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Natural abundance N and O isotope composition of KCl-extractable soil nitrate from distinct agricultural treatments in southern Alberta, Canada

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The natural abundance of ^{15}N in NO_3^- is rarely used to investigate N dynamics in agroecosystem studies. Most studies use ^{15}N-enriched substances. Furthermore, the O isotopic signature on soil NO_3^- has received even less attention. The aim of this paper is to present preliminary findings of a study that investigated the δ^{15}N and δ^{18}O values of KCl-extractable soil nitrate from five agricultural treatments representing contrasting crops and N amendments which are part of a long-term irrigated cropping systems study. For each treatment, soil samples were collected from three replicate plots and five distinct depth intervals up to 90 cm during spring 2006. The N and O isotopic composition of nitrate were determined using the denitrifier technique. Considering the inherent variability among soil properties and microbial processes in the field, excellent reproducibility was observed among δ values for replicate plots. The SE of the mean δ^{15}N and δ^{18}O values did not exceed 1.5‰ in 90% and 70% of the cases, respectively. Furthermore, almost identical δ values were obtained for the same soil samples that were extracted on two separate occasions. Mean δ^{15}N values ranged from 0.4 to 7.9‰, with the highest values generally being measured at depth. Mean δ^{18}O values ranged from -4.8 to 12.3‰, with the highest values generally measured for the top most soil layer. Integrating over the entire depth interval, soil nitrate from the various treatments were characterized by distinct δ^{15}N and δ^{18}O values. The lowest δ^{15}Nand δ^{18}O values of soil nitrate were measured for unamended alfalfa (+1.5‰) and recent unamended cereal (-2.8‰), respectively. The highest δ^{15}Nand δ^{18}O values of soil nitrate were measured for recent unamended cereal (+6.5‰) and recent

fertilized cereal (+4.5‰), respectively. Note that soil nitrate from a manured treatment was not characterized by the highest δ^{15}N values, as might have been expected. This might be related to the timing of manure application which lastly occurred in 2001. For the top-most soil layer, significant differences in the δ values between fertilized and unfertilized soil were observed, up to 6‰ for δ^{15}N and 17‰ for δ^{18}O. For the deeper soil layers, the long-term fertilized cereal treatment was characterized by the highest nitrate concentrations which increased with depth and by a concomitant increase in both δ^{15}N and δ^{18}O values relative to the other treatments. In summary, distinct differences in the N-15 and O-18 natural abundance of KCl-extractable soil nitrate between agricultural treatments and depth intervals were observed, which indicates the potential of adopting a dual natural abundance isotope approach to investigate soil N sources and transformations. Furthermore, the denitrifier technique may help to better understand what controls the δ^{18}O value of soil nitrate, and provide more insight into the variability of δ^{15}N values of soil nitrate.