

Changes in Soil Test Phosphorus from Field to Stream Bank in the Missisquoi Watershed



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Introduction

Vermont farms apply manure and inorganic phosphorus to improve corn yields. Excess phosphorus from farm fields can enter surface water through erosion and contribute to harmful algae blooms. Climate change may lead to increasing storm severity and greater erosion. Riparian buffers along the fields also offer some protection from soil erosion and phosphorus (P) runoff although the majority of Vermont's stream banks are still subject to erosion and may be a major source of P. To have broader knowledge of the processes by which P is able to move from fertilized agricultural fields towards stream banks over time is of great importance in our efforts to understand non-point pollution sources in the surrounding Missisquoi watershed. The hypothesis to be tested is that lateral water movement to streams will increase P loading to the Missisquoi River network and also the P level will decline with depth in the soil.

Purpose



- To test:**
- How does nutrient (in this case P) status change in a transect from corn to stream bank?
 - How does P status changes from depth?



- To answer:**
- Is there evidence that P is moving laterally towards the stream from fertilized fields?
 - Is there evidence that either is moving downward through the soil profile towards the groundwater?



Methods

- To assess the potential P contribution a total **216 soil samples** were taken from corn fields, adjacent riparian zones and stream banks (bank samples were taken only in farms where it was possible).
- **Three points** were sampled within each transect (1 meter away from the stream bank, halfway through buffer and 5 meters into corn field), each point with **four different depths** (0-15 (plow layer), 15-30, 30-60, 60-90cm)



Lab Tests

- All soils were air dried and sieved through a 2.0 mm.

Soil test 'available' P

- Modified Morgans (1.25M NH₄-acetate at pH 4.8)
- 5:1 solution:soil ratio, shaken 15 minutes and filtered
- P in extract determined both colorimetrically (Murphy-Riley procedure) on a flow injection autoanalyzer and by ICP-AES
- Difference between ICP and colorimetric = **organic P**

Results

- 18 transects were sampled in four fields from three active dairy farms.
- 18 transects x 3 points x 4 depths = 216 samples.
- 30 bank samples (not all transects had bank samples)



- Available soil test P higher in 0-15 cm layer and higher in corn.
- Most samples were 'optimum' or below in soil test P. Nothing really high or excessive.
- There was a trend towards higher soil test P with depth in the corn.
- Organic P: The percent of soil test P that was organic (ICP – colorimetric) was lowest in the corn. This probably reflects additions of inorganic P fertilizer.

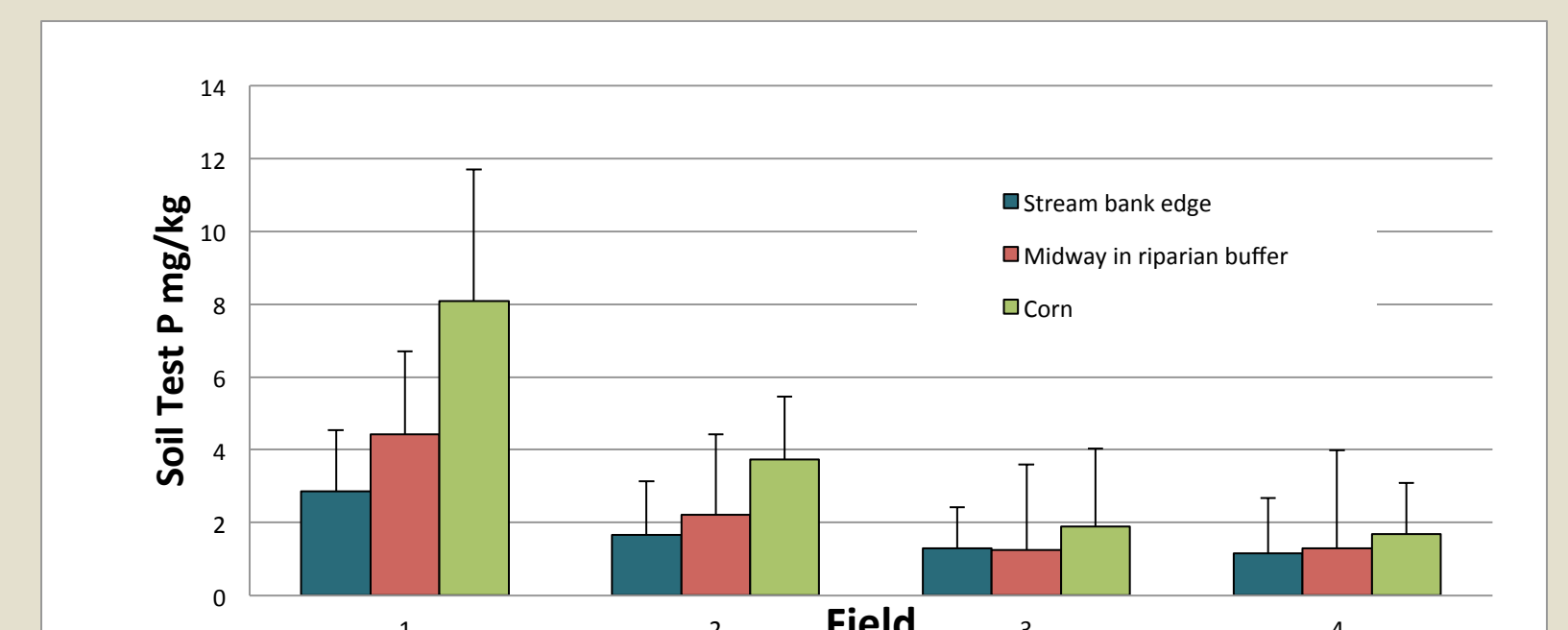


Figure 1. Mean concentrations of P for all depths (0-90 cm) from stream bank edge to corn field.

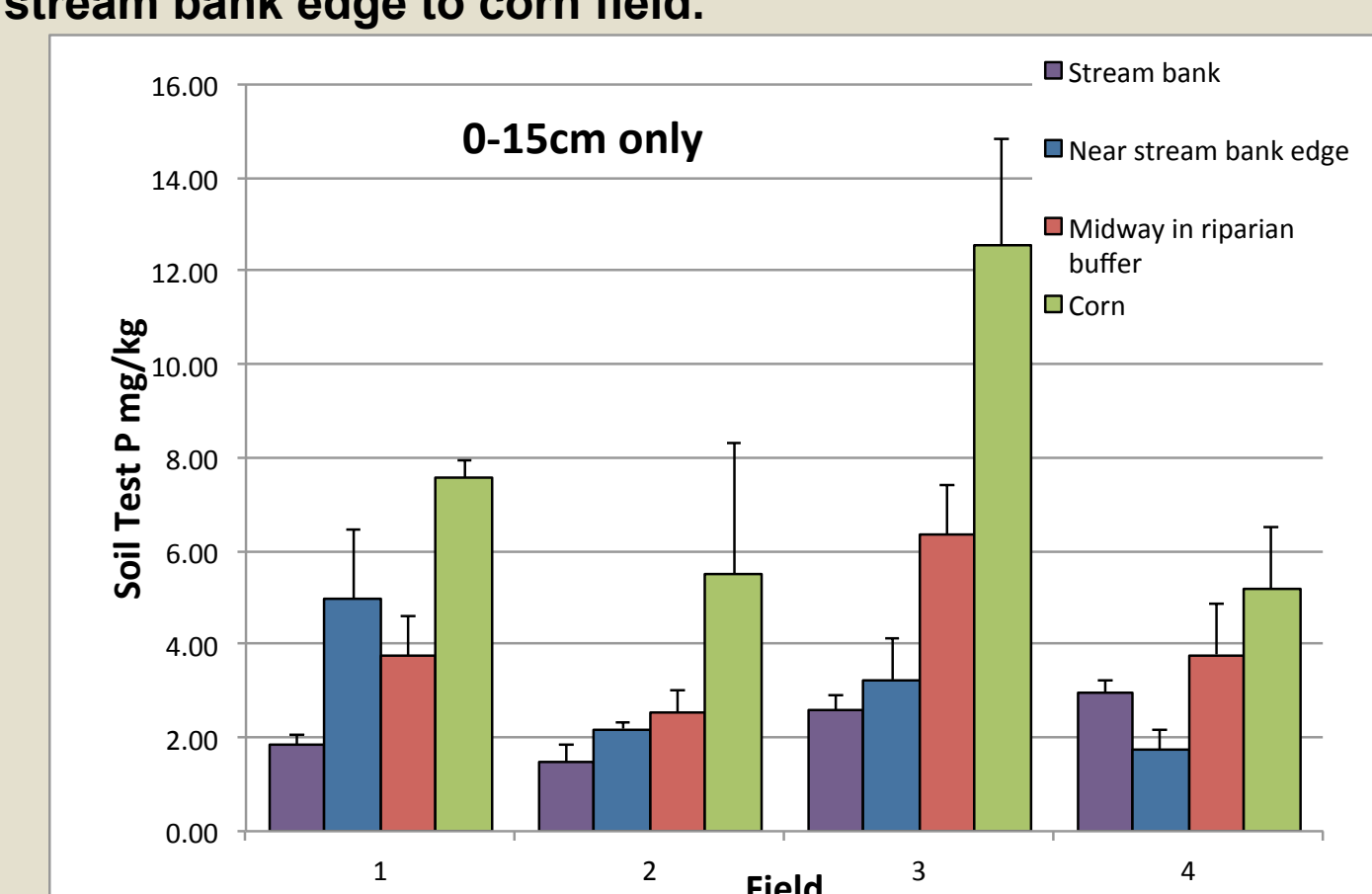


Figure 2. Mean P concentrations for eroding stream bank walls, as well as plow layer of stream bank edge to corn field.

- A full factorial analysis of variance (ANOVA) was performed using field, position-in-field and depth. The three-way interaction was highly insignificant and was dropped from the model.

- Because a stream bank sample was not able to be taken from every transect, these were not included in the statistical analyses.

Conclusion

- There was no clear evidence found to support the hypothesis, level were much higher in the corn field.
- The highest levels of P were found in the upper layer and near the corn (where fertilized).
- The samples were usually at an optimum soil test P level and there was no evidence of excessive fertilization .

Future Work

- The investigation can be expanded into other types of crop fields and other land uses in the Missisquoi Watershed.
- Other watersheds, such as the Winooski, will also be investigated.

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References

- Publication on soil test procedures used in the Northeastern US: <http://extension.udel.edu/lawngarden/lawn-garden/soil-health-composting/recommended-soil-testing-procedures-for-the-northeastern-united-states/>.

- Publication on nutrient recommendations for field crops in Vermont: http://pss.uvm.edu/vtcrops/articles/VT_Nutrient_Rec_Field_Crops_1390.pdf