Exploring the Impact of Nitrogen Sources on Yield, Partitioning and Nitrogen Use Efficiencies of Irrigated Lowland Rice Fields

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Abstract

The nitrogen use efficiency (NUE) by crops in sub-Saharan African cropping systems is relatively low as a result of low Nitrogen (N) inputs and high N losses, posing both economic and environmental concerns. In rice production, nitrogen is one of the most yield-limiting nutrients in the world. In this study, efficiencies of two locally used sources of nitrogen (ammonium sulphate ($(NH_4)2SO_4$) and urea ($CO(NH_2)2$) were assessed on yield, N partitioning in plant tissue and NUE of low land rice (*Oryza sativa* L.) within Lake Victoria Catchment in East Africa. The choice of low land rice was based on the fact that it is a major crop that farmers use nitrogen for production within the Lake Victoria catchment which eventually acts as the main source of nitrogen loading to the water masses causing algal bloom and the problem of eutrophication. The two sources of N were applied at rates of 0 $kgha^{-1}$, 25 $kgha^{-1}$ and 50 $kgha^{-1}$, using two methods of application (full dose and 2 splits). Both N sources influenced an increase of rice grain yield with split method of application resulting in higher R^2 values (0.79 and 0.86) than full dose) for $(NH_4)2SO_4$ and $CO(NH_2)2$, respectively. The positive response of high yield on addition of more N implies that the rate applied was inadequate since an incremental N elicited more grain yield. Furthermore, highest percentage was partitioned into grain; ranging from 33.3% to 36.6% for $(NH_4)2SO_4$ and $CO(NH_2)2$, respectively. These results imply that a higher N efficiency in rice could be obtained during grain filling stage since the crop N requirement at this stage is higher than other crop stages. Consequently, less N losses could be realized and even more if split method of N fertilizer application would be embraced. Nevertheless, split and full dose fertilizer application methods did not show any significant differences in NUE of rice that was determined at critical stages of crop growth including vegetative, reproductive and harvesting stages although split had higher NUE at reproductive and harvesting stages (46.70 and 182.00) respectively. Application of $CO(NH_2)2$ at 50 $kgha^{-1}$ resulted in a high NUE of 146.53 exceeding 100 %; an indication of soil mining. The findings confirmed that the amount of N applied in farms is too low to obtain optimum yields while the extent of losses through leaching and emissions could be fairly high. Therefore, there is need to revisit the N fertilizer recommendations in lowland irrigated rice including the splitting schedule and the form of fertilizers to address the current scenario of low N use efficiency in the cropping system.

Key Words: nitrogen sources, nitrogen losses, nitrogen loading, soil mining, environmental threats