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A systematic study of pre-incubation on the release of nitric oxide from arid soils

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There is microbial activity in nearly in all terrestrial soils, since primeval times. During the last decades, an increasing number of laboratory studies on biogenic nitric oxide (NO) emission from dryland became available. However, the fast adaptation of microbes to changing environmental conditions, which is known as the "lab rat effect", may cause a series of problems for these studies. Particularly, the question of initial conditions and standardized preparation (e.g. pre-incubation) is not well investigated. These parameters are very important to make different studies comparable, especially for a comparison between usually dry arid soils and organic rich, usually wet mid-latitude soils. The length of the pre-incubation period, the (controlled) soil temperature and soil water content seem to be the most variable parameters. Pre-incubation of (air-dried) soil samples from semi-arid, arid, and hyper-arid regions has been considered as an effective measure to avoid the so-called "pulsing effect", a strong and sudden enhancement of NO release from re-wetted of completely dry soil. However, in a lot of previous studies, the increase of NO release after rewetting is considered generally as "pulsing". However, this could be misleading, because NO release depends strongly on the initial soil water content before re-wetting. For that reason, we define "pulsing" more specifically: it is the increase of the NO release rate over the entire range of soil water content during an experiment with a given (non-zero) pre-incubation length compared to the NO release rate over the entire range of soil water content during an experiment of no pre-incubation.

We present results of a systematic study on different soil samples from the Gobi desert (Mongolia) and from the Taklimakan desert (NW-China). These samples have been exposed to different time periods of pre-incubation (0, 3, 12, 48 and 192 hours) under constant soil temperature (25°C) and soil water content (field capacity, pF1.8). Afterwards, the soil samples have been fumigated within an automated dynamic soil chamber system and the net release of NO has been determined as a function of soil temperature and soil water content (WFPS). While the NO release shows an exponential relationship on soil temperature (Q_{10} about 2), the dependence on WFPS follows an optimum curve with a single maximum at WFPS $<.20\%$.

Concerning the length of pre-incubation periods our results are somewhat ambiguous: while for limited sections of the WFPS range there could be substantial changes of the NO release rates, the overall change of the NO release rate over the entire range of WFPS was found to be hardly distinctive, if not in consisting. As a consequence, we recommend not to apply any pre-incubation for the quantification of the NO release from soil samples of semi-arid, arid, and particularly hyper-arid regions.