The promotion effect of salt-alkali on ammonia volatilization in coastal soil

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Abstract

Globally, soil salinization is intensifying, with alkalization coexisting. In particular, coastal ecosystems are more susceptible to salt problems due to their formation process and geographical locations. The nitrogen (N)-cycling processes of coastal ecosystems are bound to salt-alkali changes. Ammonia (NH_3) volatilization from agricultural ecosystems is one of the most important pathways of N loss and has also been considered the main contributor to air pollution in coastal ecosystems. As the most accessible land resource on earth, clarifying and quantifying the effect of saline-alkali on N content and on NH_3 volatilization in coastal ecosystems are pivotal to promote coastal agriculture productivity. The challenge in demonstrating the effect is how to identify the direct effects of salt-alkali and how these two factors indirectly impact NH_3 volatilization through interactions. By combining incubation experiments with the structural equation modeling method (SEM 'element' model), we revealed the net effects of salt-alkali on NH_3 volatilization and the roles of environmental factors in mutual interaction networks. Compared to the CK treatment, NH_3 volatilization increased by 9.31-34.98%, 3.07-26.92% and 2.99-43.61% with salt gradient increases from 10.10alkalinity from 0.5significantly increased by 8.36-56.46%, 5.49-30.10% and 30.72-73.18%, respectively. According to the element model, salt and alkali both promoted NH_3 volatilization directly and had an indirect negative effect by altering the N contents and N transformations of microbes. The N contents in the incubation system showed a direct positive effect on NH_3 volatilization, with an obvious decrease under elevated salinity and alkalinity. Additionally, the gene abundance of N-transformed microbes strengthened NH_3 volatilization indirectly. The indirect prohibitory effect on NH_3 volatilization resulting from salt and alkali was compensated by the direct stimulating effects on the pH and NH_4^+ contents, and the overall positive contribution of salt was less than that of alkali. Our results indicated that the potential of NH_3 emissions from coastal saline areas could be enhanced by concomitant soil alkalization.

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