

# Evaluating alternative cover crops for the control of runoff phosphorus losses.

Peter J.A. Kleinman<sup>1</sup>, Paul Salon<sup>2</sup> and Andrew N. Sharpley<sup>1</sup>.

<sup>1</sup> USDA-ARS Pasture Systems and Watershed Management Research Unit, Curtin Road, University Park, PA 16802.

<sup>2</sup> USDA-NRCS, Big Flats Plant Materials Center, Corning, NY 14830.



## Background

This study evaluates the water quality benefits of a cover cropping system targeted at small dairies in the Northeast where traditional cover cropping is not feasible. The system intercropped cover crop species with silage corn at time of corn planting, using post-emergence herbicides (low volume imidazolinone) to reduce competition between the cover crop and the corn, and results in silage corn yields comparable to conventionally cropped corn. In addition to reducing erosion, and therefore particulate P losses, interseeding of a leguminous cover crop can reduce N fertilizer demands in subsequent years and therefore enable P-based manure application.

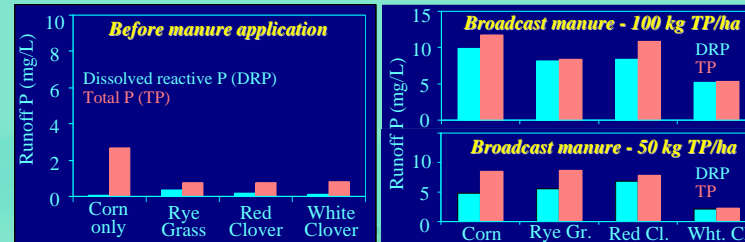
Trials were initiated in spring, 2000 on a Lewbeach silt loam (Typic Fragiudcept), in the Town Brook Watershed, part of the New York City water supply system in New York's Catskill Mountains. Three cover crops (white clover, red clover, perennial rye grass) and one control (corn only) were established in a randomized complete block design.

**Runoff experiment** A rainfall-runoff experiment was conducted in each of the treatments following the National P Research Project protocol. Simulated rain (7.0 cm/hr) was used to generate 30 min runoff from 1x2 m runoff boxes over two consecutive days in May, 2001.

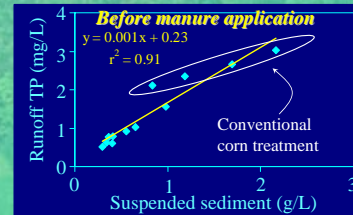


The following week, dairy manure was broadcast onto each runoff box on ~ N-basis (TP = 100 kg/ha) or ~ P-basis (TP = 50 kg/ha), and the rainfall-runoff experiment was repeated.

## Effect on runoff P concentration

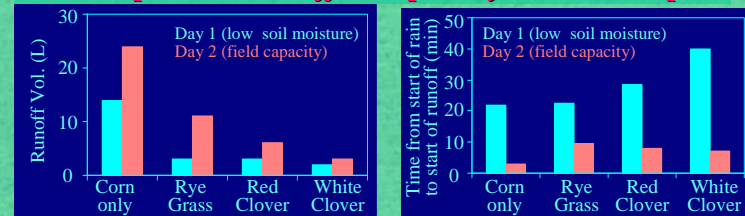


Prior to manure application, DRP concentration in runoff reflects soil P concentration in the various plots (Mehlich-3 P ranged from 64-94 mg/kg) and TP concentration is controlled by erosion (see plot below). As such, cover crop benefits extend to control of TP losses. Following manure application, soluble P in manure serves as the major source of P to runoff, and manure application rate (50 vs 100 kg TP/ha) primarily controls runoff P concentration. Before manure application, DRP was 2-52% of TP; after manure application, DRP ranged from 56-97% of TP.



Relationship of TP to erosion, illustrating the importance of erosion control to TP loss prior to manure application. Reduced erosion under cover crops resulted in lower TP concentrations in runoff. After manure addition, this relationship was no longer apparent due to the overwhelming contribution of manure P to runoff.

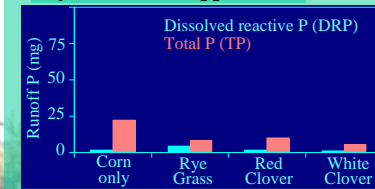
## Cover crops reduce runoff susceptibility- unmanured plots



Conventional corn resulted in greatest runoff volumes and shorter periods of runoff initiation. Drier antecedent moisture at the start of the first day resulted in lower runoff volumes and longer periods between rainfall and runoff initiation.

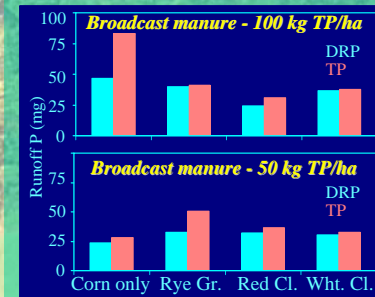
## Effect on runoff P loads

### Before manure application



Runoff P load represents the mass of P lost from the runoff box during the runoff event and is a function of runoff P concentration and volume.

### After manure application



Prior to manure application, given the influence of cover crops on rain infiltration, differences in P load are more striking than differences in P concentration.

## Conclusions

Cover crops planted at the time of corn planting have the potential to reduce P loss from steeply sloped corn fields by (a) reducing erosion, therefore TP losses in runoff, (b) improving infiltration, thereby increasing rainfall required to generate runoff and reducing runoff volume, and (c) in the case of the leguminous cover crops, enabling lower rates of manure application by supplying N to subsequent crops (i.e. supporting P-based manure application rates). Thus, this system can reduce runoff P losses before and after spring manure application.

Trials continue at additional locations in New York and Pennsylvania and rainfall-runoff experiments are being repeated to assess temporal differences (fall vs spring) in runoff P losses.