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Growth Response of Upland Rice (*Oryza Sativa* L.) Varieties to Nitrogen and Seed Rates in the Northern Guinea Savahah.

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Abstract
Field experiments were carried out at the Institute for Agricultural Research (IAR) farm at Samaru during 2011 and 2012 rainy season. The treatments evaluated were two rice varieties (NERICA 4 and 8), three rates of nitrogen (0, 65 and 130 kg N ha^{-1}) and three seed rates (30, 60 and 90kgha^{-1}). The treatments were factorially combined and laid out in a Randomized Complete Block Design (RCBD) replicated three times. Results obtained shows that NERICA 4 produced taller plants than NERICA 8. Application of nitrogen up to 65 kg N ha^{-1}significantly increased plant height, and leaf area index, however, crop growth rate and relative growth rate responded to applied 130 kg N ha^{-1}. Plant height was not significantly increased beyond seed rate of 60 kg ha^{-1}. Based on this study it can be concluded that both NERICA varieties can be sown at the rate of 60 kg ha^{-1} with application of 65 kg N ha^{-1}.

Key words: NERICA, Nitrogen, Seed rate, Northern guinea savannah

1.0 Introduction

Rice (*Oryza sativa* L.) is one of the oldest and most important cereal food crops in the world belonging to the family Poaceae, subfamily Bambusoideae and tribe Oryzae (Clayton and Rendoice, 1986). There are two cultivated species: *O. sativa*, of Asian origin, and *O. glaberrima*, of African origin. NERICA was obtained as a result of inter- specific hybridization between *Oryza sativa* (Asian rice) and *Oryza glaberrima* (African rice). The progeny was developed by West Africa Rice Development Association (WARDA) in 1994, combining traits from the hardy African rice that is resistant to pests, weeds and problematic soils with high yielding, good response to mineral fertilization and non – shattering characteristics of the Asian rice (Dzomeku *et al*., 2007; Kijima *et al*., 2006; WARDA, 2001a). NERICA is also tolerant to drought and blast diseases with a potential yield of 5tha^{-1} (WARDA, 2006). Rice is the world's second most widely grown cereal crop after wheat, more than half of the world's population depend on it as staple food. Lombin 1987 has reported that savannah soils are low in inherent soil fertility hence, the need to evaluate the optimum rate of nitrogen fertilizer for NERICA varieties. The availability and high cost of improved seeds is a major constraint for rice production by the farmers. Likewise the wastage incurred during planting as a result of over seeding is something that needs to be curtailed in order to maximize profits and further reduce cost of rice production. More so, seeding density is believed to affect crop performance due to intense competition for the available growth factors that might be inherently limiting. Equally worrisome was the low yield that was usually recorded under farmers' practice where plant population below the optimum lead to reduced yield. In view of the foregoing reasons the study was conceived to determine the optimum rate of nitrogen fertilizer and seed for the varieties in the northern guinea savannah ecology.

1.1 Materials and Methods

The experiment was carried out at the Institute for Agricultural Research (IAR) farm Samaru (latitude 11°18' 16"N, longitude 07°62' 34"E and 686 m above sea level) during 2011 and 2012 rainy season. Random samples of soil were taken at depths of 0-15cm and 15-30cm from the experimental sites using an auger before land preparation and analyzed for physico-chemical properties. The treatments evaluated consisted of two rice varieties (NERICA 4 and 8), three rates of nitrogen (0, 65 and 130 kg N ha^{-1}) and three seed rates of 30, 60 and 90 kg ha^{-1}. The treatments were factorially combined and laid down in a randomized complete block design (RCBD) replicated three times. The land was sprayed with glyphosate at the rate of 1.5kg a.i ha^{-1} in order to control already emerged weeds prior to land preparation. Thereafter the land was ploughed and harrowed into a fine tilth after 14 days. The bonds of beds were raised (4×3m) manually with hoe before seed sowing. Seeds were sown in July by dibbling at 20 × 20cm apart. Manual hoe weeding was also carried out at 2 and 4 weeks

after sowing there after weeds were hand pulled when the need arose. Nitrogen fertilizer (Urea) was applied as par treatment in two split doses at 3 and 6 weeks after sowing. Phosphorus and Potassium fertilizer were also supplied using single super phosphate and muriate of potash at the rate of 50 kg ha^{-1} each and these were applied at sowing. The fertilizer application was done manually by side placement. Data were collected on the following parameters; plant height, leaf area index, crop growth rate, relative growth rate and total dry matter.

1.2 Results and Discussion

The result of the soil analysis (table 1) showed that 0-15cm was loam while 25-30cm was sandy clay loam with low amount of nitrogen, phosphorus and potassium. The effect of nitrogen and seed rate on the varieties is presented on table 2. Application of nitrogen up to 65 kg N ha^{-1} significantly increased plant height in 2012 and leaf area index (LAI) in both years. However, crop growth rate (CGR) and relative growth rate (RGR) were significantly increased with application of 130 kg N ha^{-1} than the other rates except with CGR which was at par to applied 65 kg N ha^{-1}.

Significant interaction on TDM and CGR was observed between nitrogen and varieties in 2012 (Table 3). NERICA 4 showed increases in TDM when N was applied at 65 kg ha^{-1} and further increase to 130 kg ha^{-1} produced similar results. NERICA 8 however produced statistically similar TDM throughout the fertilizer levels. The crop growth rate for NERICA 4 was increased with application 65 kg N ha^{-1} but further increase to 130 kg N ha^{-1} depressed CGR, however for NERICA 8 CGR was similar throughout all the N levels.

The significant responses in of the parameters to nitrogen fertilization could be attributed to the fact that among various nutrients, nitrogen has the strongest influence on growth of Rice (Ahmed *et al.*, 2005). In addition, nitrogen is an important component of chlorophyll which enhances photosynthesis thus promoting vegetative growth which leads to increased production of assimilates. The results from soil samples analyzed showed (table 1) that the soil is poor in nitrogen thus the positive responses to nitrogen observed. This is in agreement with Lombin (1987), who reported that Savannah soils are poor in inherent fertility and are easily leached, have low organic matter content, low CEC and poor buffering capacity.

Seed rate had significant effect only on plant height in 2012 where taller plants were observed when seed rate was increased to 60 kg ha^{-1}. The increase in height observed at higher seed rates could be attributed to competition for light which is required by the plant for photosynthesis.

Between the varieties, it was observed that NERICA 4 produced taller plants than NERICA 8. The difference in height could be attributed to the genetic makeup of the plant as it has been reported that NERICA 4 can grow up to 120 cm while NERICA 8 grows up to 100 cm tall (WARDA, 2001).

Table 1 Physical and chemical properties of the soil of the experimental site.

Depth	**0-15cm**	**15-30cm**
Particle size distribution (g/kg)		
Sand	460	500
Silt	300	260
Clay	240	240
Textural class	Loam	Sandy clay loam
Chemical properties		
pH in 0.01m $CaCl_2$	4.20	4.10
Organic carbon (gkg^{-1})	10.3	6.50
Total N (gkg^{-1})	0.88	0.56
Available P ($mgkg^{-1}$)	0.50	1.75
Exchangeable bases ($cmolkg^{-1}$)		
Ca	3.60	3.60
Mg	1.30	0.48
K	0.18	0.12
Na	0.58	0.32
CEC	7.8	6.60

Soil samples as analyzed by Agronomy Department, Ahmadu Bello University, Samaru, Zaria

Table 2 Effect of nitrogen and seed rate on growth of NERICA at Samaru during 2011 and 2012 rainy season.

	Plant height (cm)		LAI		CGR(gwk^{-1})		RGR($gg^{-1}wk^{-1}$)		TDM(g)	
Years	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**
Nitrogen ($kgha^{-1}$)										
0	89.38	68.00b	3.425b	2.920b	2.56b	3.18	0.30b	0.36	14.69	16.67
65	94.93	75.39a	4.231a	3.920a	2.84a	3.47	0.31b	0.40	15.98	17.39
130	92.08	74.67a	4.255a	4.040a	3.23a	3.21	3.37a	0.36	16.81	16.82
SE±	1.940	1.771	0.1787	0.2260	0.210	0.287	0.020	0.021	0.890	1.165
Seed rate ($kgha^{-1}$)										
30	90.78	68.00b	4.077	3.700	2.85	3.26	0.33	0.39	15.53	16.47
60	94.83	75.39a	3.890	3.680	2.98	3.28	0.33	0.35	16.31	17.29
90	90.77	74.67a	3.944	3.500	2.80	3.33	0.31	0.38	15.63	17.11
SE±	1.940	1.771	0.1787	0.2260	0.210	0.287	0.020	0.021	0.890	1.165
Variety										
NERICA 4	96.69a	77.37a	4.066	3.500	2.93	3.36	0.33	0.38	6.81	17.32
NERICA 8	87.57b	68.00b	3.875	3.750	2.83	3.22	0.32	0.37	6.22	16.60
SE±	1.580	1.446	0.1459	0.1840	0.170	0.042	0.010	0.017	0.280	0.951
Interaction										
N*S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
N*V	NS	NS	NS	NS	NS	*	NS	NS	NS	*
S*V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT. NS = Not Significant.

Table 3 Interaction of nitrogen and variety on crop growth rate and total dry matter at Samaru during 2012 rainy season.

	Crop growth rate ($g.wk^{-1}$)		Total dry matter (g)	
Nitrogen rates($kgha^{-1}$)	NERICA 4	NERICA 8	NERICA 4	NERICA 8
0	2.64b	3.73a	14.61b	18.72a
65	3.97a	2.96a	19.58a	15.20a
130	3.46b	2.96a	17.77a	15.87a
SE±	0.406		1.647	

Means followed by the same letter(s) within a treatment group are not significantly different at 0.05 level of probability using DMRT. NS = Not Significant.

1.3 Conclusion

The results obtained from the experiment showed that either of the two varieties can be used with the application of 65 kg N ha^{-1} at 60 kg ha^{-1}seed rate.

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