

Progres report

Influence of roots and rhizodeposits of grain legumes on N dynamics in different legume-cereal systems of West-Africa.

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Background

N fixed by legumes enters the soil ecosystem when the aboveground residues, leaves and stems, are being incorporated. Legumes also contribute fixed N through their roots, nodules and root exudates. Due to difficulties in their measurements, these underground N fractions are often ignored or grossly underestimated when N balances are calculated (Khan et al., 2003).

In West-African contexts, farmers remove all above-ground products, grain and stover, from the field, thereby exporting a large proportion of the nutrients and nitrogen accumulated in legumes. Crop residues are seldom incorporated or left in the fields. Crop residues are needed as construction material and animal feed. On-station trials do not provide an adequate estimate of on-farm situations since residues often remain in the field and no roaming cattle or fire destroy residues (Weber, 1996). On-farm, legume N-fixation will provide N to the soil through their aboveground residues when these are fed to animals and the manure produced is brought back to the fields. The residues-animal-manure-crop nitrogen cycling has been extensively studied and, if a few questions remain, is fairly well understood (Rufino et al., 2006). But legumes will mainly contribute N through the release of exudates in the rhizosphere and through the decay of their below-ground residues. Close to nothing is known on the influence of these below-ground fractions on nutrient cycling in the agro ecosystems of West-Africa. To understand N dynamics in those systems, information is needed on the nature and quantity of N contributed by the below-ground fractions of leguminous crops (Bationo et al., 2004).

Objective

To understand the influence of roots and rhizodeposits on N dynamics of various legume-cereal systems of West-Africa. Evaluate the importance of below-ground nitrogen of leguminous crops in various environment of the West-African Savannah. We aim to refine N balance in rotations and association of grain legumes and cereals by measuring legume below-ground N content.

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Season spent at ICRISAT in Niger.

Evaluation of below-ground N contribution of cowpea grown in association with millet.

We labelled the below-ground N fractions of cowpea in ^{15}N to 1) quantify BGN of cowpea grown in association with millet. 2) Perhaps demonstrate/quantify? transfer of N from cowpea to millet. 3) Establish N balances of cowpea by combining our BGN measurements to N fixation measurements 4) Try studying lateral and vertical development of cowpea roots using novel direct ^{15}N methods. 5) A new technique to measure BGN is also being developed as, for the first time, the roots are not being restrained within a container such as a frame or cylinder. Influence of water dynamics on field variability is also being studied here with weekly neutron probe measurements down to 2m.

Evaluation of root characteristics of pearl-millet varieties for increased nutrient-use efficiency

We evaluate differences between pearl-millet varieties in their root parameters and in their nutrient-use-efficiency. Classical methods of root studies (root length, root length density) are compared to a new isotopic method to study difference in root activities. The new isotopic method consists in flushing ^{15}N in the soil to determine and compare individual plant root activities in the area flushed.