Geophysical Research Abstracts
Vol. 17, EGU2015-1681, 2015
EGU General Assembly 2015

Effect of nitrification inhibitors (DMPP and 3MP+TZ) on soil nitrous oxide emissions from a sub-tropical vegetable production system in Queensland, Australia

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The use of nitrification inhibitors, in combination with ammonium based fertilisers, has been promoted recently as an effective method to reduce nitrous oxide (N_2O) emissions from fertilised agricultural fields, whilst increasing yield and nitrogen use efficiency. Vegetable cropping systems are often characterised by high inputs of nitrogen fertiliser and consequently elevated emissions of nitrous oxide (N_2O) can be expected. However, to date only limited data is available on the use of nitrification inhibitors in sub-tropical vegetable systems. A field experiment investigated the effect of the nitrification inhibitors (DMPP & 3MP+TZ) on N_2O emissions and yield from a typical vegetable production system in sub-tropical Australia. Soil N_2O fluxes were monitored continuously over an entire year with a fully automated system. Measurements were taken from three subplots for each treatment within a randomized complete blocks design. There was a significant inhibition effect of DMPP and 3MP+TZ on N_2O emissions and soil mineral N content directly following the application of the fertiliser over the vegetable cropping phase. However this mitigation was offset by elevated N_2O emissions from the inhibitor treatments over the post-harvest fallow period. Cumulative annual N_2O emissions amounted to 1.22 kg-N/ha, 1.16 kg-N/ha, 1.50 kg-N/ha and 0.86 kg-N/ha in the conventional fertiliser (CONV), the DMPP treatment, the 3MP+TZ treatment and the zero fertiliser (0N) respectively. Corresponding fertiliser induced emission factors (EFs) were low with only 0.09 - 0.20% of the total applied fertiliser lost as N_2O. There was no significant effect of the nitrification inhibitors on yield compared to the CONV treatment for the three vegetable crops (green beans, broccoli, lettuce) grown over the experimental period. This study highlights that N_2O emissions from such vegetable cropping system are primarily controlled by post-harvest emissions following the incorporation of vegetable crop residues into the soil. It also shows that the use of nitrification inhibitors can lead to elevated N_2O emissions by storing N in the soil profile that is available to soil microbes during the decomposition of the vegetable residues over the post-harvest phase. Hence the use of nitrification inhibitors in vegetable systems has to be treated carefully and fertiliser rates need to be adjusted to avoid excess soil nitrogen during the postharvest phase.