Varför den starka växthusgasen LUSTGAS bildas vid odling i jord- och skogsbruk

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1 Summary

Natural activities such as agriculture and forestry influence the concentration of greenhouse gases in the atmosphere. This is a survey of why nitrous oxide (N_2O) is produced in soil and how much is leaving the soil in different plantations. Mostly small amounts but sometimes high emissions of nitrous oxide occur, which is produced by soil fungi and bacteria converting nitrogen compounds. Denitrification is the process most often producing the greatest amounts of nitrous oxide but nitrification having a need for oxygen can be decisive since this process produces the nitrate needed in denitrification. Nitrous oxide is formed at occasions with oxygen shortage which can arise inside soil clods with high biological activity consuming the oxygen, or if the oxygen diffusion into the soil is slow since it is soaking wet or the soil pores have been compacted by for example tractor driving. Some techniques for measuring nitrous oxide leaving the soil to the air are described. To escape the tough work of measuring simple estimation methods are desired, and there are a few developed, but no one is reliable.

The atmospheric nitrous oxide increase can be connected to the increased fixation of the air dinitrogen gas (N_2) into reactive nitrogen which is possible to use for living cells. Most nitrogen is fixed biologically in leguminous plants or in the manufacturing of fertilisers. Reactive nitrogen is decisive for plant photosynthesis function, but in most natural ecosystems available nitrogen is scarce so photosynthesis and plant production often increase when nitrogen is added. An increased production of bioenergy crops will increase the demand of more reactive nitrogen in addition to the nitrogen used in existing food production. Most of the soil nitrogen is tied to dead and living organic material and will not be available until the organic material is decomposed and the nitrogen is liberated. The plant community and competition between organisms of the available nitrogen can determine the nitrous oxide emission. This is one explanation why forest soils often present lower emissions than agricultural land. Another explanation of the lower emission from forests is that in Sweden and the rest of the world the most fertile soils are cultivated, while remaining forests in stony and less fertile areas suffer from nitrogen deficits. As long as the forest is growing, absorbing the nitrogen, the risk for nitrous oxide emission is low, but after clear cutting the risk increases. But there are forests where the nitrous oxide emission is high most of the time, such as fertile soils like drained fens with, typically, birch, raspberry and nettles.

Biomass for energy use is sometimes specified as carbon dioxide neutral, since equal amounts of carbon dioxide is taken up by the photosynthesis as is released in the combustion or decomposition. But harvesting and manufacturing needs energy, often fossil, which adds carbon dioxide. Moreover, the cropping results in emission of nitrous oxide, which is a strong greenhouse gas with a long lifetime in the atmosphere. In the debate it has been claimed that, for climate reasons, the emission of nitrous oxide makes the exchange of oil for bioenergy meaningless. It can be concluded that biofuels almost always have a “cost” of nitrous oxide and there is no climate neutral biofuel, but there are better and worse. In agriculture and forestry alike, the nitrous oxide production is influenced by management both in the short and the long run. As an example, addition of large amounts of nitrogen-fertilisers or manure increases the N_2O-emission when the available nitrogen exceeds the crop uptake capacity. But there are cropping systems as well where a low nitrous oxide emission has been measured in spite of an expected high emission.

To get a minimum of nitrous oxide there is need for a tight connection between nitrogen liberation and plant uptake where minimal amounts are left to nitrification and denitrification. A naked soil, fallow, causes more nitrous oxide than having a crop on the land, and the more fertile the soil the higher the risk for the production of nitrous oxide. It is a challenge for both science and agricultural industry to develop agricultural methods that effectively catch the nitrogen in soil organic matter while enabling plants to yield a good harvest and yet minimize nitrous oxide production. Relating nitrous oxide to production of biomass this implies that forest products too, carry a ”cost” of nitrous oxide in spite of a low soil emission since the growth is smaller than in agriculture. Every change in agriculture and forestry production performed can have effects on the size of nitrous oxide emission, at the spot or in the surroundings or even in other countries. System analyses are needed to study the effects obtained. The EU-commission has stated sustainability criterions that must be met if the biofuel is to be included in the class of renewable energy. Soil nitrous oxide emission has a substantial impact since the emission can amount to half the allowed greenhouse gas emissions, which have to be added to emissions caused by energy use in the production.