Biomass harvesting decreases phosphorus runoff from frozen and thawed grass fields

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Dense grass decreases erosion and particle bound nutrients in surface runoff from grassed fields. Surface application of phosphorus (P) fertilizers on grass, however, increases P losses to watercourses. High amounts of dissolved reactive P (DRP) may also be leached from perennial grass (e.g. cultivated grass, green fallows, buffer zone areas between fields and watercourses, and managed uncultivated fields) during spring runoff when P is liberated from frost-injured vegetation.

To estimate P loss potential through pathways describe above the losses of total P (TP) and DRP (<0.2 µm) from unfertilized grass were studied after freezing and thawing, typical phenomena in Finland. Samples of surface soil (0–2 cm), surface and subsurface runoff (0–30 cm), and above-ground biomass as well as undisturbed soil samples (0–7 cm) were taken from the Lintupaju buffer zones located at Jokioinen, SW Finland. Concentration of plant available P (PAc) was analysed from the soil samples using the Finnish method of ammonium acetate extractable P at pH 4.65. Surface runoff water was collected from the experimental field, and from previously frozen and thawed soil blocks which were placed under indoor rainfall simulation. Grass samples were also frozen and thawed and then leached with deionised water.

The concentration of plant available P increased in surface soil of perennial grass fields if the above-ground biomass was not annually harvested. The highest concentration of PAc was observed from unharvested natural grass (16 mg l-1) corresponding to good P status for cultivated soil. The equivalent value for soil where grass was harvested was 8 mg l-1 (fair or satisfactory P status). In the Lintupaju experimental field, up to 0.9 kg ha-1 DRP was observed in surface runoff from field plots with unharvested buffer zones in spring 2003. The equivalent values from the plots with harvested buffer zones were 0.4–0.7 kg ha-1.

The P concentrations in plant tissues varied along with growing season and plant species. The highest P concentrations (3.1–5.0 mg g-1) were measured in the beginning of growing season. Both the above-ground biomass and P amounts in the biomass were the greatest during blooming and in the beginning of ripening. The highest P concentrations were measured from dandelion and yarrow species and the smallest ones from timothy, meadow fescue, common bent, and white clover.

When leached with deionised water, the DRP concentration in surface runoff water from grass covered soil blocks increased after the first freeze-thaw cycle. The highest observed DRP concentration was up to 3.7 mg l-1.

In plant leachates, high DRP quantities representing 1.6–3.1 kg ha-1 were observed after four freeze-thaw cycles. The highest amounts were from unharvested grass areas and from grass grown above dung and urine patches.

The results indicate that the spring time load for DRP from perennial grass to water can be markedly decreased by annual harvesting of the grass biomass and by choosing suitable plant species to grassed fields. More research is needed to specify the optimum harvest time.