Application of NH_3 passive sampler for soil air

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The emissions of ammonia (NH_3) to atmosphere have accelerated rapidly due to increase fossil fuel combustion and intensive agricultural activities, and it affect the atmosphere, the soil and the vegetation (Erisman et al., 2011; Li et al., 2016). It is thus necessary to investigate not only the amounts of NH3 gas released from the soil surface but also the dynamics of NH3 gas in the soil. Active sampling is widely accepted method (Hamada & Tanaka, 2001; Wu et al., 2010) for soil-air observation. However, gas aspiration for active sampling disturbs gas in the soil, and it is unescapable to collect a wide range of soil gas when the active method using. We suggest to use a diffusion passive sampler for measuring soil gas without disturbing gas. In this experiment, passive sampler was applied to measure NH_3 gas in the soil and compared it to active sampling.

For a laboratory experiment, 5 kg Akadama soil was mixed with 300 mM ammonia solution in 12 L container and passive samplers (Warashina & Tanaka et al., 2001) were installed in the sample soil at 5 cm and 10 cm depth. A flter pack method as an active sampling was used to measure NH_3 gas in the sample soil at 10 cm depth (flow rate 0.1 L / min) in order to compare with passive sampler. For a field experiment, NH_3 gas in the soil at the farm in Osaka was measured by passive samplers from August 2nd 2017 to August 9th 2017. Twenty patassive samplers were installed at 10 cm depth in the soils where urea was add (50 g/m^3) and control soil sample.

In the laboratory experiment, a t-test was applied to the measurements at 5 and 10 cm depth, and there was no significant difference at the 95% confidence level. In addition, the difference in NH_3 concentration for each passive sampler at the same depth was small (relative standard deviation = 0.10 to 0.14). Thus, we concluded that the accuracy of the passive sampler in the soil is suitable high. The NH_3 measured by filter pack (366 ppb) was significantly lower than it measured by passive sampler in the soil (1411 ± 327 ppb). This is because the wide range collection of active sampling as we mentioned above. Passive sampling seems to compensate for most of the disadvantages of active sampling in soil air. In the field experiments, the average concentrations of NH_3 gas were 43 ± 29 ppb in urea-added soil and 1 ± 1 ppb in control soil. The relative standard deviation of NH_3 concentration in urea-added soil was large because the soil changes its characteristic under the influence of ambient environment such as wind, rain and temperature. Therefore, the generation of NH_3 gas was scattered. The present results suggested that the site-to-site differences in NH_3 emissions were reflected by passive sampling measurements.

Keywords: Passive sampler, Ammonia gas, Soil air

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