INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

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EVALUATION OF COMPLEMENTRY USE OF ORGANIC AND INORGANIC FERTILIZERS ON THE PERFORMANCE OF UPLAND RICE (*Oryza sativa* L.)

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ABSTRACT
A field experiment was conducted at the National Cereals Research Institute Badeggi upland rice field to evaluate the complementary use of organic (poultry dropping and cow dung) and inorganic fertilizers(urea) on the performance of rice cultivars. The experiment was arranged in a randomized complete block design(RCBD) with four replicates. The treatment consisted of three types of fertilizers (urea, cow dung, and poultry dropping) which were used as sole and combined at different rates. Application of 2kg of cow dung plus 260g N and 2kg of poultry dropping plus 260g N resulted in the highest number of rice plant vigour while the rest applications did not show any significant difference. There was no significant difference ($p>0.05$) in rice plant height at 30 DAS in almost all the plots except plot treated with 4kg of poultry dropping plus 173g N which recorded highest rice plant height. The application of 80kg N/ha resulted in highest plant height at 60DAS and 90DAS respectively. However, all fertilizer types and rates increased rice plant height significantly. The highest number of tillers was observed at 30 DAS when 6kg of poultry dropping plus 86g N was applied while other applications did not show any significant ($p>0.05$) difference. The lowest number of tillers was recorded at 30 DAS, 60 DAS, and 90 DAS in plot where 2kg of cow dung plus 6 kg of poultry dropping was applied. The control recorded a appreciable number of tillers. There was no significant ($p>0.05$) difference in panicle length, the application of 2kg poultry dropping plus 260g N recorded highest panicle length while the lowest panicle was observed in control. There was no significant ($p>0.05$) difference in panicle number. However, significant ($p<0.05$) difference was observed in grain yield. The application of 2kg poultry dropping plus 260g N recorded highest grain yield while lowest observed in control. Therefore, the application of 2kg poultry dropping plus 260g N to upland rice could be recommended could be recommended for optimal yield.

KEY WORDS: Poultry dropping, cow dung, Nitrogen, Panicle length, Grain yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is an important stable food providing 66-70 body calorie intakes of the consumers. There is the need to heighten awareness of the role of rice in alleviating poverty and malnutrition (Barah and Pandy, 2005). Nitrogen is typically the nutrient of most concern because it has strong influence on cereal crop yields. It is mostly abundantly found in the N_2 gaseous form, 99.4% of which is found in the earth's atmosphere Havlin *et al*. (2005). Nitrogen rate, type of nitrogen, and timing of its application are important factors to increase wheat yield Garrido–Lestanche *et al*., (2005),

Application of organic materials as fertilizers provides growth regulating substances and improves the physical, chemical and microbial properties of the soil Belay *et al*., (2001). Several field research reports have indicated that high and sustainable crops yields are only possible with integrated use of mineral fertilizer with organic manure Satyanarayana *et al*., (2002). Complementary application of organic and inorganic fertilizers increase nutrient synchrony and reduces losses by converting inorganic nitrogen to organic forms Kramer *et al*., (2002). The use of organic and inorganic fertilizer has its advantages and disadvantages in the content of nutrient supply, crop growth and environmental quality. The advantages need to be integrated in order to make optimum use of each type of fertilizer and achieve balanced nutrient management for crop growth.

Application of organic manures also improves the soil microbial properties Belay *et al*. (2001). Growth and sustained crop yield could be obtained with judicious and balanced NPK fertilization combined with organic manure amendments Makinde *et al*., (2001), Bayu *et al*., (2006). According to Gupta *et al*., (2004), the effect varies according to inherent physical and chemical properties of the soil**,** particularly on the nature and content. All together, the use of organic manure helps in improving soil structure, soil aeration and therefore the activities of the soil micro-organisms (Olayinka and Ailenubhi, 2001). Dung contains the undigested portion of the feed eaten by animals, whereas urine contains only soluble products and has higher nitrogen and potassium contents than dung and since these are in solution, they are quickly available to plant (Fagbenro, 2001). Long term use of cow-dung increase aggregate stability, pore space, bulk density and availability of water range Vanlauwe *et al*., (2001). Greater amount of manure is obtained when applied in small amounts and more often Vanlauwe *et al*., (2001).

Cow dung applied with inorganic nitrogen (N), increase soil (pH) and ameliorated acidity (Olayinka and Ailenubhi, 2001).

Mullens et. al., (2002) revealed that poultry litter contains a considerable amount of organic matter due to the manure and bedding material. Poultry manure improves soil physical properties significantly by reducing soil bulk density, temperature, and increasing total soil porosity and moisture content in Nigeria (Agbede et. al., 2008). In India, Amanullah et. al., (2007c) found that tuber yield was the highest with composted poultry manure followed by FYM plus CPM which was due to higher availability of nutrients and uptake by the crop as influenced by composted poultry manure.

Akande et. al., (2005) reported that complementary application of rook phosphate with poultry manure increase maize grain yield by 33% while cowpea yield was increased by 25%. Buri et. al., (2004) in an experiment with poultry manure, cattle manure and rice husk, applied single or in combination with mineral fertilizer (using urea or sulphate of ammonia as N source), found that a combination of half rate of organic amendment and half rate of mineral fertilizer significantly contributed to the growth and yield of rice.

In contrast to mineral fertilizer, poultry manure adds organic matter to soil which improves soil structures, nutrient retention, soil moisture holding capacity, and water infiltration (Deksissa et. al., 2008). It was also indicated that poultry manure moves readily, supplies P to plants than other organic manure sources (Gary and Bahla, 2008). Most studies on the use of animal wastes dealt with cow dung and poultry droppings and their fertility-improving value has been confirmed for many crops (Akanbi 2002). The use of available and cheap cow dung by vegetable farmers in Nigeria ensure sustainability of production and balanced nutrition as described by Moyin (2003). Soils treated with farmyard manure were found to contain enough soluble phosphoric acid, potash and lime (Pal *et al*., 2001). The long term use of cow dung increased aggregate stability, macro pores. Addition of cow dung to soil lower bulk density (Olaniyan *et al*., 2006).

MATRIALS & METHODS

Field experiment was conducted at National Cereals Research Institute Badeggi upland rice field (LAT. 9^0 45. N, Long. 06^0 07.E, 70.5 metres above sea level in southern Guinea Savanna ecological zone of Nigeria) to evaluate the complementary use of organic and inorganic fertilizers on the performance of rice cultivars. Soil at the site was randomly sampled at two depths (0-15cm and 15-30cm) using soil auger before land preparation and after harvesting of rice. The soil samples were analyzed for its physical and chemical characteristics. The soil of the experimental site was sandy clay textured (USDA classification), characterized with p^H of 5.7. The experiment was laid out in a randomized complete block design with four replicates. The treatments consisted of fertilizer types and rates. The treatments imposed were 8kgN/ha; cow dung at the rates of 8kgN/ha, 2kg/ha plus 260gN/ha, 4kg/ha plus 173gN/ha, 6kg/ha plus 86gN/ha, and 2kg/ha cow dung plus 6kg/ha of poultry manure; poultry manure at the rates of 8kg/ha, 2kg/ha plus 260gN/ha, 4kg/ha plus 173g N/ha, 6kg/ha plus 86g N/ha, and 2kg/ha poultry manure plus 6kg/ha cow dung; and control plot where no fertilizer was applied. Field preparation was by tractor after which seed beds each measuring 4mx5m were manually prepared. The treatments (cow dung and poultry manure at varying rates) were incorporated into the soil prior to sowing of rice seeds. The seeds used was obtained from seeds unit of NCRI Badeggi and were sown at the rate of four rice seeds per hill in July 2011. Fertilizer (urea) was split applied by broadcasting method on the plots that were to receive fertilizer (urea) at 30DAS, 60DAS, and at booting stage. The plot was weeded twice (3 and 6 weeks after sowing) using native hoe. Ten stands of rice plant were randomly selected and tagged from each of the plot for data collection. Data collected included plant vigour, plant height(cm) and tiller count at 30, 60, and 90 DAS; length of central panicle(cm) and number of panicles at maximum booting; grain yield (kg/ha). The rice was harvested in October 2011. Data collected were subjected to analysis of variance.

RESULTS

Plant height

There was no significant difference($p>0.05$) in Plant height at 30 DAS in almost all the plots with exception of plot treated with 4kg of poultry manure plus 173g N which recorded highest plant height(40cm) while the lowest plant height(29cm) was observed in plot treated with 2kg of poultry manure plus 260gN. At 60 and 90 DAS significant difference ($p<0.05$) was observed in all the treatments. The highest plant height (66.75cm and 82.75cm) was observed at 60 DAS and 90 DAS in plot treated with 8kg N/ha. However, all fertilizer types and rates increased plant height significantly.

Number of tillers

The numbers of tillers did not show significant difference ($p>0.05$) among the treatments at 30 DAS. The number of tillers increased with increase in number of days after sowing (DAS) across the fertilizer types and rates. The 8kg N/ha produced highest number (21) of tillers at 60 DAS while 2kg of poultry manure plus 260g N recorded the highest number (22) of tillers at 90 DAS. The control recorded the lowest of tillers throughout.

Number of panicles and central panicle length

The number of panicles between the treatments were not significantly ($p>0.05$) influenced by fertilizer types and rates. The number of panicles across the fertilizer types and rates ranged from 27-38. Among the fertilizer types and rates, the 2kg of poultry manure plus 260g N produced the highest number of panicles (38) while the lowest number of panicles (25) was observed in control. The central panicle lengths of the rice were not significantly affected the types of fertilizer and rates. The central panicle length varied from 16.75cm in the control plot to 21.50cm where 2kgh/ha of poultry manure plus 260g N/ha was applied.

TABLE 1: Effect of complementary use of organic and inorganic fertilizer on plant height

Treatment	Plant height (cm)		
	30DAS	60DAS	90DAS
Control	35.50ab	50.25ef	71.50cde
80KgN/ha	37.50ab	66.75aa	82.72aa
8Kg (CD)	34.25ab	51.00def	70.75cde
8Kg (PD)	36.75ab	62.00abc	75.00bcd
2Kg (CD) + 260gN	35.50ab	53.75c-f	81.75ab
4Kg (CD) + 173gN	36.50ab	62.75ab	78.00abc
2Kg (PD) + 260gN	29.00b	64.75ab	76.25a-d
4Kg (PD) +173gN	40.00a	58.25a-e	71.75cde
6Kg (CD) + 86gN	36.50ab	56.75a-f	71.00cde
6Kg (PD) + 86gN	36.75ab	59.25a-d	70.00de
2Kg (PD) + 6Kg (CD)	30.50ab	50.00ef	71.75cde
2Kg (CD) + 6Kg (PD)	35.75ab	48.25f	65.75e
SE±	3.07	2.71	2.39

Means with different superscript within the column are significantly different ($p<0.05$)
Poultry dropping (PD), Cow dung (CD), Urea (N)

TABLE 2: Effect of complementary use of organic and inorganic fertilizer on tiller count

Treatment	Tiller count		
	30DAS	60DAS	90DAS
Control	17.75abc	17.75ab	15.75d
80KgN/ha	15.50abc	20.50a	21.25ab
8Kg (CD)	20.50ab	15.25ab	16.50cd
8Kg (PD)	15.50abc	12.25ab	19.00a-d
2Kg (CD) + 260gN	17.50abc	16.25ab	20.25ab
4Kg (CD) + 173gN	16.00abc	16.75ab	20.25ab
2Kg (PD) + 260gN	12.25c	17.75ab	22.00a
4Kg (PD) +173gN	16.75abc	17.50ab	19.50abc
6Kg (CD) + 86gN	16.50abc	17.50ab	19.50abc
6Kg (PD) + 86gN	21.75a	16.75ab	18.25bcd
2Kg (PD) + 6Kg (CD)	13.75bc	18.00ab	19.50abc
2Kg (CD) + 6Kg (PD)	11.75c	15.50ab	15.75d
SE±	2.27	2.01	1.06

Means with different superscript within the column are significantly different ($p<0.05$)
Poultry dropping (PD), Cow dung (CD), Urea (N)

TABLE 3: Effect of complementary use of organic and inorganic fertilizer on panicle length, panicle number, grain yield and 1000 grain wt

Treatment	Panicle length (cm)	Panicle No.	Grain yield Kg/ha	1000 Grain wt(g)
Control	16.75e	30.25a	390.0d	22.65d
80KgN/ha	20.50abc	34.50a	1810.0ab	27.17abc
8Kg (CD)	18.25de	29.25a	652.5cd	25.65bcd
8Kg (PD)	20.00a-d	28.50a	1237.5bc	27.40abc
2Kg (CD) + 260gN	20.75abc	27.25a	1390.0abc	24.27cd
4Kg (CD) + 173gN	21.25ab	35.00a	1775.0ab	26.62abc
2Kg (PD) + 260gN	21.50aa	38.00a	2127.5a	27.20abc
4Kg (PD) +173gN	20.50abc	32.50a	1807.5ab	28.37ab
6Kg (CD) + 86gN	20.25abc	27.50a	935.0cd	25.35bcd
6Kg (PD) + 86gN	20.00a-d	28.75a	2055.0a	28.82a
2Kg (PD) + 6Kg (CD)	19.25cd	32.50a	1125.0bc	24.62cd
2Kg (CD) + 6Kg (PD)	19.50bcd	30.00a	680.0cd	24.52cd
SE±	0.58	3.87	230.10	0.94

Means with different superscript within the column are significantly different ($p<0.05$) Poultry dropping (PD), Cow dung (CD), Urea (N)

Grain yield

Rice yield was significantly influenced by types of fertilizer and rates. The rice variety used exhibited significant response to application of fertilizer types and rates. It was observed that application of 2kg/ha of poultry manure plus 260g N/ha and 6kg/ha of poultry manure plus 86gN/ha to rice yielded significantly higher (2127.5kg/ha) than other fertilizer types and types while the lowest (390kg/ha) rice yield was recorded in control. The rice yield across the treatments rates ranged from 390kg/ha to 2127.5kg/ha.

DISCUSSION

Inorganic fertilizers are known to have the peculiarity of fast release of their nutrient contents. Nutrients supplied from the inorganic fertilizer seemed to be released fast enough at 30 DAS to give significantly taller plants. Even nutrients supplied from the complementary application of organic and inorganic fertilizers seemed enough to have plants not significantly shorter than plants treated with sole inorganic fertilizer application. Organic fertilizers are known to the characteristics nature of slow release of nutrients. The observed shorter plants from the sole organic fertilized plants can be attributed to the slow release nature of the fertilizer as assessed throughout the growing period. A similar observation has been made with other in other studies (Ayoola and Makinde, 2007). Rice plant heights with inorganic fertilizer and a complementary application of organic and inorganic fertilizers were observed to be similar and were significantly greater than those from sole organic fertilizer application. Comparable rice yield from both complementary application of organic and inorganic fertilizers and from sole inorganic fertilizer is a further indication that the nutrients supplied from the complementary application were effective enough to those supplied with sole inorganic fertilizer. A similar study on maize had reported grain yields from sole inorganic fertilizer and from complementary application of inorganic and organic fertilizers to be comparable and significantly higher than yields from sole organic fertilizer application (Makinde *et al*., 2001). It was also observed that sole organic fertilizer (cow dung) application did not benefit the yield of rice significantly. The observed lower yield from sole organic fertilizer application supports the observation that organic fertilizers are better used for sustaining continuous cropping for 2-3 years than inorganic fertilizers (Agbim 1985).

CONCLUSSION

The findings from this study revealed that the rice responded differently to the application of different rates of organic and inorganic fertilizers. Increase in the rates of organic fertilizer did not significantly increase yield of upland rice. The study indicated that 2kg/ha of poultry manure plus 260g N/ha could support the growth and yield of upland in this agro-ecology particularly when FARO 55 is planted.

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