Creating a Multivariate Query-able Database of Filter Strip Nutrient Removal Effectiveness in Agriculture

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ABSTRACT

- Vegetative filter strips are strips of vegetation planted at the end of an agricultural field. These plants filter out the nitrogen (N) and phosphorus (P) from the field runoff water
- Our goal this summer was to build a query-able database containing information on filter strip efficiencies and their related variables
- This database contains information about filter strip and field dimensions in different locations around the U.S. and will help farmers and researchers come to conclusions about how implement and manage efficient filter strips

PROCESS

- Reading published filter strip papers
  - Reading to gain an understanding of filter strips and how they function
  - Collecting filter strip efficiency data
  - Recording the filter strip and field characteristics
- Recording all the qualitative and quantitative data in excel
  - In this step we also established a list of variables that are related to filter strip efficiencies

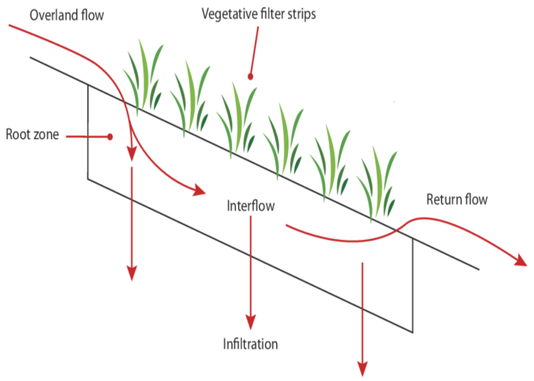

Figure 1: *Filter Strip Diagram*
Grismer, Mark & TOBY, ANTHONY & Lewis, David. (2006). Vegetative Filter Strips for Nonpoint Source Pollution Control in Agriculture. ANR Publ.. 8195.

- Uploading the excel csv file into MySQL
  - MySQL allowed us to upload the database as well as enter commands to pull up different columns of data
  - Two specific columns of data could be pulled up side by side for comparison
  - Allows for quick and easy analysis for database builders
  - Is not user friendly for end-users, only for internal work
- Connecting MySQL and RMarkdown
  - To turn the database into an HTML webpage, we connected MySQL with RMarkdown—this allowed us to pull up the MySQL database in RMarkdown, and use both MySQL and RMarkdown commands, along with r. code to edit and analyze the data
  - With the help of Shiny Widgets, users will be able to use features such as pull down menus to select specific data columns they would like to view, as well as put two or more data columns together in a graph
  - Users will be able to use sliders to adjust variable values and see how the adjustments affect N and P percent removal values

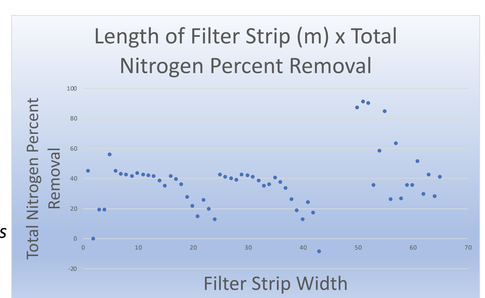

Figure 1: *Example of a Graph Users Could Pull Up in the Finished Webpage*

RESULTS

Examples of the data reflected in the database:

- Dosskey et al. found that wider strips tend to increase efficiency; however, if a strip is too wide it adds unnecessary cost.
- For a given strip width, the load trapped is also related to the pollutant load, type of pollutant, and dimensions of the field such as area and slope. These field dimensions along with weather patterns determine the runoff load that encounters the filter strip [2]
- A larger runoff load for a given filter strip width decreases the trapping efficiency for that strip, as does a higher slope, and increased concentration of the pollutant [1]

The database currently contains 67 rows and 55 columns of data, and 12 locations around the United States. As more filter strip data is found, more data will be added to the database. Some examples of variables listed in the database include filter strip width and length, field width and length, yearly precipitation, fertilizer application, filter strip vegetation type, field agriculture type, grazing management, N and P inflow concentrations, climate, and soil type among many others.

	Dimensions	Strip Characteristics (Qualitative)	Field Characteristics (Qualitative)	Weather patterns	N % Removal	P % Removal	Locations
Number of Columns	8	4	4	4	1	1	1
Total Datapoints (8/7/2020)	114	148	105	100	59	58	12
Units	m, m2	Text	Text	mm/hr, mm/yr	Percent	Percent	NA
Description	Field dimensions, filter strip dimensions. (length, width, area, etc.)	Ex: Vegetation type, soil type, grazing patterns, Filter strip vs buffer strip,	Ex: Agriculture type, fertilizer application, type of fertilizer applied, soil type	Ex: Field precipitation, study season, number of weather events, etc.	Percent of N inflow filter strip was able to remove from runoff	Percent of P inflow filter strip was able to remove from runoff	Location of filter strip and field

Figure 3: *Summary table of data in database---this does not include all the data in the database, just the main categories*

Filter Cols: « ‹ 1 – 50 › »

	Author.Date	Notes	location	BMP_type	vegetation_type
1	Ahiablame-2012		Texas, US	VBS/VFS	grass_swales
2	Ahiablame-2012		Melbourn, Australia	VBS/VFS	grass_swales
3	Ahiablame-2012		Virginia, US	VBS/VFS	grass_swales
4	Ahiablame-2012		Lab Experiment, Sweden	VBS/VFS	grass_swales
5	Ahiablame-2012		Aberdeen and Brisbane, Australia	VBS/VFS	grass_swales
6	Rahman-2013		Richland,ND	VBS/VFS	mixed vegetation
7	Rahman-2013	has settling basin at end	Cass,ND	VBS/VFS	common cattails grass
8	Rahman-2013	has settling basin at end	Cass,ND	VBS/VFS	common cattails grass
9	Rahman-2013	has retaining pond at end	Sargent,ND	VBS/VFS	garrison creeping foxta
0	Rahman-2013	has retaining pond at end	Sargent,ND	VBS/VFS	garrison creeping foxta
1	Ahiablame-2012		Texas, US	VBS/VFS	grass_swales
2	Ahiablame-2012		Melbourn, Australia	VBS/VFS	grass_swales

Showing 1 to 13 of 20 entries, 55 total columns

Figure 4: *Screenshot of Database Columns from RMarkdown*

MOTIVATION

When agricultural fields are irrigated and/or when it rains, excess N and P are released into the environment in the field runoff—this is nonpoint source pollution. Many states are beginning to or have already implemented nonpoint source pollution regulations, and filter strips are one way to comply with these regulations. This database will provide famers with information on filter strips to help them set up their own.

CONCLUSION

- The database contains around 45 variables that will help farmers and researchers draw conclusions about how to efficiently implement and manage filter strips
- The efficiency of the filter strips in the database are based on their abilities to filter out N and P—all the other columns help show the relationship between the variables and N and P percent reductions
- When published, the database will be query-able, and users will be able to query for specific information they are looking for, ie. certain variables, or several variable columns side by side for comparison

FUTURE WORK

- Mikaela will continue developing the database
- More datapoints will be added as they're found
- The database will be published in a webpage format
- Graphics will be set up to visualize the information

ACKNOWLEDGEMENTS

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