Surface Runoff Simulator (SIMU) hastens the research on phosphorus losses from grassland

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In Finland most important grass production areas are located on areas that have severe winter conditions, soil frost and snow cover that affect the runoff patterns. Surface waters of these areas suffer from dissolved phosphorus (P) pollution originated from intensive dairy farming. To study the effects of different treatments and changing winter conditions on surface runoff, we developed a device called Surface runoff Simulator (SIMU). The aim of this study was to determine the accuracy of the device and to evaluate its practical value in surface runoff research.

The experimental treatments are randomized on small grass plots during growing season. At the end of the growing season, the top soil (0-5 cm) from each plot is lifted by a turf grass cutter and frozen. Then the grass mats are placed individually on the sloping SIMU devices and covered with snow. Infrared heaters are used to melt the snow and the melt water is collected. Many factors are completely adjustable: the treatments on the field, the slope of the grass mat, the duration of melting period and the amount of snow that produces the surface runoff. The treatments in this experiment were control, 20 t of slurry ha^{-1}, 40 t slurry ha^{-1}, 20 t slurry + 3 t fine lime ha^{-1} and 40 t slurry + 3 t fine lime ha^{-1} and there were four replicates of each. Soil samples were taken before the runoff experiment and analysed for water extractable P (1:60). The amount of melted snow was equal to 71 mm of water.

The results of the experiment (Table 1) were realistic when compared to results from the experiments on field scales (Turtola and Kemppainen 1998). The procedure found differences in total P and dissolved Ca concentrations and tendency in dissolved P concentration although water extractable P in soil was the same for all treatments. It seemed that 20 t slurry ha^{-1} had no effect on concentration of total or dissolved P but 40 t slurry ha^{-1} increased clearly the concentration of total P. Even though the measuring of the runoff for dissolved P seems to be quite scale independent, the processes operating on small scale are still different than on field scale (Cornish *et al.* 2002). Thus, the SIMU is more reliable for measuring the differences between the treatments. SIMU is a useful tool when estimating the effects of climate change on P losses from grassland as it is economical, easy to use, fast and adjustable.

Table 1. The soil and the runoff water concentrations in SIMU experiment.

	Soil of the grass mats	Runoff water from the grass mats					
	Water extractable P mg l^{-1} (1:60)	Total P mg l^{-1}	*SE*	Dissolved P mg l^{-1}	*SE*	Dissolved Ca mg l^{-1}	*SE*
Untreated	11.0	0.38	0.045	0.26	0.049	11.3	1.41
Slurry 20 t	10.6	0.36	0.021	0.27	0.021	14.2	1.96
Slurry 40 t	11.7	0.45	0.034	0.32	0.038	10.3	1.41
Slurry 20 t+Ca 3 t	11.7	0.35	0.034	0.26	0.031	15.6	1.61
Slurry 40 t+Ca 3 t	11.1	0.48	0.024	0.37	0.005	15.0	2.19
tr *P* values	0.52	0.005		0.078		0.005	

References

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