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Potassium, Nitrogen and CO2 Sequestration

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Abstract

The Kyoto Protocol imposed limits to industrial emission of six greenhouse gases (GHGs) the years 2008-2012. (mostly CO_2 and N_2O). Concomitantly, it recognized three mitigation actions, all associated with land-use. Within this category, crop residue, and nitrogen management with respect to carbon sequestration have been evaluated qualitatively. No attempt has been made to evaluate quantitatively the impact of plant nutrition on CO_2 sequestration. Potassium and nitrogen are of particular interest in land use category since crops are very responsive to them. Specifically important is K because its production processes requires considerably less energy than nitrogen for fertilizer manufacture and at an adequate level in plants can enhance N-use efficiency (NUE). This improving effect of potassium on NUE thus optimizes N management, while contributing to a lowering in emission of N_2O. The objective of this study was to quantify crop potential to reduce atmospheric CO_2 concentration and comparing a model with experimental results. The Global Potential Carbon sequestration (GPCS) calculations are based on a widely used soil-crop model known as DSSAT (Decision Support System for Agro-technology Transfer. Hoogenboom G et.al. https://DSSAT.net.)/ It has been modified to combine with NPK application, coupling it with the QPAIS model (Zhang et al., 2007) to obtain the actual carbon sequestration (ACS) as output. The simulated total corn dry matter (DM) weight in an arbitrary fertilization control resulted in the following: Applying 100 kg/ha K (at N=200 and P=100) increases the DM yield from 15,515 to 20,357 kg/ha and associated GPCS that increased from 7,137 to 9,364 kgC/ha. Hence the application of 100 kg/ha K resulted in an additional 2,227 kg/ha Carbon bound in the plant material (equivalent to ~8,166 kg/ha CO_2), or 22.3 kg/ha of C per 1 kg of K. that was sequestrated from the Atmosphere. This contribution of 100 kg/ha K to C sequestration is the calculated GPCS and is equivalent to 81.8 kgC/ha CO2/kg K. The Potential Carbon Sequestration (PCS) i.e. binding of carbon only in the root system under zero CO_2 efflux from soil can be also evaluated from the model. Here, root DM increased from 1,875 to 2,852 kg/ha in the K amended soil. Hence the application of 100 kg/ha K resulted in 449 kg/ha C being bound in the roots (equivalent to 1,646 kgC/ha CO_2), or 7.6 kg/ha CO_2/kg K. The model assumes that Actual Carbon Sequestration (ACS) is 30-70% of the PCS, which leads to the calculation of ACS to be 394-918 kg C/ha per 100 kg of K. Predicted soil CO_2 sequestration per kg fertilizer K exceeds considerably the CO_2

emission per kg K in industrial potash production (14–24 vs. the industry-reported 0.2–0.6 kg CO_2 [kg K]$^{-1}$).

Keywords: greenhouse gases (GHGs), CO2 sequestration, fertilizer application.

References
None

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