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Use of the Taguchi methodology to rank the importance of factors affecting emissions of N_2O from incubated agricultural soils

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The Taguchi approach was applied to evaluate the combined influence of 6 potential controlling factors (soil compaction, WFPS, soil temperature, use of cellulose and glucose as C source and use of nitrate as N source) on N_2O emissions from incubated agricultural soils. The selected 6 parameters, with a well-known critical effect on these emissions from soils, were considered at two or three levels (low and high temperature, WFPS and compaction levels; low, medium and high cellulose, glucose and nitrate levels). The experimental design was based on an orthogonal array of L16 (16 combinations). Sieved grassland soil (silty clay loam)was incubated under the assigned parameter combinations in Kilner jars at 15 and 25°C. Nitrous oxide fluxes were measured for 25 days after the treatment applications by sampling the headspace from the Kilner jars via syringe and analysing the N_2O concentration using gas chromatography. The results of the Taguchi data analysis showed that the most influential factor for N_2O emissions was WFPS, accounting for 35% of the overall variance of the emissions, followed by nitrate (34%), temperature (11%), cellulose (10%), soil compaction (5%) and glucose (3%) at their individual levels. However, when interactions of different factors were analysed, it was interesting to note that glucose and soil compaction with low effect individually, showed highest severity index percentage (measure of the strength of the presence of interaction between two factors) in combination. Similarly, the severity index percentage of interaction for glucose (least impact factor) with nitrate (strong impact factor) was only 22%. These results suggest that the influence of one factor on N_2O emissions was dependent on other factors in the involved processes (nitrification or denitrification). The proposed Taguchi methodology facilitated a systematic mathematical approach to understand the controlling factors and their interactions for N_2O emissions from incubated soils, using only a few representative combinations.