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SOURCES AND TRANSPORT OF PHOSPHORUS

AND NITROGEN IN A STREAM DRAINING

A DOMINANTLY PASTURE CATCHMENT

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ABSTRACT

The literature relating to the sources and amounts of P and N forms transported in runoff types (surface, accelerated subsurface, and subsurface runoff) and in stream flow from catchments of varying land use was reviewed. There is a paucity of information available on this topic for New Zealand situations.

Concentration-flow relationships of P and N forms varied between different runoff types in the dominantly pasture catchment under study. Flow was the more important variable, however, in determining the P and N loadings in each runoff type. Because of more rapid fluctuations in P and N concentrations, ^{and in} surface and accelerated subsurface runoff, and storm flow in the stream, smaller sampling intervals were required than for subsurface runoff in order to obtain reliable estimates of P and N loadings.

An appreciably greater proportion of fertilizer P was transported in surface runoff from 13 and 6° undrained slopes (6.7 and 5.6% as TP, respectively) than from a 6° drained slope (1.0%) in four months following application (50kgP ha⁻¹). This could be attributed to a four-fold reduction in the volume of surface runoff from drained slopes. Although 0.77 and 4.18kg ha⁻¹ of total P (TP) and total N (TN), respectively, were transported in surface runoff in four weeks as a result of grazing with dairy cattle, the effect of grazing was less sustained than that due to fertilizer P application.

Following the application of urea to the drained area of a 20-ha subcatchment, 2.3% of the applied N was lost as TN (87% as NO₃) in tile drainage in a four-week period. Although the volume of tile drainage was dramatically reduced following grazing, the concentrations of P and N forms increased. The effect of grazing on N concentrations in tile drainage was not as sustained as that of urea application.

Highly significant correlations were obtained between extractable soil P in surface soil (0-10cm) and the dissolved inorganic P (DIP) concentrations in surface runoff, and between extractable soil

P and nitrate (NO_3) in the subsoil (40-50cm) and the DIP and NO_3 loadings, respectively, of tile drainage.

A much greater amount of N (13.15 and 16.32 kg $\text{ha}^{-1} \text{y}^{-1}$ as NO_3 and TN, respectively) than of P (0.43 and 1.31 kg $\text{ha}^{-1} \text{y}^{-1}$ as total dissolved P (TDP) and TP, respectively) was transported in stream flow in 1975. Although surface runoff contributed the major proportion of P transported (13% for TP) by the runoff types, stream-bank erosion contributed 64 and 67%, respectively, of the TP and sediment transported in stream flow during 1975. The major proportion of stream flow (67%) and N transported (59% as TN), however, was contributed by subsurface runoff.

Earthworm casts contained appreciably more inorganic P (IP) than underlying soil, of which 90% of the additional IP was held by a more-physical sorption type and thus, readily released to solution. The data point to the importance of surface casts as a potential source of particulate material and P in surface runoff, and in the cycling of P in a soil under pasture. A differing ability of potential source and suspended-particulate materials to sorb and release IP from solution was observed and this was related, with some success, to field data.

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