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Nitrous oxide emissions after sewage sludge and inorganic N-fertilization of a willow bio-energy plantation

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The use of sewage sludge as fertilizer after harvest or inorganic N-fertilization of bio-energy plantations can give rise to high emissions of the greenhouse gas nitrous oxide (N2O). Plantations of e.g. willow (Salix) are today grown and used for bioenergy purposes. They could serve as carbon and nitrogen sinks, lowering greenhouse gas emissions and helping to mitigate a change in climate. However, since N2O is such a powerful greenhouse gas it can have a large impact on the total emission of greenhouse gases from a bio-energy plantation. The magnitude of N2O emissions after fertilization is therefore important to investigate.

This study concerns N2O emissions from a conventionally grown bio-energy plantation of Salix. The aim of the study was to investigate the use of sewage sludge after harvest as well as inorganic N-fertilization in a growing plantation, and its effect on emissions of N2O from the soil ecosystem. The field site is a Salix plantation in south-western Sweden, a representative site in management practices and abiotic conditions. The site was divided into two areas, a larger field and smaller plots.

The field was applied with sewage sludge after harvest 2013. Emissions of N2O were measured using the micrometeorological Eddy covariance technique, with a Quantum Cascade laser (Aerodyne). The fluxes of CO_2 and H_2O were measured using a LI-7200(Li-cor) instrument. The flux was calculated using the EddyPro software. On the plots, N2O emissions from inorganic N-fertilization (2013) were monitored using automatic chambers (height 1.05 m, volume 0.2625 m3) and a trace gas analyzer (TGA100, Campbell Scientific, USA) during approximately one (1) year.

The N2O emissions from the plots (inorganic fertilizer) and field (sewage sludge) were compared with non-fertilized plots (controls) using the automatic chambers for both comparisons.

The N2O emissions from the control plot for the inorganic fertilizer had an emission over the growing season that was 0.33 kg N2O per hectare (SD 0.21 kg N2O per hectare), while the fertilized plots had a non-significant higher emission of 0.52 kg N2O per hectare (SD 0.31 kg N2O per hectare).

The sewage sludge treated field had a fertilized induced emission of about 3 kg N2O per hectare (preliminary data), which was in the same range as the measured emission during 2012 for sewage sludge fertilization. The flux during 2012 was estimated using automatic chambers. The N2O emissions from the control plot for the sewage sludge field had an emission over the growing season that was less than 0.1 kg N2O per hectare (SD 0.02 kg N2O per hectare).

The emissions from organic and inorganic fertilizers, methodological issues as well as inter-annual variability will be discussed.