Towards critical levels for ammonia – a fumigation study using endangered nitrogen sensitive plant species

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Abstract

Ammonia (NH_3) is emitted from agriculture and traffic and may have phytotoxic effects only at high concentrations. Nevertheless, chronic responses may occur in higher and lower plant species at slightly elevated levels near stables and major roads, but provisional critical levels rely only on a few experiments. In order to gain more knowledge, we will expose a number of rare and protected Central European plant species to low concentrations of the gas in greenhouse compartments and will follow their responses over two seasons. Species stem from oligotrophic ecosystems, which host a high biodiversity and where critical loads for nutrient N are often exceeded.

Keywords: ammonia, critical levels, biodiversity, chronic responses

1. Background and objectives

Ammonia (NH_3) is mainly released from agriculture and traffic and may have phytotoxic effects only at high concentrations. At levels below 50 µg m^{-3} acute effects are unlikely, but chronic responses may occur in nitrogen sensitive species. While classical air pollutants are included in Air Quality guidelines and have been studied extensively, phytotoxic and chronic effects of ammonia have not often been tested in the past. Based on experiments in Scotland, long-term critical levels of 3 µg m^{-3} were suggested to protect N-sensitive higher plant species and of 1 µg m^{-3} for lichens and mosses (Cape et al., 2009). In the past ten years only few studies have dealt with ammonia and communities other than bog ecosystems have not often been addressed.

In the present experiment, we will expose rare Central European plant species to low concentrations of the gas and will follow their responses over two seasons. Species stem from oligotrophic calcareous and acidic grasslands, which host a high biodiversity and where N-critical loads are often exceeded.

2. Materials and methods

In order to avoid peak concentrations and as a precautionary measure, we will base the exposure on the gentle evaporation of NH_4OH-solutions. We aim at five concentrations in the range from 0-10 µg m^{-3}, but are aware that the local ammonia background will be above zero. Radiello® passive samplers will be used to measure the concentrations. We will use pre-cultivated, potted one-year old plants of six species from N-sensitive protected European habitat types. In order to simulate realistic edaphic conditions, soil substrates from the relevant habitats and rain instead of tap water will be used. We also aim to cultivate lichens using collections of host twigs from montane forests.

3. Expected outcome

We will address physiological responses, the phenology of the plants and in the end of the experiment, will perform a

destructive harvest to determine shoot and root mass. NPK analyses will investigate how much nitrogen had been accumulated. We expect that some plant species will show positive responses to slightly elevated ammonia when grown as single plants, but are aware that over multiple seasons this may be different in competition with faster growing species.

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References

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