WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: SD1981

Title: Hydraulic Calibration of the Upper Soil Layers in a Glacial Till System

Focus Categories: Agriculture, Non Point Pollution

Keywords: Soil Physics, Soil Water Movement, Agriculture

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Federal Funds: $4,998

Non-Federal Matching Funds: $10,192

Congressional District: First

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Abstract

Precision farming holds great potential for decreasing the amount of inputs used in production agriculture by targeting (reducing) input applications to areas of lower potential yield. If the crop is unable to use higher levels of the inputs (especially fertilizers) because of reduced yield, reduced inputs will result in reduced nonpoint source pollution.

One of the greatest factors causing the reduced yield is water stress. Under rain fed conditions, water stress at specific areas within a field, especially areas high in the landscape, can be caused by water redistribution after precipitation. This water redistribution can happen via three different pathways: overland flow (runoff/runon), downward movement then lateral movement near the top of the weathered till layer, and downward movement then lateral movement through the saturated till deeper in the soil profile.

Water movement through glacial till soils is poorly defined and is a major impediment to better water stress modeling and more accurate yield goal specification. The lateral water movement has significant implications in the redistribution of rainfall. Better prediction of water stress and resulting grain yields will result in more efficient use of applied agricultural inputs.

The objective of this project is to measure the vertical soil water movement in the upper layers of the soil profile and measure the short-scale lateral water movement near the top of the weathered till layer. We will use tensiometry to measure matric potentials and define hydraulic gradients to fit Darcian flow models to the vertical flux in the topsoil layers. We will also measure the soil water contents with neutron attenuation and time-domain reflectometry to assist in the Darcian definitions and to fit a Wilcoxian drainage function to the measured downward flux.

Results of this field research will be used to validate and improve existing water flow models. Improvement of those models will assists in the improvement of yield goal specification by better predicting the water stress experienced by the crop at various locations within a field. Improved yield goal specification benefits the general public by reducing the potential of nonpoint source pollution by the agricultural inputs.

Improved yield goal specification also benefits agricultural producers by increasing the use efficiency of the agricultural inputs that they must purchase.