CFAES

Department of Horticulture and Crop Science

Theoretical Analyses of Phosphorus Discharge from Substrate-based Production in Greenhouses and Open Fields

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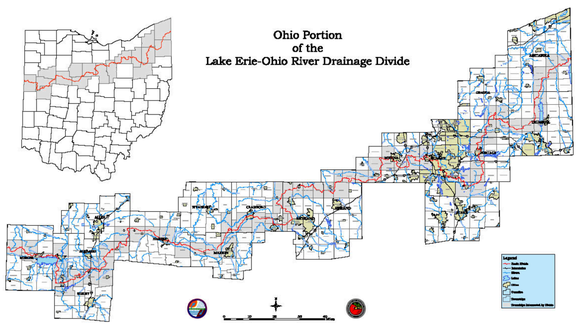
Introduction and Background

The heavy usage of fertilizer application in the agriculture industry is largely looked at as a major non-point source contributor to algal blooms occurring in Lake Erie. Another aspect for consideration is the horticulture industry who uses substrates as growing medium, such as ornamental/floriculture greenhouses and containerized nurseries. Among these agricultural fertilizer usages, quantifying potential impact of phosphorous discharge from greenhouses and nurseries is critical for establishing strategies to reduce the overall load.

Approach

The objective of this study was to quantity phosphorus discharge from each production system. To do so, a worst-case scenario (water soluble fertilizer via hose irrigation) was considered for greenhouses and a reported value of annual phosphorous discharge was considered for containerized nurseries. A watershed divide line between Lake Erie and the Ohio River, as reported by Ohio Department of Natural Resources (ODNR, 2019) was used to select counties. The 2017 USDA NASS Census of Agriculture was used to select specific Ohio county data. Ohio county data was broken down into two categories: ornamental/floriculture greenhouses (under glass and other protection) and open-field container nursery practices.



http://water.ohiodnr.gov/maps/watershed-drainage-basin-maps

Figure 1. Ohio Watershed Divide by County reported by ODNR (2019). The following 34 Counties contribute to the Lake Erie Watershed: Allen, Ashland, Ashtabula, Auglaize, Crawford, Cuyahoga, Defiance, Erie, Fulton, Geauga, Hancock, Hardin, Henry, Huron, Lake, Lorain, Lucas, Marion, Medina, Mercer, Ottawa, Paulding, Putnam, Portage, Richland, Sandusky, Shelby, Seneca, Summit, Trumbull, Van Wert, Williams, Wood, Wyandot.

Ornamental/Floriculture Greenhouses

Based on our prior knowledge, we assumed almost all greenhouses of this sector do not use recirculation system of nutrient solution. Some greenhouses, due to the nature of continuous crop production, fertilize on a more frequent basis throughout the year to maximize plant growth and yield. Methods from Andiru et al. (2015) were used to find an average of the amount of nutrient solution and phosphorous being leached and missed on a volume-per-week basis per area when a wasteful but conventional hose-watering with water-soluble fertilizers is used. These values can then be applied to the overall area to quantify total discharge.

Table 1. Phosphorus leached, missed and lost from containers during hose irrigation with water soluble fertilizers (WSF) (after Andiru et al. 2015)

Phosphorus (mg/L)				
Treatment	Week 1	Week 2	Week 3	Average
Nutrients in leachates	46.9	117.3	151.2	105.1
Nutrients missed	105.3	273.9	393.8	257.7
Total lost (leached + missed)	152.2	391.2	545	362.8

https://hrjournal.org/doi/pdf/10.24266/0738-2898-33.1.29

Open-Field Containerized Nurseries

Because nurseries typically sit on a gravel site this allows for a high exposure level of excess runoff. Also, plants are in pots and substrate, which have a higher concentration of nutrient runoff and leachates compared to other open field practices. As mentioned, area was calculated via USDA data, to further estimate specific container nursery practices versus open field. Extension personnel estimated 60% of this area containerized out of which 40% as not using retention ponds (24% of this area to be considered). A study done by Alamdari et al. (2019) calculated 12.9 kg/ha/yr of phosphorus discharge from a container nursery located in the Mid Atlantic. This value can then be applied to the overall area of the nurseries to quantify total discharge.

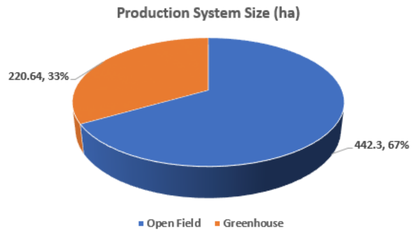


Figure 2. Production size (ha) of ornamental/floriculture greenhouses and open-field containerized nurseries that do not use retention ponds, located in the 34 countries (see Fig. 1)

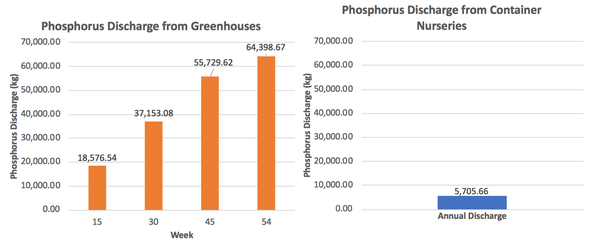
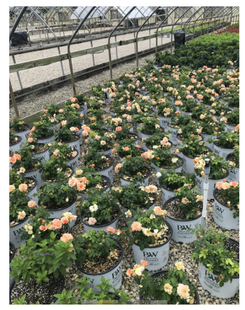


Figure 3. Estimated annual phosphorous discharge from ornamental/floriculture greenhouses (left chart) and containerized nurseries that do not have retention ponds (right chart). Greenhouse data were prorated from a weekly value for different number of production weeks per year.

Discussion

When looking at the area difference between the two different types of practices, container nurseries have twice as much surface area as opposed to greenhouses (ornamental/floriculture greenhouse, 220.64 ha vs. open field containerized nurseries, 442.30 ha, Figure 2). But, when looking at discharge rates, greenhouses have significantly more discharge than open field practices (ornamental/floriculture greenhouse, 18,576 to 64,399 kg/yr vs. open field containerized nurseries, 5,705.66 kg/yr). Due to the assumption that all greenhouses use WSF and hose irrigation, this number is likely an overestimate. However, it should be noted that runoff phosphorous concentration from greenhouses is excessively high (>30 ppm, per Andiru et al. (2015)). Discharge was then cross referenced with the 2018 EPA Nutrient Mass Balance Study to find a percentage contribution of ornamental/floriculture greenhouses and open-field containerized nurseries accounts for up to 1.6% and 0.15%, respectively, of phosphorus discharge per annum.



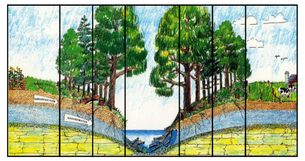
Best Management Practices

Horticultural practices contribute to environmental hazards, and public perception of environmental awareness is growing. The horticulture industry will need to be progressive to meet new requirements. Otherwise, the industry may face scrutiny from the public and potential government regulation. Growers may be able to meet higher standards by implementing best management practices (BMPs):

- Current irrigation methods
- High risk areas
- Control Release Fertilizer (CRF's)
- Retention ponds
- Buffer zones and channels

These BMPs will help reduce the risk of phosphorus runoff and chemicals that are discharged from common production practices. To best deal with phosphorus runoff, best management practices should primarily be focused on water quality and quantity.

https://www.houseofpots.com/news-detail/5375-1-global-control-release-fertilizers-market-2019:-analysis-methodology,-high-rate-of-growth-and-market-trends-2024



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