3 SEASONAL SOIL N DYNAMICS AND THEIR EFFECT ON LOWLAND RICE IN AN INLAND VALLEY OF BURKINA FASO

ABSTRACT

Rainfed lowland rice farmers in the inland valleys of the Dry Savanna zone of Burkina Faso are challenged with N deficiency as a major production constraint. With extremely low use of external inputs, there is a need to efficiently use systems' internal resources such as native soil N. Organic matter starts to mineralize with the onset of the rains after a prolonged dry season, leading to transient peaks of nitrate in the soil. Substantial amounts of this nitrate may be translocated to the lowlands by (sub) surface flow from adjacent valley slopes. Largest soil nitrate-N losses are expected to occur in lowlands when the soil aeration status changes from aerobic to anaerobic conditions. We quantified seasonal soil N dynamics along the toposequence of an inland valley and assessed the effect of slope N contribution to the yield of lowland rice near Dano in Burkina Faso during the transition period between the dry and the wet season (DWT) of 2013 and 2014. Soil N mineralization and nitrate accumulation and translocation (both vertical and horizontal) were determined in soils solution sampled 3 times per week and by ion exchange resin capsules (cumulative N mineralization during DWT). The biomass and yield of rice were determined in both the absence and the presence of nitrate fluxes. With the onset of the first rains, soil nitrate accumulated, reaching peaks of 20-45 kg N ha^{-1} after about 25 days. Some 10-15 kg of the nitrate in lowland soils was contributed via interflow from the slope, corresponding to an addition of 11 and 13 µmol cm^{-2} RAQ-N in 2013 and 2014, respectively. Subsequently, nitrate gradually decreased in the upland soil and 77-80% disappeared in the lowland upon reaching soil saturation around day 60. Despite substantial nitrate-N losses, N contribution from the slope increased the N uptake of rice by 11 kg ha^{-1} and the grain yield by 0.4 Mg ha^{-1}. We conclude that intense N dynamics occur during DWT and that rice benefits from nitrate losses from the valley slope into the lowland. Given the substantial amounts of unaccounted nitrate, appropriate options for soil N management are required to minimize native soil N losses and to enhance rice productivity in the low-input production systems in inland valleys of West Africa's dry savanna zone.

Keywords: Dry Savanna zone, Ion exchange resin, Nitrate, *Oryza sativa*, West Africa.