Information on Seasonal and Varietal Differences Provide Opportunities for Improving Nitrogen Use efficiency and Nitrogen Management in Irrigated Paddy Rice in Kenya

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Abstract

Nitrogen pays key role in plant growth and development. Despite being abundant in the atmosphere, it is one of the limiting plant growth nutrient. Additional N has been shown to increase yield of rice with temptation of over-supplyby some farmers, with a resultant lower N use efficiency, higher costs and environmental pollution. Apart from nitrogen rates, there are factors such as temperature, stage of crop growth during nitrogen fertilization as well as cultivar responses to N application that affect yields and N efficiencies. The current results showed differencesin NUES amongst cultivars and rates of N application across the sites.

Key words: *grain filling, temperature, Nitrogen use efficiency, Nitrogen agronomic efficiency, N-mining*

Introduction

To maximize grain yield, farmers (particularly in developed world) have often applied a higher amount of N fertilizer than the minimum required for maximum crop growth (Lemaire and Gastal., 1997). The scenario is however different in Sub-Saharan Africa (SSA), where the situation is characterized by inadequate N fertilizer input compounded with poor soil fertility are the determinants of rice production. There is need to synchronize fertilizer application and plant nutrient demand to avoid pollution or nutrient mining.

Materials and Methods

The experiment was a split plot design with varieties as main plot and N forms constituting subplots and replicated three times in two sites Kenya. The N content in the plant tissue was determined by Kjeldahl (Bremner, 1996) while Agronomic use efficiency was determined through use of the following equation; Difference method. NAE = (GY1)-(GY0) / R; GY1 = Grain yield from fertilized plots; GY0 = Grain yield from unfertilized plots; R = rate of fertilizer N applied- where NAE- Nitrogen Agronomic efficiency. NHI was computed according to Muchow (1988), as the ratio between N uptake in the grain and N uptake in the straw.

Results and Discussion

The results revealed NAE tobe within the ranges reported by previous workers. For instance, Rahman et al. (2014) reported an NAE of 23.6-17.7g g^{-1} for N rates ranging between 40-80 kg ha^{-1}. While NUEs ranged between 26- 158 (depending on variety). The two ranges fall within what Masso et al. (2017)referred to as spatial paradox of “too little” and “too much” N scenarios.respectively, perpetuating food insecurity quantitatively and qualitatively.

Table 1. Mean Nitrogen harvest indices (NHI), nitrogen agronomic efficiency (NAE) and nitrogen use efficiencies (NUE) of rice varieties as affected by nitrogen rates.

	NERICA 4			NERICA 10		
N rates kgha^{-1}	NH1	NAE	NUE	NHI	NAE	NUE
0	0.69[a]	-	-	0.68[a]	-	-
26	0.69[a]	23.37[a]	107.13[ab]	0.74[a]	25.68[a]	158.16 [a]
52	0.74[a]	24.49[a]	182.55[ab]	0.69[a]	25.50[a]	45.90[ab]
78	0.76[a]	24.57[a]	30.70[a]	0.81[a]	26.22[a]	26.18[b]
LSD	0.15	0.39		0.10	1.22	

Values followed by same letters within the same column are not statistically different at $p \leq 0.05$

The case of "too much" are likely to contribute to nutrient pollution and eutrophication (Marler and Wallin 2006). In case of "too little"; scenario as in SSA case, Kenya included, higher NUE could imply nutrient mining and land degradation.

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