



Analysis of Nitrogen and Phosphorous in Soil and Water Influenced by Agricultural Practices

Virginia Tech
Institute for Critical Technology and Applied Science

Alicia L. Lowe - Franklin County High School, Rocky Mount, Virginia

Dr. Kang Xia - Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, Virginia

Introduction

Soil and water are resources vital to life on Earth but are subject to pollution and overuse through agricultural practices. Animal manure is a traditional source of nitrogen and phosphorous, among other nutrients, used by farmers to fertilize their crops.

The old adage "too much of a good thing" applies here; not all nutrients in fertilizer can be used by plants and the excess meet their fate by accumulating in surface waters. Such conditions can be devastating to aquatic life over prolonged periods of time.

Buffer plants, such as grasses, are often grown between cropland and streams in order to prevent excess nutrients from entering the stream and preventing issues within the ecosystem.

Objective

- To analyze water extractable nitrogen and phosphorous in soil and dissolved nitrogen and phosphorus in water sampled near a field subjected to long-term animal manure application in order to determine the impact of the buffer zone.



Figure 2. Corn field, site of soil sampling adjacent to Stroubles Creek (Alicia Lowe, 2017)



Figure 1. Stroubles Creek, site of water sampling (Alicia Lowe, 2017)

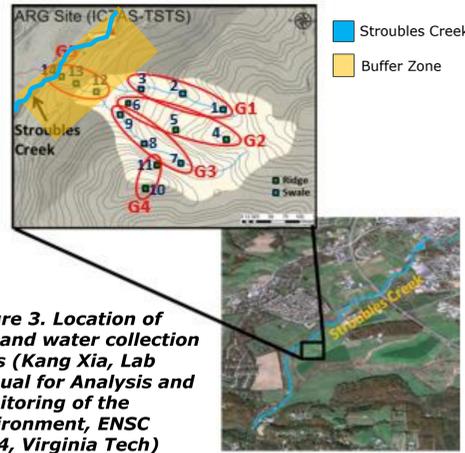


Figure 3. Location of soil and water collection sites (Kang Xia, Lab Manual for Analysis and Monitoring of the Environment, ENSC 4414, Virginia Tech)

Figure 4. Collecting water samples (Karen Hicks, 2017)



General Methods

Soil

- Samples collected, processed, and stored by Virginia Tech students in ENSC 4414 in a buffer zone adjacent to a corn field that has received long-term animal manure application (Fig. 3).
- Combined 25 mL water and 5 g soil, centrifuged for 15 min, and filtered to obtain filtrate (Fig. 5).

Water

- Water samples collected in Stroubles Creek, near soil sampling site (Fig. 1).

UV-Vis Spectroscopy Analysis

- 15 mL soil filtrate and water samples were treated with Nitrate Vacu-vials® kit #K-6923 and 25 mL soil filtrate and water samples were treated Phosphate Vacu-vials® kit #K-8513
- Spectronic 20D+ was used to determine absorbance of each sample (Fig. 5)



Figure 5. Treated samples ready for analysis (Alicia Lowe, 2017)

Results

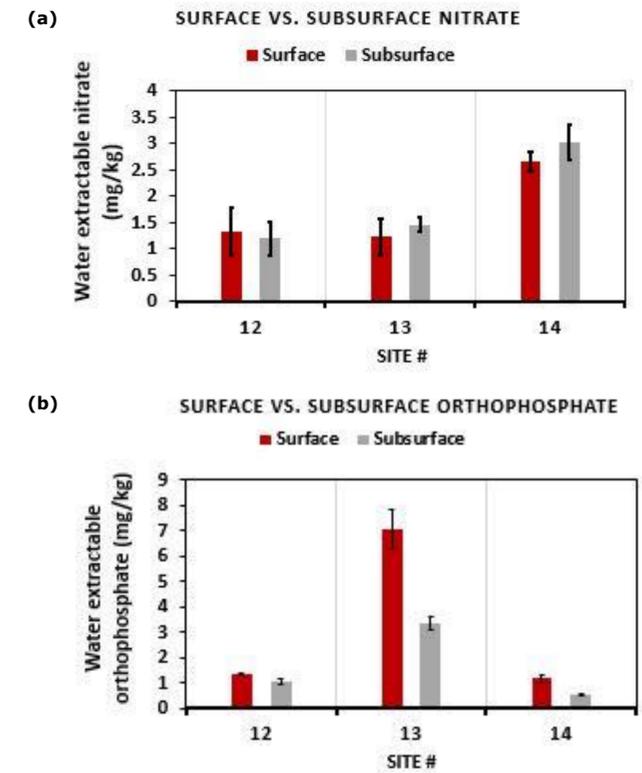


Figure 7. Comparison of water extractable nitrate (7a) and phosphate (7b) in soil from the buffer zone at surface (0-5 cm) and subsurface (5-20 cm) depths.

Discussion

The soil and water results combined indicate that the buffer zone between Stroubles Creek and the adjacent farmland is effective in preventing nutrient runoff from entering the stream.

Soil

- An unpaired t-test analysis indicates that the difference in levels of water extractable nitrate between surface and subsurface soil is not statistically different (Fig. 7a). As nitrate quickly moves down the soil column to be assimilated into plants or washes away as runoff, our results are not surprising.
- Differences in surface and subsurface water extractable orthophosphate contents were found to be statistically significant for all sites (Fig. 7b). The data is understandable, as orthophosphate strongly binds to soil particles at the surface, preventing it from percolating lower into the soil column.

Water

- Nitrate and orthophosphate levels in all three water samples are well below the MCL set by the Safe Drinking Water Act.

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Translation to High School Classroom

- Secondary Objective:** adapt college-level lab work to a high school setting
- Challenge AP Environmental Science students at Franklin County High School (Rocky Mount, VA) to design their own inquiry-based research project
- Authentic, informal assessments: data collection skills, equipment use, etc.
- Formal assessment: written description of how to apply results to other topics, such as plant growth, eutrophication, sustainable agriculture, etc.
- We hope that this experience will give students an insight into what scientific research entails and provide them with career ideas.



Figure 6. Franklin County High School, Rocky Mount, VA (Tony Hudson, 2011)