2013 Oregon Department of Agriculture (ODA)/Oregon Association of Nurseries (OAN) Project Final Report

Title: Evaluating compost filter socks for agrichemical remediation of runoff in ornamental nurseries as a cost-effective means to effectively treat water.

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Introduction

Nursery and greenhouse producers near impaired waterways are facing impending federal, state, or local water quality regulations for non-point source runoff. Concurrently, ornamental crop producers have learned the importance of healthy bodies of water (i.e. streams and collection ponds) on the impact of production water quality. This has led to efforts to reduce agrichemicals via reduced runoff and on-site remediation. Many operations remain land-limited, reducing their options for implementation of Best Management Practices (BMPs) that require a large area of land and capital to be effectively implemented. Efficiency of these BMPs remains variable based on location, design and cultural practices. Low cost, small footprint BMPs are needed to work independently or in conjunction with existing water management practices.

Filter socks, a proven and accepted BMP in managing runoff from construction sites, may be a low-cost remediation technique that is easily adaptable to varying nursery sites, requiring little or no change to existing infrastructure. Filter socks act as check dams, slope interruption or filtration systems that slow or redirect water movement while simultaneously allowing retained runoff to be filtered as it flows through the sock. As runoff passes through the sock, total suspended solids are captured. These solids act as a carrier for phosphorus, pesticides and herbicides. The overarching goal of this proposal was to investigate filter socks for agrichemical remediation efficacy by removal of the dissolved and adsorbed pesticides and nutrients.

Materials and Methods

Filtrexx® envirosoxx® filter socks were deployed in May 2014 at two ornamental container nurseries in Virginia. Nursery sites were surveyed and mapped (Image 1) for optimal sock placement prior to deployment. Filter socks were obtained as continuous length, 8-inch diameter prefilled socks on pallets then measured to desired lengths, cut and end material folded and secured with 11/16" c-rings (Image 2). Based on manufacturer recommendations, socks were placed in series approximately 10 meters apart where possible. Due to logistical limitations within the nurseries, a number of socks were solitary. All socks were placed perpendicular to water flow.

On May 1st, 15 filter socks were deployed to Colesville Nursery, Ashland, VA. Socks deployed in series were 1.2 m long and placed in a sloped drainage ditch (Image 3) which funnels runoff from approximately 10 hoop houses with actively growing plants. Solitary socks were 1.8 m long and placed in larger drainage ditches, around culverts and near an irrigation retention pond inlet. Immediately upon placement, a ponding effect on the inlet flow side of the socks was observed (Image 4). The ponding, or "damming", of runoff increased to the extent of runoff flow diverting around the socks. Socks were not anchored or staked, with an understanding that should they cause adversity for nursery work they would be removed. Otherwise, socks were installed with the intention of collecting water samples from the inlet and outlet side of each sock on a bimonthly basis.

On May 2nd, 17 filter socks were deployed to Lancaster Farms Nursery, Suffolk, VA. The first series of socks were approximately 0.6 m long and placed in a concrete drainage culvert, which funneled runoff from several nursery beds to an irrigation retention pond. The second series of socks were 1.8 m long and placed in a runoff stream flowing through the center of a road and to a different irrigation retention pond on the north side of the nursery. Solitary socks were 1.8 or 3 m long and placed in larger drainage ditches, around culverts and near irrigation retention pond inlets. The aforementioned ponding effect was also observed at several sock placements in Lancaster Farms. This issue caused particular concern with socks in the concrete drainage culvert due to its close proximity to the retail and management building and potential flooding. Socks were not anchored or staked, with an understanding that they would be removed should they cause any adversity for the nursery. Otherwise, socks were installed with the intention of collecting water samples from the inlet and outlet side of each sock on a bimonthly basis.

As a result of excessive pooling prior to socks, a sample of the compost media was removed from the socks and oven dried at 103°C. The dry sock media was then shaken in Ro-Tap® Sieve Shaker using ASTM E-11 specified sieve sizes 1.27 cm, 6.35 mm, 4 mm, 2 mm, and pan. Based on these results it was concluded that sock media from the first batch (B1), early May, did not meet particle size specifications and resulted in damning. In late May, a new shipment of sock pallets were ordered and particle size of media analyzed using the aforementioned protocol. This second batch (B2) also failed to meet Filtrexx® envirosoxx® specifications. In mid-June, after extensive communication and cooperation with Filtrexx®, filter socks were obtained [Batch 3 (B3)] with compost media meeting specifications.

Filter socks from B3 were sized and deployed to Lancaster Farms Nursery, Suffolk, VA on June 26^{th}. B1 socks were removed and replaced with B3 socks. Sock locations and sizes remained the same. However, B3 socks were secured with wooden stakes, multiple per sock, based on observations and reports of sock movement during high flow situations such as storm events, and issues with maintaining effective sock to ground contact. July 12, 2014 was the first scheduled water sample collection date. Upon arrival it was clear that a recent, major storm event, averaging approximately 2.54 cm of rain per hour for three consecutive hours, disturbed the socks (Images 5 & 6), rendering them ineffective for purposes of this trial. Socks remained in place for further observation, but sampling ceased.

Filter socks were retrieved from Lancaster Farms on September 18^{th}. Distinct particle size differences were observed between original B3 media and that of socks that had been deployed at the nursery. As a result of this observation two smaller trials were conducted. The first to evaluate potential toxicity from agrichemicals collected in filter socks, and the second to compare media weights as a relative metric indicating the amount of particulate matter filtered and retained by socks.

In the first trial, media from socks retrieved from 3 locations in the nursery was collected and used as a seedling germination mix, along with media from and unused B3 sock, and a standard trade germination mix as control. Each media germination tray was separated into 3 sections, one section for each seed species. This was replicated 3 times per media for a total of 12 trays. Each section of each tray was seeded with periwinkle *Vinca rosea,* crabgrass *Digitatria,* or snapdragon *Antirrhinum majus* (Image 7). Germination rate and foliar development were monitored for signs of toxicity.

In the second small trial, media was collected from 2 socks retrieved from the nursery and from B3 unused socks. A 600 ml plastic beaker was filled one-third way with media, gently shaken and tapped. Next, the beaker was filled two-thirds, gently shaken and tapped. Finally the beaker was filled to the brim, gently shaken, tapped and topped off to be level with the brim of the beaker if necessary. Contents of the beakers were transferred completely to a metal tray, weighed then oven dried at 103°C for 48 hours, after which the weight was again taken and recorded. This process was repeated three times for each media.

Results and Discussion

Filter socks were able to retain 541 kg m^{-3} of sediment when effectively, linearly, deployed to ensure water passed through the mesh and compost media. When filter socks were bypassed due to storm events or high flow rates of water, allowing a portion of runoff to bypass the treatment technology, they were able to retain 194 kg m^{-3}, a 64% reduction in efficacy. However, this could be a result of varying sediment load encountered by the filter sock. Further research is needed to determine the best methodology to ensure operational water is treated by filter socks while allowing larger volumes of water to bypass the treatment technology without compromising long-term effectiveness.

Germination tests of all seedlings were inconclusive because of the varying properties of the media though all efforts were taken (i.e. top-dressed with pine bark) to normalize treatments. Therefore, no inferences could be made of the substrate harboring pathogens or if the quantity of inoculum was sufficient to infect plants. Germinated seed from all taxa exhibited no foliar symptomology of herbicide damage. Regardless of the pathogen and agrichemical assays, recovered media from socks would not be usable as a soilless substrate amendment, even if pasteurized, because of the muddy composition of the substrate after harvest. We hypothesize the bark soil combination would have inadequate air space to produce container plants.

Conclusion

Research herein remains anecdotal; however, it shows promise that filter socks, if deployed effectively, remove sediment from nursery runoff. This should in turn reduce the amount of agrichemicals bound or sorbed to sediment particulate matter. However, more research is needed to quantify the effectiveness of filter socks as an onsite treatment technology for ornamental container nurseries. Virginia Tech will continue to research filter socks at the Hampton Roads AREC and regional nurseries to optimize deployment strategies and quantify effectiveness at removing sediment and agrichemicals.

Image 1. Survey water flow and direction at participating Virginia nursery site.


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Image 2. Securing end of filter sock with c-rings

Image 3. Series of filter socks in sloped drainage ditch adjacent to hoop houses.

Image 4. Ponding effect behind filter sock.

Image 5. Filter socks disturbed by storm event.

Image 6. Erosion around sock from storm event.

Image 7. Seedling germination in sock media from nursery site.