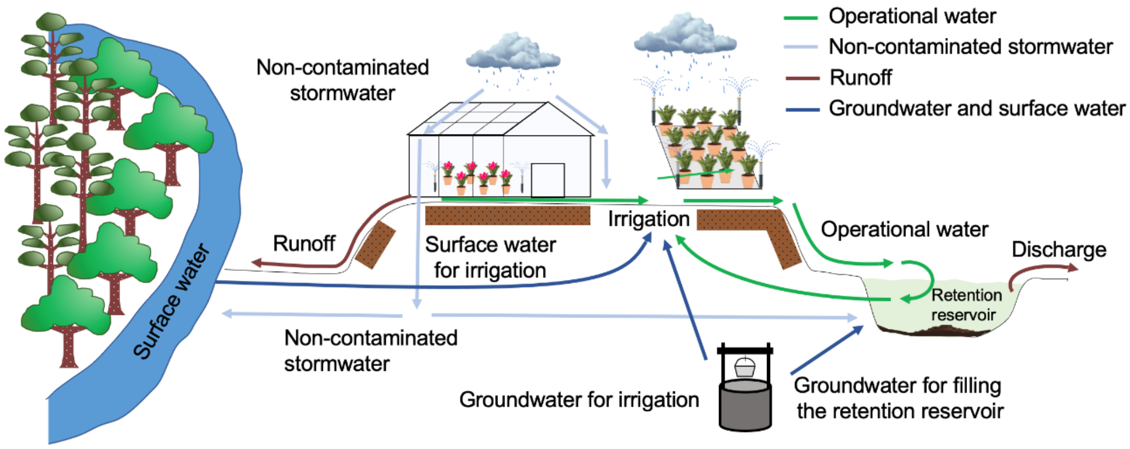

Figure 1. Types of on-farm water.

Operational water is runoff from stormwater and captured irrigation return flow. Ornamental producers should consider using a reservoir to (1) conserve water via capturing operational water, irrigation return flow, and stormwater, (2) reduce reliance on surface and ground water via enabling water recycling and reuse, and (3) clean additional contaminants from water prior to its discharge into receiving waters.

Yazdi et al. (2021) proposed changes to reservoir design to enhance water security on-farm. Sahoo et al. (2021) translated those recommendations into actionable items for use on-farm (**Fig. 2**).

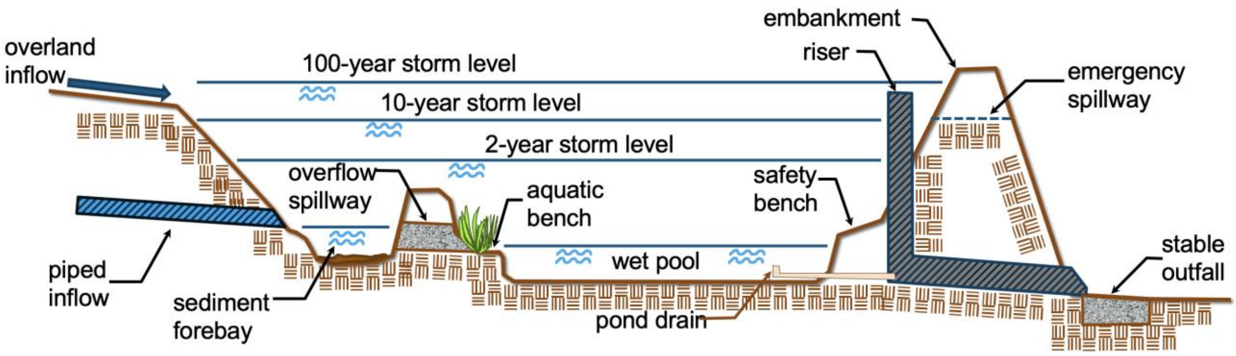

Figure 2. New design recommendation to consider for irrigation reservoirs (Sahoo et al., 2021)

When designing a reservoir, consider ways to manage sediment and detain it before it enters the reservoir (e.g., a sediment forebay, **Fig. 3**) to help maintain reservoir storage capacity and to have a means to remove sediment from the reservoir without dredging the entire reservoir.

Figure 3. Sediment forebay designed for easy clean out.

Biological Treatment Solutions. Researchers collaborating on the Specialty Crops Research Initiative project – Clean, WateR[3] (https://cleanwater3.org/) evaluated various treatment technologies that harness plant and microbial-based biological systems to clean water. All of these systems operate under the principle that the longer the amount of time water (and contaminants) are held in one place, the more contaminants can be removed from the water. Each of the following treatment technologies have a minimum treatment capacity that is enhanced as the contact time between the water+contaminant and the treatment technologies lengthens. These technologies work best when placed strategically on-farm to capture operational water and when used in concert with each other. As each technology may work better for specific contaminants, grouping/pairing technologies (i.e., treatment train) enhances treatment efficacy (**Fig. 4**).

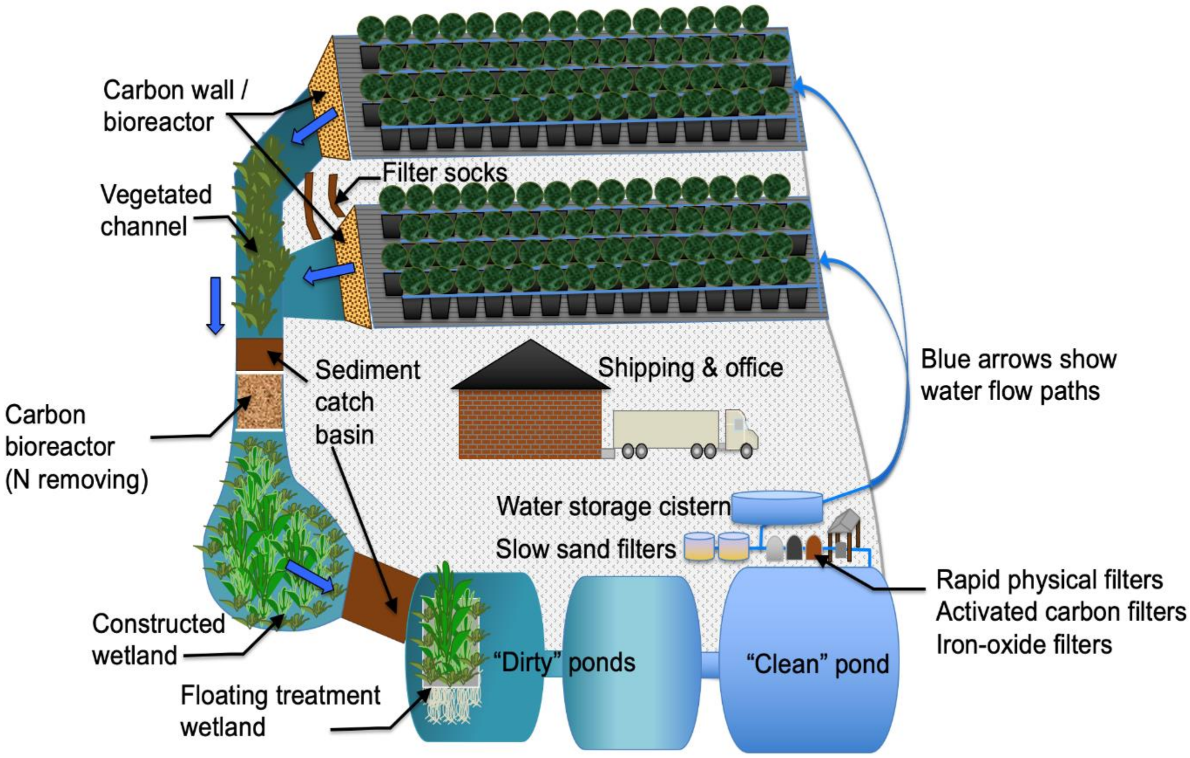

Figure 4. Integration of treatment technologies and on-farm practices to manage water quality and availability.

Vegetated Waterways and Filter Strips. Vegetated waterways, ditches, or channels serve to help reduce contaminant entry into reservoirs by prefiltering contaminants from water prior to their entry into the reservoir (Majsztrik et al., 2017). The plants in these vegetated waterways help to diminish flow velocity and disperse the flow so sediment can settle from the water (**Fig. 5**). The plants within the buffer serve to absorb nutrients. The microbial communities within their rhizosphere also increase the degradation or transformation of pesticide and nutrient (e.g., nitrate) contaminants.

Figure 5. Vegetated buffer and channel to help minimize movement of sediment or other agrichemical contaminants in operational waters into reservoirs or off-farm.

Floating Treatment Wetlands. Floating treatment wetlands are a style of constructed wetland that has been modified for use (i.e., made buoyant) within existing infrastructure (e.g., reservoirs or ponds) (White, 2013). Floating treatment wetlands comprise a scaffold or buoyant structure that helps keep the plant crowns above the water surface and plants whose root systems extend within the water column (**Fig. 6**).

Figure 6. Floating treatment wetland deployed in a nursery reservoir in Florida.

As long as the plant crowns remain above the surface of the water, a wide range of plants (even ornamental plants) can be grown within these wetlands. If used as a secondary production area on-farm, Garcia Chance et al. (2022) estimated a return on investment can be attained within as little as 2.2 years. Bell et al. (2018) reported that the plants in floating treatment wetlands helped diminish the viability of zoospores transported in simulated irrigation runoff and that none of the plants screened were infected by *Phytophthora*. However, subsequent work has noted that three species (*Carex stricta, Panicum virgatum,* and *Typha latifolia*) became infested with *Phytophthora*. These three species should be avoided if growers are worried about the circulation of *Phytophthora* propagules in irrigation water.

CONCLUSIONS

Water management on-farm is not a once-and-done plan, it is a constantly evolving strategy that considers crop mix, economic goals, water security needs, and the treatment technologies needed to meet your goals. It is the integration of these factors that makes for successful on-farm water management. As the weather becomes more variable and the prevalence of flash (micro)-droughts and intense storms come more frequently and at atypical times of the year when we may be less prepared to manage them. It becomes all the more important to plan ahead and invest in the infrastructure and treatment technologies needed to help your operation maintain its capacity to produce plants profitably.

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