

National Phosphorus Runoff Project: New Hampshire

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Background

The effects of soil test phosphorus (P), field management and runoff P losses from New Hampshire soils are being studied as part of the National P Research Project (NPRP). The NPRP represents a consortium of federal and state agencies, as well as land grant universities, with collaboration in over 20 states. New Hampshire's contribution to the NPRP has two immediate objectives: (1) identify soil P thresholds for water quality; and, (2) assist in the development of cost-effective, integrated nutrient management guidelines that target remedial activities on areas specifically at risk of P loss.

Research approach

To address the objective of identifying soil P thresholds for water quality, scientists with the University of New Hampshire and U.S.D.A.'s Agricultural Research Service have collected data to describe the relationship between soil test P and P in runoff P for a Marlow soil (coarse-loamy, isotic, frigid Oxyaquic Haplorthod). To do this, portable rainfall simulators were used to generate runoff from 2 m² runoff plots established on soils with a wide range of soil test P concentrations. The project relies on runoff generated by rainfall simulators, rather than by natural rainfall, in order to control potentially confounding variables such as rainfall intensity and uniformity. Extensive research has been conducted to ensure that the simulated rainfall closely matches the intensity, drop size and energy of natural rainfall. Raining on soils in the field, rather than collecting the soils and conducting indoor runoff studies, ensures that results more closely represent actual field conditions.

Because soil is but one source of P in runoff, research has also been initiated to assess the effects of manure management on runoff P losses. This research employed the field rainfall simulators described above, and continues with indoor rainfall simulations. Indoor rainfall simulations are identical to those carried out in the field; but, rather than rain on intact soils, indoor simulations are conducted on runoff trays. Specifically, thoroughly mixed soil is packed into 1 x 0.2 m runoff trays, which are rained upon to generate runoff. A variety of management alternatives have been evaluated. Results of both the field and indoor rainfall simulation experiments are being used to ensure that nutrient management guidelines apply to New Hampshire's unique soil and management conditions.

Research findings

Soil test P

Soil P can play an important role in determining runoff P losses. Figure 1 illustrates the relationship between soil test P (Mehlich-3 P) and dissolved P concentrations in runoff from rainfall/runoff experiments conducted over two days on a

the Marlow soil. Results show that, as soil test P increases, so too does dissolved P in runoff.

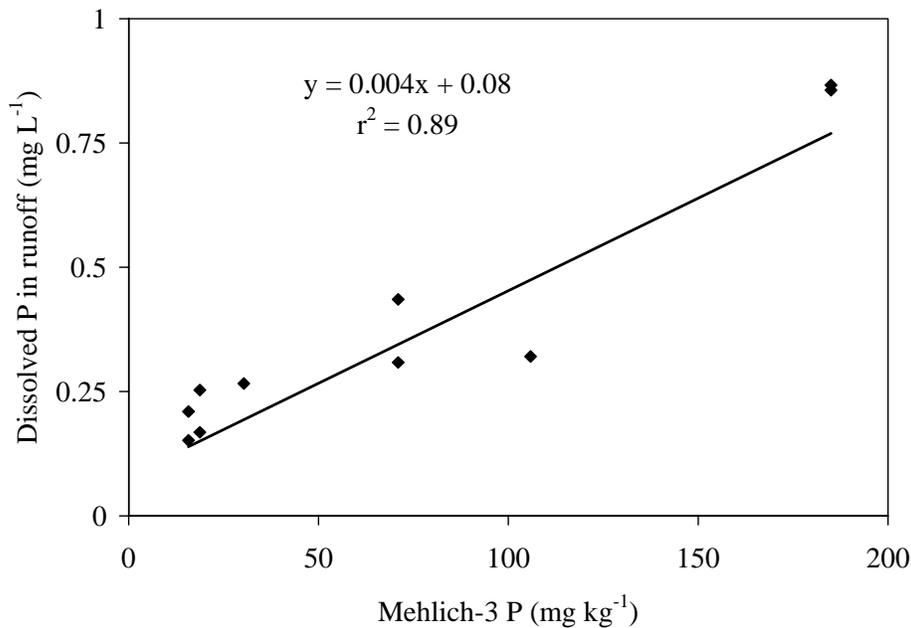


Figure 1. Relationship of soil test P to dissolved P in runoff from a Marlow soil.

Manure management

While soil P serves as a long-term source of P in runoff, as it changes slowly with time, recent additions of manure may greatly exacerbate P loss in runoff in the near-term. To quantify the potential for losses under current nitrogen-based management guidelines, rain simulations were conducted on 1 x 2 m runoff plots before and after dairy manure application at total P addition rates of 75 kg ha⁻¹ (approximately 3000 gallon liquid dairy manure acre⁻¹). Figure 2 summarizes the findings of this study. While soil test P was strongly correlated with dissolved P in runoff prior to manure application, after manure application the correlation became quite poor. This is because soluble P in the manure, rather than soil P, served as the primary source of P in runoff water. Notably, broadcasting dairy manure at a rate corresponding to crop nitrogen demands resulted in dissolved P concentrations in runoff that were nearly an order of magnitude greater than in runoff from unamended soils.

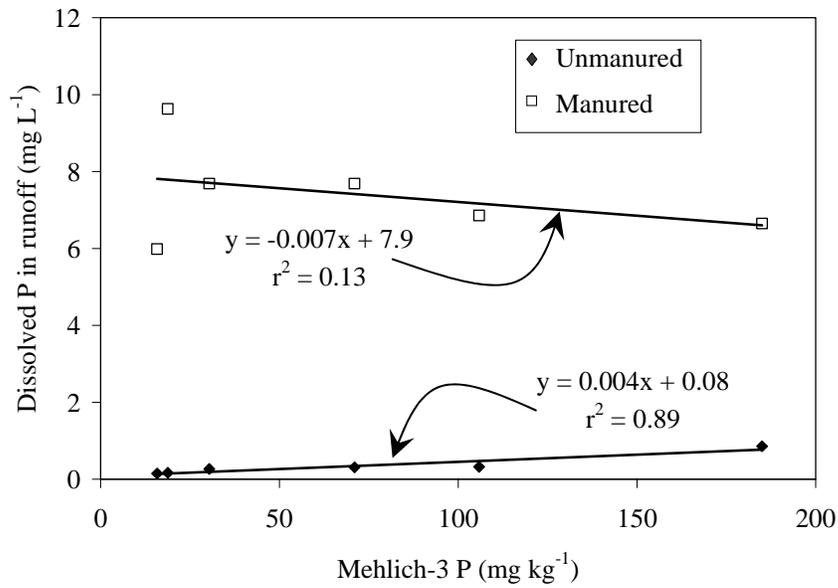


Figure 2. Dissolved P in runoff from a Marlow soil with and without surface application of dairy manure.

Ongoing research

Research under the NPRP continues in New Hampshire, with an emphasis on providing data necessary to develop manure management guidelines for farmers that are both effective in reducing phosphorus losses in runoff as well as affordable. In addition, research is underway to evaluate the potential for leaching losses of P, particularly in sandy or tile-drained soils.