Growth Characters of Nerica Rice (*O.sativa* × *O.glaberrima)* as Affected by Cowdung and Nitrogen Fertilizer in Mubi Adamawa State Nigeria

D. A. AREMU[1] A. A. SAJO[2] B. B. JAKUSKO[3]
1.Department of Agric, Tech., Federal Polytechnic, Mubi
2.Department of Crop Production and Horticulture, MAUTECH Yola

Abstract
Field experiment were conducted during the 2011 and 2012 cropping seasons at the Teaching and Research Farm of the Department of Agriculture Technology. Federal Polytechnic Mubi to study the effects of different levels of cowdung and nitrogen on the growth of NERICA rice. The experiments were laid out in a split plot design with cowdung levels (0,1,2 and 3 t/ha) assigned to the main plots and collected on growth characters were subjected to analysis of variance. Significant different means were separated using least significant difference (LSD). Results obtained showed significant (P =0.01) effect on plant heights at 6,9 and 12 weeks after sowing in 2012 season while there were no significant (P=0.05) effect on plant heights at 6,9 and 12 weeks after sowing in 2011 season. It was observed that tallest plants were recorded from application of cowdung and nitrogen at the rate of 3 t/ha and 180 kg N/ha (99.92 cm and 109.25 cm) respectively while the shortest plant were recorded from 0 t/ha and 0 kg N/ha (75.92 cm and 64.17 cm) respectively. The highest weight of dry matter per plant and weight of dry matter per plot were obtained from application of cowdung and nitrogen at the rate of 3 t/ha and 180 kg N/ha in both seasons, while the least were obtained from 0 t/ha and 120 kg N/ha. Based on the findings, it would be concluded that optimum growth of NERICA-3 rice in Mubi agro ecological zone would be obtained by a combined rate of 3 t/ha and 180 kg N/ha.
Keywords: NERICA, Cowdung, Nitrogen, Growth, Yield, Fertilizer.

INTRODUCTION

New Rice of Africa (NERICA) is an interspecific culture of rice developed by West Africa Rice Development Association (WARDA) to improve the yield of African rice varieties (Dingkuhn *et al,* 1998). Rice is a staple food for nearly one half of the world's population. In Africa, the crop meant to be a luxurious food which was only consumed during festivities. Over the past decades in Nigeria, the crop has moved from being luxurious to a staple food crop due to increase in population by the teeming subsistence farmers and eating habit of the people. Similarly, Nigeria being the most populous country in Africa with over 150 million people (Census, 2006), struggle for food is expected to have increased with the increase in its inhabitants, and the demand for rice has since being rising steadily at about 14% annually (Ereinstein *et al.,* 2003). With the exception of a few countries that have obtained self-sufficiency in rice, demand of rice in Nigeria exceeds its production and large quantities are imported to meet the demand at large cost to the government. (Fagade, 2000).

Nitrogen is not a major component of FYM. Its influence on crop is not always evident except when applied in a very large quantity (Yanami *et al.,* 1997). Ezeakuna *et al,* (1986) observed that the small quantity of N present is usually tied up in an unavailable form and that less than 30% of total N is utilized in the first year of the plant growth. Lee and Ota (2001) observed that nitrogen top dressing at booting or heading stage promoted the photosynthetic activity of the leaves. Alam and Azmi (1989) also reported an increase in plant height with increase in nitrogen. Nitrogen has most profound influence on vegetative growth when enough quantity is applied (Giller, 2002). It increased vigour, size and deep colour action for efficient photosynthesis and build up of amino acids and other plant nutrients (Delipathy *et al.,* 1994). In the presence of adequate moisture, nitrogen stimulates and increases the growth of rice.

In an experiment with rice varieties, Nayak *et al*., (1988), noted spectacular increase in dry matter accumulation due to nitrogen application. Abubakar (1991), observed an increase in plant height with application of nitrogen up to the rate of 150 kg N/ha at 6 and 8 WAS and that no significant difference in plant height between 100 kg N/ha and 150 kg N/ha at 10 WAS. The continuous application of cowdung versus inorganic fertilizer for 5 years on rice field slightly superiority of annual application of 6 t/ha of cowdung over annual rate of 120 – 16 – 160 kg/ha of NP_2O_5 and K_2O (Belay *et al.,* 1997). They considered this to increased soil organic carbon, organic nitrogen and exchangeable calcium, thereby resulting in a significant increase in plant height and dry matter. Yadev and Prasad (1992) reported that combination of cowdung at 2 t/ha and 1 t/ha with 5 kg N/kg minimized production in yield from successive rice cropping. However, variation in climatic and edaphic factors of the state necessitates this study to validate and if possible improve on the previous findings in Mubi.

MATERIALS IN METHODS

Field experiments were conducted during the 2011 and 2012 cropping seasons at the Teaching and Research Farm of Agricultural Technology Department, Federal Polytechnic Mubi. Mubi North is situated at the North eastern part of Adamawa State and located between latitude 13^{o} 15' and longitude 13^{o} 16'E, it has a land area of 50,640 km^2 and population size of 759,045, with a density of 160.5 people per square kilometer (AD, ADP 2009).

The experimental site in each year were cleared of all plant debris, gathered and burnt after which the land was ploughed and harrowed to obtain fine tilt, thereafter the plots were marked out.

The experimental design in both seasons (2011 and 2012) was split plot in which cowdung (0, 1, 2 and 3 t/ha) constitute the main plots while the four (4) levels of nitrogen (0, 60, 120 and 180 kg N/ha) as sub plots in three replications given a total of forty eight (48) sub plots. Each subplot size was measured 4 m x 3 m (12 m^2) and the measurement of each main plot was 19 m x 3 m (57 m^2) each main subplot as well as replication was separation was separated by 1 m wide pathway.

Basal application of cowdung at the rate given above was applied to each main plot. Seeds were sown two weeks after cowdung application. Sowing was done on 1st July 2011, and 21st July 2012 when rains were fully established. The spacing adopted in both seasons was 25 cm by 25 cm. seven seeds were sown per hole which was later thinned into five (5) plants per stand at three (3) weeks after sowing.

Data collected on growth characters was subjected to analysis of variance as desbribed by Gomez and Gomez (1984) using mixed model procedure of statistical analysis system. Means were separated using Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

The results of composite soil samples for the two cropping seasons used in determining the physicochemical properties of the experimental sites as well as rainfall data for the two seasons are presented in table 1. The physical characteristics of soil of the experimental area was sandy loam with proportion of silt and sand in 2011 (58.2). The analysis also revealed that the soil contain low amount of nitrogen (0.294), low organic carbon (0.409), available phosphorus (0.02), potassium (0.87 and magnesium (0.86) content.

Table 2 shows the effect of cowdung and nitrogen on some growth characters of NERICA rice during the 2011 and 2012 cropping seasons. There was no significant (P=0.05) effect of cowdung on plant height at 3, 6, 9 and 12 weeks after sowing in 2011 season (Table 2). However, in 2012 season, application of cowdung in plant height at 6, 9 and 12 weeks after sowing at the rate of 3 t/ha resulted in significant taller plants (69.17, 91.92 and 99.92 cm) respectively while the shortest plants were recorded from 0 t/ha on plant height at 6, 9 and 12 weeks after sowing (50.75, 68.33 and 75.92 cm) respectively. There was no significant (P=0.05) effect of nitrogen on plant height (6, 9 and 12 weeks after sowing) in 2011. However, in 2012 season, the tallest plant at 6, 9 and 12 weeks after sowing was obtained from the application of nitrogen at the rate of 180 kg N/ha (68.33, 99.33 and 109.25 cm) respectively.

In this study, growth characters (plant height) were significantly influenced by nitrogen and cowdung application. At the first three (3) weeks after sowing, there was no significant differences in plant height probably due to residual fertility from which the plant were taking up nitrogen for their growth. Thereafter, significant differences in plant height with increased nitrogen and cowdung showed that nitrogen and cowdung stress leads to stunting of rice plants. The tallest plants were obtained from application of both nitrogen and cowdung at the rate of 180 kg N/ha and 3 t/ha respectively. This is an indication that these tall reducing the shading effect of lower leaves by higher leaves, thus allowing radiation capture throughout the canopy. According to Mokwunye, (1981), application of cowdung with urea increase soil organic content from 0.34% to 0.363% and in further rice growing, the organic content decreased when urea was without organic N.

Application of cowdung and nitrogen had significant (P=0.01) effect on weight of dry matter per plant in both seasons (2011 and 2012) (Table 3). Weight of dry matter per plant in 2011 and 2012 seasons was significantly higher, with the application of cowdung at the rate of 3 t/ha (56.17 and 55.50 g) respectively, while the least weight of dry matter per plant were obtained from 0 t/ha in 2011 and 2012 seasons (49.50 and 50.08 g) respectively.

Application of nitrogen was highly significantly in both years of trials (2011 and 2012). In both seasons application of nitrogen at the rate of 180 kg N/ha (57.67 and 56.00 g) respectively resulted into higher weight of dry matter per plant while the lowest was recorded in both years (2011 and 2012) from 0 kg N/ha (52.67 and 50.61 g) respectively.

In 2012 season there was no significant (P=0.05) effect of cowdung and nitrogen on weight of dry matter per plot. However, in 2011 application of cowdung and nitrogen at 3 t/ha and 180 kg N/ha gave the highest weight of dry matter per plot (3.69 and 3.78 g) respectively while the least was obtained from 0 t/ha and 0 kg N/ha (2.37 and 2.44 g) respectively.

There was no significant effect of cowdung and nitrogen on weight of dry matter in kg/ha in 2011 season. However, in 2012 season, the highest weight of dry matter in kg/ha was recorded from application of cowdung and nitrogen at the rate of 0 kg N/ha (2924 and 1708 kg/ha) respectively.

Dry matter significantly increased with increase in nitrogen and cowdung rates with highest value of 180 kg N/ha and 3 t/ha respectively for NERICA rice. The low dry matter at low nitrogen and cowdung greatly affect the photosynthetic activity of the plant and subsequent storage of dry matter produced. Oikeh *et al.,* (2006) obtained a similar result. Singh *et al.,* (1997) reported that continuous application of cowdung versus inorganic fertilizer for three years on rice field slightly superiority of annual application of 6 t/ha of cowdung over annual rate 120 – 16 – 16 kg N/ha, NP_2O_5 and K_2O. Among the most important nutrient element known to promote growth and development, nitrogen has been identified to play major roles in cell elongation and expansion (Katyal, 2005). Therefore, since nutrient components make up a significant increase in nitrogen to some extent ultimately lead to increase height and dry matter production. Similar result was reported by Dedatta (2005) and Reddy and Reddy (1987).

From the result, it can be concluded that cowdung and nitrogen application has a significant effects on some growth characters of NERICA rice with 3 t/ha and 180 kg N/ha producing maximum effect in plant height at 6, 9 and 12 weeks after sowing and weight of dry matter per plant and in kg/ha. Similarly, there were no significant interaction between cowdung and nitrogen on the growth of NERICA rice in 2011 season in the study area. Thus for better performance of NERICA rice, cowdung and nitrogen at the rate of 3 t/ha and 180 kg N/ha should be applied. Therefore further research should be conducted on other varieties of NERICA rice with the same combination of cowdung and nitrogen.

Table 1: Soil Physicochemical Properties and Monthly Rainfall of the Experimental Site During the 2011 and 2012 Cropping Seasons.

Soil Properties	**2011**	**2012**
Soil P^H ($CaCl_2$)	5.65	5.92
Organic Carbon (%)	0.48	0.41
Bulk Density (g/cm^3)	1.45	1.26
Total N (%)	0.29	1.53
Available P (ppm)	0.02	0.05
C.E.C. (cmol kg/ha)	4.90	4.91
Exchangeable Ca (cmol kg/ha)	0.16	0.92
Exchangeable Mg (cmol kg/ha)	0.86	0.64
Exchangeable K (cmol kg/ha)	0.87	1.79
Exchangeable Na (cmol kg/ha)	0.22	0.15
Textural Class	Sandy Loam	Sandy Loam
Monthly Rainfall (mm)		
April	7.9	65.4
May	67.0	133.0
June	93.9	187.0
July	140.0	201.8
August	195.0	331.5
September	182.3	314.5
October	83.7	109.7
Total	**769.8**	**1342.9**
Mean	**109.97**	**191.84**

Table 2: Effects of cowdung and nitrogen on growth characters of NERICA rice during 2011 and 2012 cropping seasons.

Treatment	**Plant Height at 3 WAS**			**Plant Height of 6 WAS**			**Plant Height at 9 WAS**			**Plant Height at 12 WAS**		
	2011	**2012**	**Mean**	**2011**	**2012**	**Mean**	**2011**	**2012**	**Mean**	**2011**	**2012**	**Mean**
Nitrogen (kg N/ha)												
0	36.42	34.58	35.50	60.08	49.58	54.83	79.08	59.08	69.08	88.00	64.17	76.09
60	36.17	41.00	38.59	60.50	65.25	62.88	82.17	80.50	81.34	92.17	90.75	91.46
120	39.33	47.17	43.25	64.92	68.33	66.63	90.92	94.75	92.84	99.83	100.50	100.17
180	37.42	41.00	39.21	65.00	68.33	66.67	89.92	99.33	94.63	97.83	109.25	103.54
Prob of F	Ns	Ns	Ns	Ns	**		*	**		*	**	
Cowdung (t/ha)												
0	34.67	40.58	37.63	59.58	50.75	55.17	81.75	68.33	75.04	87.75	75.92	81.84
1	37.83	41.83	39.83	62.42	63.75	63.09	84.08	84.00	84.04	91.58	90.50	91.04
2	40.58	40.58	40.58	63.17	67.83	65.50	91.33	89.42	90.36	98.83	98.33	98.58
3	36.25	40.25	38.25	65.33	69.17	69.25	84.92	91.92	88.42	99.67	99.92	99.80
Prob of F	Ns	Ns	Ns	Ns	**	*	Ns	**	*	Ns	**	**

Table 3: Effects of cowdung and nitrogen on growth characters of NERICA rice during 2011 and 2012 cropping seasons

Treatment	**Weight of dry matter per plant (g)**			**Weight of dry matter per plot (kg)**			**Weight of matter in kg/ha**		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
Nitrogen (kg N/ha)									
0	52.67	50.67	51.67	2.44	2.05	2.25	1481	1708	1594.5
60	54.58	54.75	54.67	3.08	4.68	3.88	2372	2611	2491.5
120	47.50	50.75	49.13	3.09	4.87	3.98	2336	4014	3175
180	57.67	56.00	56.84	3.78	4.95	4.37	2894	4125	3509.5
Prob of F	**	**	**	*	Ns		**	**	**
Cowdung (t/ha)									
0	49.50	50.08	49.79	2.37	2.92	3.15	1559	3368	2463.5
1	52.67	50.78	51.73	2.97	3.56	3.27	2219	3201	2710
2	54.08	55.83	54.96	3.37	3.51	3.44	2384	2924	2654
3	56.17	55.50	55.84	3.69	3.56	3.63	2910	2965	2937.5
Prof of F	**	**	**	**	Ns	Ns	Ns	**	Ns

REFERENCE

Adamawa State, Agricultural Development Programme (AD, ADP) (2009). Annual Report.

Abubakar, A. (1991), Effect of Different weed control methods and nitrogen levels on yield and components of upland rice. MSc, Thesis pp 12-40.

Alam, S.M. and Azmi A.R. (1989). Effect of Phosphorus on growth and nutrient of rice plant Int. rice red News 141:20.

Belay, A., Gbebrekidan, H., Uloro, Y. and Zewdie, E. (1997). Effects of crop residues on grain yield response of sorghum (sorghum bicolour 2) to application N and P fertilizer. Nutrient cycling in Agric Ecosystems. 48:191-196.

Dedatta, S.K. and Ross V.E. (2005). Cultural Practices for Upland rice. In IRRI, Major Research in Upland rice. Los Benos, Philippines, pp 160-163.

Delipathy, J., Herbert, J.S. and Vaneman, P.L.M. (1994). Diary manure application to Alfalfa crop response to soil nitrate and soil water. *Agronomy Journal of America,* 86 (6): 927-929.

Dingkuhn M., Jones M.P., Johnson D.E. and Sow, A. (1998). Growth and Yield potential of *oryza sativa and o.glaberrima* upland rice cultivar and their interspecific progenies. Field crops research 57:57-69.

Duncan, D.B. (1955). Multiple range and Multiple F. Test *Biometric* 2:1-14, Duncan, M.G. and J.D. Hasketh (1968); Net photosynthesis rates, relative growth and rate and leaf number of 22 cases of Maize and eight temperatures. *Crop Science* 8(11)670-674.

Erenstein O; Lancon F., Osimane, A and Kebbeb, M. (2003). Operationalizing the strategic frame work fort rice revitalization in Nigeria. In the Nigeria rice Economy on a competitive world, constraints, opportunities and strategies choices. A report by USAID fund project implemented by West Africa Development Association (WARDA). The African rice centre, Abidjan, Cote d'Ivoire 38p.

Ezeakunna, C.O. Kari Kari, S.K, Olarewaju, J.D., Adu, J.K and Ladi H.M. (1986).The effects of N and P

Fertilizer and FYM on growth and yield of local garden egg var. Samaru Stripped. *Paper Presented at 22nd Conference of the Agric Asso. of Nigeria.* AERLS/ABU Zaria, Nigeria. Pp. 45-50.

Giller, K.E. (2002). Targeting Management of Organic Resources and Mineral Fertilizer CAB International Integrated Plant Nutrient Management in Sub-Saharan Africa, pp 1-10.

Gomez, K.A. and Gomez K.A. (1984). Statistical procedure for agricultural research, 680.

Katyal, K.C. Bijay, S., Sharima, V.K. and Craswel E.T. (2005). Efficiency of some modified urea fertilizers of wet land rice grown on preamble soil fert. Res 8: 137-140.

Lee, J.H. and Ota, Y (2001). In the role of root system of rice plant in relation to the physicochemical and morphological characteristics of aerial part *Y.Proc. Crop Science Soc. Japan:* 40.217-222 (in Japanese with English Summary).

Mokwunye, A.U. (1981). The role of inorganic fertilizer chemical degradation of Nigerian Savannah soils. Samaru Conference Papers 14: 1-15.

Oikeh, S.O., Nwilene, F. Diatta, S., Osimane, O., Toure, A and Okhindiecbie (2006 a). Agro Physiological responses upland NERICA rice to nitrogen and phosphorus fertilization in the forest agro ecology of West Africa paper presented at the ASACSSA-SSSA 2006 International Meetings, Indianapolis, USA, 12-16 November, 2006.

Preliminary Census (2006). Nigeria's Country Contrivers, National Population Commission of Nigeria bbc.co.uk BBC News December, 2005.

Reddy, G.R.S and Reddy, K.A. (1987). Effect of different forms of urea at various level of nitrogen for lowland rice. Abst. Trop. Agric. Viol. 12, No. 11, 81.

Singh, C., Singh, P and Singh R. (2003). Modern Techniques for raising field crops. Oxford and IBH Publishing Co. PVT Ltd. New Delhi 478p.

Yadev, R.L. and Prasad, S.K. (1992) Conserving the organic matter content of the soil to sustain sugar cane yield. *Experimental Agriculture.* 28 (1): 57-62.

Yanami, I, Emtery, O., Dinguing, L and Grip, H. (1997). Effect of organic manure and chemical fertilizer on nitrogen uptake and nitrate leaching in a Eumarthi eathrosolsprofile. Nutrient cycling Agro Eco-Systems. 48:225-229.