

Seasonal and spatial variation of nutrient fluxes as the factors controlling soil pH on a tropical dry forest slope

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Tropical dry forests exhibit clear rainfall and litterfall periodicity. Large spatial heterogeneity of elemental input to the forest floor via litterfall is also reported in tropical forest. We hypothesized that the timing and spatial variability of leaf litterfall and nutrient leaching from forest floor litter can establish temporal-spatial patterns in the levels of pH at the surface of the mineral soil. Our objectives were: 1) to determine the seasonal changes and intra-stand spatial variability of inorganic N and base cations leached from the litter and surface soil (0-5-cm depth), and 2) to examine the effect of the leaching fluxes and ion balance on the variability of soil pH.

The study was conducted at the Sakaerat Environmental Research Station (SERS) located in northeastern Thailand. The study was conducted in a small first-order catchment of dry evergreen forest (35 ha). Nutrients fluxes via throughfall and stemflow (TF+SF) in the catchment were determined using ion chromatography. We also established a rectangular study plot (40 by 180 m) on a 5% slope, stretching from a plateau to a nearby stream. To evaluate intra-stand spatial variability in litterfall, litter layer and elemental fluxes in the soil surface, 15 subplots were set within the plot. To assess the leaching of inorganic N through litter and soil layers, we used a PVC 'resin ring' filled with cation and anion exchange resins. The resin rings were set out for 90 consecutive days. The year was divided into four periods: early wet season, middle wet season, late wet season, and dry season. Resin rings were placed beneath the litter layer and at 5-cm soil depth in each of the 15 subplots. NO_3^- , NH_4^+ , Ca^{2+} , Mg^{2+} , Na^+ and K^+ in recovered resins were determined. In addition, soil pH was determined using a glass electrode (1:2.5, soil:water ratio) for each study season and subplots.

All ions leached from litter and soil layer significantly increased from dry to early wet season. In particular, NO_3^- and K^+ leaching from litter and 5-cm soil depth rapidly increased in early wet season and decreased in middle and late wet season, whereas Ca^{2+} and Mg^{2+} were relatively constant during wet season. Nutrients leaching through litter and surface soil layers exhibited distinct intra-stand spatial variability among the 15 subplots. Soil pH was high in time and place with high base-cation / NO_3^- ratio. In tropical dry evergreen forests, a variability of nutrients leaching fluxes and ion balance in litter and surface soil layers may be crucial to the seasonal changes and spatial variation in pH at surface soil.

Keywords: tropical dry forest, forest soil, pH, nutrient dynamics