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The impact of synthetic and biological nitrification inhibitors on the ammonia-oxidizing archaeon *Nitrososphaera viennensis*

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Nitrification is a crucial process in the global nitrogen cycle. However, its accelerated activity in high-production agricultural systems results in substantial nitrogen losses, leading to agronomic inefficiency in ammonium-based fertilization strategies and environmental pollution. Decelerating nitrification is vital for improving nitrogen use efficiency in agroecosystems. This is typically achieved through the application of nitrification inhibitors which target ammonia-oxidizing microorganisms, the primary drivers of nitrification. Among these microbes, ammonia-oxidizing archaea such as *Nitrososphaera viennensis* are prevalent in soil environments. Yet, little is known about their responses to various nitrification inhibitors. We investigated *in vitro* the effects of two synthetic (DMPP and ethoxyquin) and six biological nitrification inhibitors (sakuranetin, MHPP, 1,9-decanediol, zeanone and its analogue 2-methoxy-1,4-naphthoquinone, and MBOA) on *N*. viennensis, comparing its responses to that of other diverse and globally distributed lineages of soil ammonia-oxidizing bacteria and archaea. Our findings, including estimated inhibition thresholds (effective concentrations 50), underscored the distinct inhibition patterns and processes of ammonia oxidation between *N. viennensis* and commonly found in soil ammonia-oxidizing bacteria such as *Nitrosospira multiformis* and *Nitrosomonas communis*, while revealed a high correlation with *Ca.* N. franklandianus, another neutrophilic ammonia-oxidizing archaeon representative of the ζ clade. To further explore the physiological impact of nitrification inhibition, we conducted a time-series experiment using the established nitrification inhibitor DMPP, employing dual extraction techniques for RNA and proteins. The resulting data will provide valuable insights into the physiological responses of *N. viennensis* to nitrification inhibition contributing to a better understanding of nitrogen flux control in the environment.

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