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Soil N Management Using Combined Application of Crop Residue and N Fertiliser: What is the Environmental Cost?

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Abstract

Crop production in Africa is often limited by nitrogen availability. Crop residues could serve as alternative as they are readily available and easily accessible. However, certain limitations associated with crop residue use such as low-N use efficiency, high N losses via leaching and gaseous losses (N_2O emission) make the exclusive use of crop residue problematic.

Inorganic N (NO_3^- and NH_4^+) release, and N_2O emission were measured in laboratory soil microcosm experiments following combined application of crop residues (clover and barley straw) and inorganic N fertiliser (NH_4NO_3) in different proportional ratios: 100:0, 75:25, 50:50, 25:75 and 100:0; fertiliser-N: crop residue-N, respectively. Preliminary results indicated that inorganic N release and N_2O emissions were relatively higher in soils after incorporating crop residues with a lower C-to-N ratio. Moreover, results obtained showed that inorganic N availability increased significantly ($p < 0.05$) with increasing proportion of inorganic N fertiliser applied. Whether this input stimulated N release from the residues, resulting in greater N availability for nitrification and subsequent denitrification, is verified using a ^{15}N -enrichment approach to quantify ^{15}N - N_2O production following addition of ^{15}N -labelled residues to soil.

Furthermore, labelled crop residue from tropical legumes cultivated under controlled environmental conditions are being applied either solely or in combination with N fertiliser to determine the contribution of crop residue to N release and N_2O emission. Furthermore the impact of recommended soil fertility management practices such a liming and soil water management on N availability and N_2O emission following combined application of crop residue and inorganic N are being investigated. It is expected that results obtained from the various experiments would amply demonstrate the optimum combination of crop residue and N fertiliser which, when applied to tropical soils would yield economically viable and environmentally sustainable yields.

Keywords: Crop residue, denitrification, nitrification, nitrous oxide