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Impact of vegetated filter strips on phosphorus surface runoff varied

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Vegetative filter strips, or buffers, were effective at retaining phosphorus after a runoff event during the growing season but not in the spring or fall outside the growing season. The findings of this study suggest that vegetative filter strips are inconsistent and not likely to reduce P concentrations substantially in cold climates such as those on the Canadian Prairies.

A vegetated filter strip (VFS), or buffer, is commonly used in agriculture to reduce phosphorus runoff in order to improve water quality in the watershed. In warmer climates, VFS have proven effective, but research has been limited cold climates.

The objective of this study was to assess VFS's ability to reduce P concentration in water as runoff passes through the VFS over multiple seasons, in a cold climate agricultural landscape within the Red River basin of Manitoba. A second objective was to compare the performance of the VFS treatments in reducing runoff P concentration to a pretreatment condition of strips of annual crop.

Three sites were established at Agriculture and Agri-Food Canada's Morden Research and Development Centre on a 49 acre (20 ha) study area. The three separate sites were located upstream of ponds or an ephemeral stream.

Each site had a crop strip seeded to an annual crop and a perennial VFS, and was 20 m in length parallel to the flow direction. The perennial VFS was a mixture of grass and forbs. In 2016, two

annual crop strips were sown to canola and the third site to soybean. In 2017, all crop strips were sown to spring wheat. The adjacent crops above the plots were the same as those sown in the annual crop strips.

Runoff monitoring was established at the inflow and outflow of each plot. Water samples were collected during four types of runoff events: two natural and two artificial. Natural runoff events were those derived from either snowmelt or rainfall. To gather additional data, “artificial events” were conducted during dry periods (fall 2015, spring 2016, and fall 2016) by pumping water from a nearby irrigation reservoir directly into one inflow site, and into the retention pond upstream of another site. Another waterflow event occurred when there was sufficient natural runoff water in either of the two retention ponds that produced overflow into two sites.

Filtered samples were used for determination of total dissolved P (TDP) concentration. Unfiltered samples were used to measure total P (TP) concentration using standard laboratory techniques for water and wastewater.

Between fall 2015 and spring 2017, 22 events occurred where at least one water sample was collected at both the inflow and outflow locations. These events were split into spring, summer and fall. Spring was when snowmelt begins and crops, and perennial vegetation start to emerge and cover the ground, typically March to May. Summer is when crops are actively growing from June through August. Fall was defined as when crops stopped growing and were harvested, and when perennial vegetation was no longer actively growing but before freeze-up typically September to October.

Vegetative filter strips were inconsistent

Analysis of water samples indicated no significant difference in the inflow and outflow concentrations of TDP or TP for either the VFS or the annual crop strips. The VFS plots performed better during the summer growing season reducing TP concentrations in 5 of 7 events – 71% of the time. The VFS strips, though, had little effect on TDP or TP during the spring. The VFS plots did not perform well during the fall events with the overall mean TP concentration in runoff increasing after flowing through the filters during this time period.

The VFS was substantially better at removing Total Suspended Solids (TSS) from surface flow compared to crop strips. The crop strips increased mean TSS concentrations by 23%, while the VFS reduced it by 30%. The researchers explained the increase in TSS in the crop strips came from the re-suspension of eroded soil particles in the runoff flowing over bare ground and disturbed soil caused by tillage operations.

This research supports previous findings that VFS are inconsistent at retaining P in cold climates. Further study of the performance of VFS during the non-growing season would help to determine why they might not be as effective during these time periods.

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