FACTORS AFFECTING PHOSPHATE CONCENTRATIONS IN SURFACE AND SUBSURFACE RUNOFF FROM STEEP EAST COAST HILL COUNTRY

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ABSTRACT

Eutrophication is a problem receiving much attention within New Zealand and throughout the rest of the world. Problems associated with eutrophication cause major financial, aesthetic and recreational costs to not only commercial and recreational water users but to society in general.

The major nutrient of concern in relation to eutrophication is phosphorus (P) as it is often considered to be the limiting factor. The two major areas from which P enters waterways are point sources and non-point sources. Point sources are relatively easy to identify and quantify. Non-point sources however, are less easy to quantify due to the size of areas from which P is sourced and the number of varying factors which can affect the amount of P which is lost to water-ways.

This study investigated P concentrations in surface runoff and subsurface flow from steep east coast hill country. Factors studied included aspect, soil P status, season and fertiliser addition.

The study was carried out on grazed pasture farmlets, in which there were 'High P' and 'Low P' fertiliser regimes. Each regime had north and south facing aspects. Four sites were used in the study. High P North (HPN), High P South (HPS), Low P North (LPN) and Low P South (LPS). Simulated rainfall was applied to the sites and surface runoff samples were collected and analysed for dissolved reactive phosphate concentration (DRP). Superphosphate fertiliser was then applied at 20 kg P ha^{-1} to each site and the runoff procedure was repeated 7 weeks and 14 weeks after fertiliser application. Subsurface runoff water samples were also collected on the southerly sites during each Run. At the time of each runoff measurement soil samples were collected and analysed for Olsen P, water extractable P and soil moisture content. The soil P retention was also measured for each site.

At each Run the HPN site produced the highest DRP concentrations followed by the LPN site with the southerly sites producing the lowest DRP concentrations. The DRP concentrations in runoff for each site increased between Run 1 and 2 (except for the HPS site) corresponding to fertiliser addition, but interestingly all sites increased markedly in runoff DRP concentration between Run 2 and 3. This corresponded to a time of decreasing soil moisture.

Concentrations of DRP in surface runoff were therefore influenced by a number of factors. These included - fertiliser addition, aspect and season. In general, soils that had previously received large inputs of P fertiliser had higher DRP concentrations in surface runoff than soils with lower fertiliser inputs. The magnitude of this fertiliser effect however, varied with aspect. Generally the impact of fertiliser on DRP concentrations was higher on north facing slopes than on south facing slopes. South facing slopes were wetter and had slightly higher P retention (although in a conventional agronomic sense the P retention across the whole trial was low (< 36 %)). This combination of higher P retention and soil moisture would assist in the immobilisation of added fertiliser P. This was also reflected in the lower P soil test values on the south-facing slopes.

A water extractable P test provided a better correlation with runoff DRP concentrations for individual runoff events than the Olsen P test. Both tests however, provided poor correlations when all of the Runs were combined. This was due largely to the large increase in DRP concentrations in surface runoff in Run 3 with no corresponding increase in soil tests.

There was no apparent relationship between fertiliser regime ie. soil P status, and the concentration of DRP in subsurface runoff. In Run 3 however, there was a marked increase in subsurface DRP concentration for both sites which was consistent with the surface runoff results and supported the theory of soil moisture playing a major role in determining the DRP concentration in water.

The study suggests that the greatest risk of P loss from soil to surface waters will be from northerly aspects with high fertiliser histories during the summer months when soil moisture levels are low.

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