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GROWTH AND YIELD OF RICE AS INFLUENCED BY VARIETY, FERTILIZER AND PLANTING METHODS

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Abstract
Field trials were conducted at Nasarawa State University Keffi, Faculty of Agriculture, Shabu Research Farm located between 08^0.33' N and 08^0.33' E, 181.53m above sea level and in Doma farm 08.23^{0}N and 08.21^{0}E in Doma local government area of Nasarawa state. They were conducted during the 2021 rainy season to study the effect of different varieties, planting methods and fertilizer types on the growth, yield and yield characters of rice (Oryza sativa L.). The experiment consisted of two varieties (Jankara and Faro 52), two fertilizer types (granulated urea and Urea Super Granule –USG) and three planting methods (dibbling, broadcasting and transplanting). The twelve treatment combinations were laid out in a split-plot design with three replications. Variety and fertilizer types were assigned to the main plot while planting method was allocated to the sub-plot. The results obtained showed that virtually all the growth, yield and yield characters of rice measured were significantly increased by planting of Faro 52, application of USG and transplanting. Transplanting method of planting, application of USG and improved variety of rice (Faro 52) is therefore recommended in this agro-ecology.
Keywords: ***Dibbling, broadcasting, transplanting, Urea Super Granule***

Introduction

Rice is a staple food for more than 3.5 billion people (nearly half the population of the world) across the globe (Ricepedia, 2017). In Asia, people often eat rice two or three times a day, obtaining 30 to 70% of their dietary energy from it (IRRI, 2016). In Africa, a similar rice consumption trend is observed in Nigeria, Ghana, Uganda, Sierra Leone, etc. Rice is also a source of livelihood for more than one-fifth of the world's population (Haruna, 2023). With the projected world population growth of 2.3 billion people between 2009 and 2050, there will be an increase in demand for rice by 25% to meet the growing population (FAO, 2009). Globally, China is the highest producer of rice and the highest consumer. In 2021/2022, China produced over 148 million metric tons of milled rice, a higher volume than any other country. India came in second place with over 129 million metric tons of milled rice in that crop year. In Africa, in 2021, rice production in Nigeria amounted to around 8.3 million metric tons, making the country the leading rice producer in Africa. Egypt and Madagascar followed with an output of about 4.8 million and 4.4 million metric tons of rice, respectively. The average yield per hectare in the world is 4.25 metric tons but it varies from country to country. The highest yield of 10.04 metric tons has been registered in Egypt, followed by 7.94 metric tons in USA, 6.54 metric tons in Japan and 6.49 metric tons in China. In India, production of rice per hectare is 3.38 metric tons sonly. It is lowest in Burma and Nigeria with 2.64 and 2.36 metric tons per hectare respectively (Haruna, 2023). The reasons for the lower average yield per hectare in Nigeria and some African countries could be attributed to the fact that most of the farmers do not use improved varieties of rice seeds, adoption of the broadcast method of planting compared to transplanting method, application of little or no fertilizer to the plant among other factors (Haruna, 2023).

Khush (2005) reported that producing varieties having resistance against biotic and abiotic stress by using conventional and modern biotechnology can increase rice yields to meet world requirement. The varieties have different physiological and morphological characters that contribute towards yield (Yang *et al.*, 2007). Ashrafuzzaman *et al.,* (2009) found variation in morphological and yield components in different varieties of aromatic rice. Nitrogen and phosphorus fertilizers are major essential plant nutrients and key input for increasing crop yield. (Alam *et al.,* 2009; Alinajoati and Mirshekari, 2011). However, nitrogen remain the most important nutrient for rice plant as it is required at much higher rates than other macro nutrients such as phosphorus and potassium. Nutrient deficiency and poor planting method generally result in stunted growth and chlorotic leaves due to poor assimilate formation that leads to premature flowing and shortening of the growth cycle. Several field researches reports have indicated that high and sustainable crops yield are only possible with integrated use of mineral fertilizer, good variety and with good planting method (Satyanarayana *et al*., 2002).

Low rice yield in Nigeria is also attributed to inadequate information on the appropriate combination of fertilizer type and planting method most suitable for the various varieties. Several experiments on crops have generally indicated yield increase due to nitrogen, while others use encapsulated urea which is referred to as Urea Super Granule (USG). It dissolves slowly thereby take a longtime releasing nutrient slowly for the growth and development of the rice plant. Granular urea is the urea commonly used by majority of farmers and usually applied by broadcast method of application. It is known to dissolve very fast and is expensive. Considering that the world population is increasing and the demand for rice as food is increasing, there is the need to enhance its productivity by adopting high-yielding varieties, proper planting methods and optimum fertilizer application. In Nasarawa State for example, bulk of the rice farmers do not use improved rice variety, indulge in broadcasting method of planting and fertilizer application thereby leading to wastage of seeds and fertilizer. Adoption of good agricultural practices in the production of rice will boost the yield and the economic status of the farmer. This study therefore seeks to examine the varietal response of rice to planting methods and types of urea fertilizer in Nasarawa State.

Materials and Methods

Field trials were conducted during the wet season of 2017 as Nasarawa State University, Faculty of Agriculture, Shabu research farm located latitude 08.33˚N and longitude 08.33^{0}E, 181.53m above sea level, in the Southern Guinea Savannah Agro-ecological Zone of Nigeria and Doma Local government area of Nasarawa State located between latitude 08.39^{0}N and 08.36˚E.

The experiment consisted of factorial combination of three different planting methods (dibbling, transplanting and broadcasting), two different nitrogen fertilizer types or forms (granulated and tablet) and two different varieties of rice (Faro 52 and Jankara). The twelve treatment combinations were laid out in a split-plot design. Varieties and fertilizer types were placed in the main plots, the various planting methods were allocated to the sub plots. The treatments were replicated three times. There were 6 rows in each plot, the gross plot size was 4 m x 4m (16 m^2) while the net plot size was 3 m x 3m (9 m^2). The fields were cleared, ploughed and harrowed then the field was marked into plots, 2 meters unplanted borders were maintained between replications, and 1meter unplanted boarder was maintained between plots.

The nursery for raising seedlings was sown in May as soon as the rain established while transplanting was done 3 weeks after sowing on the nursery (3WAS). At the time of nursery establishment, dibbling was carried out at a spacing of 20 cm x 20 cm, broadcasting was equally carried out. Three weeks after nursery establishment, transplanting was done by planting one seedling per hole at 20 cm x 20 cm. transplanting, dibbling and broadcast planting were carried out according to treatment plan. All other cultural practices for good rice yield were carried out.

Harvesting was done when 80% of the rice in each plot has changed colour from green to yellow. By cutting all the plants in each plot with the aid of a sickle. The harvested rice from each plot were put inside a bag to dry before threshing.

Five randomly selected plants were tagged and used for periodic data collection on the growth characters such as plant height, number of tillers per plant, number of leaves per plant. The yield and yield characters evaluated were panicle length, number of seeds per panicle, panicle weight and seed yield per plant, 1000 – seed weight and seed yield per hectare.

The data collected were subjected to analysis of variance using F – test to estimate the significance in the effect of the treatment as described by Snedecor and Cochran (1990) and the significant difference among the treatment mean was evaluated using the Least Significant Difference (LSD) test at 5% level of significant.

Results

Plant Height

Table 1 shows the effect of varieties, fertilizer types and planting methods on plant height of rice at 4, 6, 8 10 and 12 WAS in both Doma and Lafia during the raining season of 2021. The results obtained showed that improved variety (Faro 52) produced significantly taller plants compared to the local varieties at all sampling periods in both locations except at l0 WAS in Doma. Similarly, application of Urea super granule fertilizer types produced significantly taller plants at 4, 6, 8, 10 and 12 WAS compared to granulated urea in Doma and Lafia. Transplanting method of planting produced significantly taller plants compared to both dibbling and broadcasting which are statistically similar at 4 and 6 WAS. However, at 8, 10 and 12 WAS dibbling method of planting produced significantly taller plants compared to the broadcasting method of planting which had the shortest plants.

A significant interaction was recorded between varieties and planting method at 12 WAS in Doma (Table 2). The results of the interaction revealed that the tallest plant was produced by transplanting Faro52.

Table 1: Response of Rice Varieties, Fertilizer types and Planting Methods on Plant Height of Rice at 4, 6, 8, 10 and 12 WAS in Doma and Lafia, 2021 wet season

Treatments	DOMA					LAFIA				
	4	6	8	10	12	4	6	8	10	12
			WAS					WAS		
Variety (V)										
Jankara	24.1^{b}	34.8^{b}	61.2^{b}	92.2^{a}	105.4^{b}	23.6^{b}	40.4^{b}	46.7^{b}	57.7^{b}	74.3^{b}
Faro 52	25.6^{a}	35.8^{a}	64.3^{a}	45.8^{b}	110.5^{a}	25.6^{a}	46.9^{a}	48.9^{a}	61.9^{a}	78.8^{a}
SE±	0.10	0.04	0.03	01.0	0.10	0.18	0.82	0.47	0.33	0.68
Fertilizer types (F)										
Granulated	24.6^{b}	34.5^{b}	61.1^{b}	92.2^{b}	105.1^{b}	27.6^{b}	42.4^{b}	45.2^{b}	57.5^{b}	73.6^{b}
USG	25.8^{a}	36.1^{a}	64.4^{a}	95.7^{a}	110.9^{a}	28.8^{a}	44.9^{a}	50.4^{a}	62.1^{a}	79.5^{a}
SE±	0.10	0.04	0.03	0.10	0.10	0.18	0.82	0.47	0.33	0.68
Planting Methods (P)										
Dibbling	23.8^{b}	34.7^{b}	62.0^{b}	92.7^{b}	106.9^{b}	24.3^{b}	41.8^{b}	46.8^{b}	57.90^{b}	74.65^{b}
Broadcasting	23.5^{b}	34.2^{b}	58.5^{c}	90.0^{c}	104.0^{c}	24.2^{b}	41.9^{b}	43.8^{c}	56.57^{c}	73.62^{b}
Transplanting	27.3^{a}	37.0^{a}	67.80^{a}	99.3^{a}	113.0^{a}	25.4^{a}	47.3^{a}	52.8^{a}	64.96^{a}	81.38^{a}
SE±	0.52	0.19	0.67	0.50	0.87	0.22	1.00	0.57	0.40	0.83
Interaction										
V X F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X P	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column or treatment group are significantly the same using LSD at 5% probability level.
NS = Not significant

*** = Significant at 5% level of Significance**

Table 2 Interaction between Varieties and Planting Methods on Plant Height (cm) at 12 WAS in Doma during 2021 Rainy Season

Treatment		**Planting methods**	
Varieties	Dibbling	Broadcasting	Transplanting
Local	103.07[c]	103.14[c]	110.03[b]
Faro 52	110.70[b]	104.87[c]	116.04[a]
SE±		0.88	

Means followed by the same letter(s) are significantly similar using LSD (0.5)

Number of Leaves

Table 3 shows the effects of varieties, fertilizer types and planting methods on the number of leaves in both Doma and Lafia during the raining season of 2021. The results obtained at both locations showed that at all sampling periods, application of USG fertilizer, planting of Faro 52 and transplanting method of planting produced significantly plants with higher number of leaves compared to application of granulated urea, planting of local varieties, dibbling and broadcasting methods of planting. Interactions between the treatments tested were not significant.

Number of Tillers

At all sampling periods and in both locations (Doma and Lafia), planting of Faro 52 variety of rice by transplanting along with application of USG fertilizer produced highly significant number of tillers compared to planting of the local variety of rice, application of granulated urea, dibbling and broadcasting methods of planting (Table 4).

Highly significant interactions occurred between varieties and planting methods at 12 WAS in both locations (Table 5). The results of the interactions showed that planting of Faro 52 by transplanting produced significantly the highest number tillers.

Table 3: Response of Rice Varieties, Fertilizer Types and Planting Methods on the Number of Leaves at 4, 6, 8, 10 And 12 WAS In Doma and Lafia, 2021 Wet Season

Treatments	DOMA					LAFIA				
	4	6	8	10	12	4	6	8	10	12
			WAS					WAS		
Varieties										
Jankara	5.3[b]	13.0[b]	33.5[b]	66.8[b]	70.1[b]	4.0	9.9	27.6[b]	58.8[b]	61.6[b]
Faro 52	5.5[a]	13.8[a]	35.4[a]	69.7[a]	72.4[a]	4.0	10.9	28.8[a]	63.3[a]	66.1[a]
SE±	0.01	0.03	0.09	0.11	0.09	0.04	0.38	0.22	1.38	0.53
Fertilizer types										
Granulated 1	4.9[b]	11.5[b]	31.5[b]	63.3[b]	66.4[b]	4.0	9.6[b]	24.8[b]	56.5[b]	59.9[b]
USG 2	5.8[a]	15.4[a]	37.3[a]	73.2[a]	73.2[a]	4.1	11.2[a]	31.5[a]	65.5[a]	67.9[a+]
SE±	0.01	0.03	0.09	0.11	0.09	0.04	1.38	0.22	0.38	0.53
Planting Methods										
Dibbling	5.3[b]	13.0[b]	33.4[b]	68.5[b]	69.7[b]	4.1	9.8[b]	27.4[b]	60.7[b]	63.5[b]
Broadcasting	5.2[b]	12.5[c]	31.9[c]	65.0[c]	68.5[b]	4.0	10.2[ab]	25.3[c]	57.9[c]	61.0[c]
Transplanting	5.6[a]	14.9[a]	38.0[a]	71.1[a]	75.4[a]	4.1	11.3[a]	31.5[a]	64.4[a]	67.1[a]
SE±	0.08	0.09	0.28	1.09	0.48	0.05	0.46	0.27	0.47	0.65
Interaction										
V X F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	**
F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of treatment group are significantly the same using LSD at 5% probability level.
NS = Not significant

Table 4: Response of Varieties, Fertilizer Types and Planting Methods on Number of Tillers (m^{-2}) at 4, 6, 8, 10 and 12 WAS in Doma and Lafia, 2021 rainy season

Treatments	DOMA					LAFIA				
	4	6	8	10	12	4	6	8	10	12
			WAS					WAS		
Varieties										
Jankara	2.5	8.9^{b}	22.0^{b}	29.7^{b}	31.6^{b}	0.6^{b}	8.0^{b}	16.7^{b}	26.7^{b}	28.4^{b}
Faro 52	2.5	9.4^{a}	23.6^{a}	31.9^{a}	34.5^{a}	0.8^{a}	8.5^{a}	17.0^{a}	27.7^{a}	29.0^{a}
SE±	0.01	0.01	0.06	0.05	0.05	0.07	0.11	1.01	0.06	0.01
Fertilizer types										
Granulated 1	2.1^{b}	7.7^{b}	20.3^{b}	28.4^{b}	30.8^{b}	0.5^{b}	6.4^{b}	15.0^{b}	25.0^{b}	26.4^{b}
USG 2	3.0^{a}	10.6^{a}	25.4^{a}	33.3^{a}	35.4^{a}	1.0^{a}	10.1^{a}	18.8^{a}	29.3^{a}	31.0^{a}
SE±	0.01	0.01	0.06	0.05	0.08	0.07	0.11	1.01	0.06	0.01
Planting Methods										
Dibbling	2.3^{a}	8.9^{b}	22.1^{b}	30.1^{b}	32.4^{b}	0.6^{b}	8.1^{b}	15.9^{b}	26.8^{b}	28.1^{b}
Broadcasting	2.5^{a}	8.3^{c}	21.3^{b}	28.7^{c}	31.4^{b}	0.4^{b}	7.1^{c}	15.4^{b}	25.5^{c}	27.8^{b}
Transplanting	2.8^{a}	10.2^{a}	25.1^{a}	33.6^{a}	35.5^{a}	1.1^{a}	9.7^{a}	19.3^{a}	29.3^{a}	31.2^{a}
SE±	0.17	0.67	0.32	0.23	0.58	1.12	0.07	0.11	0.16	0.03
Interaction										
V X F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X P	NS	NS	NS	NS	**	NS	NS	NS	NS	**
F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V X F X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of treatment group are significantly the same using LSD at 5% probability level.
NS = Not significant

**** = Significant at 5% level of Significance**

Table 5: Interaction between rice Variety and Planting Methods on Number of Tillers at 12 WAS at Doma and Lafia 2021 Rainy Season.

	DOMA			LAFIA		
Treatment	Planting	Methods		Planting	Methods	
Varieties	Dibbling	Broadcasting	Transplanting	Dibbling	Broadcasting	Transplanting
Jankara	30.58^{d}	30.83^{d}	33.50^{bc}	26.85^{c}	27.32^{c}	30.97ab
Faro 52	34.14^{b}	31.94^{cd}	37.45^{a}	29.32^{b}	26.28^{b}	31.43^{a}
SE±		0.58			0.47	

Means followed by the same letter(s) are significantly similar using LSD (0.5).

Yield Characters of Rice

Table 6 shows the effect of variety, fertilizer types and planting methods on the panicle weight per plant, number of seed per panicle, weight of seeds per panicle and panicle length in both Doma and Lafia during the raining season 2021.

The results in both locations showed that varietal differences had no significant influence on panicle weigh but, significantly higher number of seeds per panicle, seed yield per panicle and panicle length were obtained by the Faro 52 compared with the Jankara variety. Application of USG produced plants with significantly higher panicle weights, number of seeds per panicle, seed yield per panicle and panicle length compared to application of granulated urea in both locations. Transplanting method of planting displayed the highest panicle weight per plant, while dibbling and broadcasting method of planting showed lowest in all both locations and at all sampling periods except at Lafia where it had no significant effect. The interactions between various treatments were not significant.

Table 6: Response of Rice Varieties to Fertilizer types and Planting methods on (panicle weight, number of seed per panicle, panicle length and weight of seeds per panicle in Doma and Lafia, 2021 Rainy Season

	DOMA				LAFIA			
Treatments	Panicle Weight	No. of seeds Per panicle	Seed wt. Per panicle	Panicle Length	Panicle Weight	No. of seeds Per panicle	Seed wt. Per panicle	Panicle Length
Varieties	(g)		(g)	(cm)	(g)		(g)	(cm)
Jankara	4.8	159.7^{b}	2.6^{b}	17.9^{b}	4.6	133.3^{b}	2.3^{b}	16.3^{b}
Faro 52	4.9	171.7^{a}	2.9^{a}	19.5^{a}	4.8	160.2^{a}	2.5^{a}	17.9^{a}
SE±	0.02	0.21	0.005	0.004	0.07	0.16	0.02	0.03
Fertilizer types								
Granulated 1	4.3^{b}	156.6^{b}	2.6^{b}	16.5^{b}	4.6^{b}	133.1^{b}	2.4^{b}	16.0^{b}
USG 2	5.4^{a}	171.9^{a}	2.9^{a}	17.9^{a}	5.0^{a}	155.4^{a}	2.5^{a}	18.2^{a}
SE±	0.02	0.21	0.005	0.004	0.07	0.16	0.02	0.03
Planting Methods								
Dibbling	4.6^{b}	163.0^{b}	2.6^{b}	17.7^{c}	4.7	148.0^{b}	2.3^{b}	16.1^{c}
Broadcasting	4.6^{b}	158.4^{c}	2.6^{b}	18.4^{b}	4.5	128.8^{b}	2.3^{b}	17.0^{b}
Transplanting	5.5^{a}	175.8^{a}	3.1^{a}	20.0^{a}	5.0	171.5^{a}	2.5^{a}	18.3^{a}
SE±	0.93	0.89	0.02	0.67	0.83	0.65	0.11	0.07
Interaction								
V X F	NS	NS	NS	NS	NS	NS	NS	NS
V X P	NS	NS	NS	NS	NS	NS	NS	NS
F X P	NS	NS	NS	NS	NS	NS	NS	NS
V X F X P	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of treatment group are significantly the same using LSD at 5% probability level.
NS = Not significant

1000 seeds weight (g) and Grain Yield (kg/ha)

Planting of Faro 52 rice variety, application of USG fertilizer and transplanting method of planting at both locations, produced significantly the heaviest 1000-seeds and grain yield per hectare (Table 7).

Table 7: Response of Rice varieties, fertilizer types and planting methods on 1000-seed weight (g) and Grain Yield of Rice Doma and Lafia, 2021 Rainy Season

Treatment	DOMA		LAFIA	
	1000-Seed Weight (g)	Grain yield (kg ha^{-1})	1000-Seed Weight (g)	Grain yield (kg ha^{-1})
Varieties				
Jankara	26.9^{b}	3045.1^{b}	26.7^{b}	2256.8^{b}
Faro 52	29.3^{a}	4574.0^{a}	28.2^{a}	4254.8^{a}
SE±	1.00	0.03	0.01	16.04
Fertilizer type				
Granulated	27.8^{b}	3122.2^{b}	27.0^{b}	3084.6^{b}
USG	28.4^{a}	4496.9^{a}	27.9^{a}	3727.1^{a}
SE±	1.00	0.03	0.01	16.04
Planting Methods				
Dibbling	27.1^{b}	3714.8^{b}	27.7^{b}	3270.4^{b}
Broadcasting	27.0^{b}	3429.6^{c}	27.2^{c}	2974.8^{c}
Transplanting	30.3^{a}	4284.3^{a}	28.6^{a}	3972.3^{a}
SE±	0.30	53.9	0.04	69.41
Interaction				
V X F	NS	NS	NS	NS
V X P	NS	NS	NS	NS
F X P	NS	NS	NS	NS
V X F X P	NS	NS	NS	NS

Means followed by the same letter(s) within a column of treatment group are significantly The same using LSD at 5% probability level.
NS = Not significant

Discussion

The crop growth and yield recorded in the two trials could be attributed to the high amount and well distributed rainfall received. The rainfall was adequate for both vegetative and reproductive stages of the crop. Apart from the high rainfall, the good performance of the crop was probably due to the relative higher total nitrogen content and available phosphorus in the soils of the experimental site. Under low fertility, the plants will be unable to obtain nutrients in adequate amount for good growth and development thereby affecting crop yield. This is in line with the study of Adeosun, (2000) in rice, in which he stressed that low yield of rice was obtained due to low levels of soil nutrient, pH, organic matter, available P and total nitrogen which made the crops unable to maximally utilize them for carbohydrate synthesis, the consequence of which was ultimately growth and yield reduction.

Varietal Response

The significant difference recorded between the two rice varieties on plant height, number of leaves of rice, leaf area, number of tillers and 1000 - seed weight could be explained by the fact that these characters are genetically controlled and can be influenced by environmental factors. This could also be due to the differences in the rate of nutrients absorption and utilization between the two varieties, which could lead to production of more assimilates in the rice plants as well as increase in growth and yield attribute. These observations were in consistence with that of Halder *et al.*, (2000) and Hag *et al.,* (2002) who reported that increased rate of the NPK fertilizer favored the vegetative growth in rice plants. Thus, variety Faro 52 was observed to be taller and has longer panicles as well as more grain yield than Local variety. Plant height is genetically determined (IAR 1985). The height of rice plant is perhaps more of genetic than environmental trait. Variety Faro 52 has wider leaves, which have the ability to intercept more solar radiation that can result in the supply of assimilate during the ripening period, and this may be the reason for more seeds development than Jankara. Ndon and Nadya (2001) reported that difference in growth indices of rice is normally attributed to their genetic make-up, this is in line with the work of Emebiri *et al*. (1992) who reported cultivars difference among okra in terms of growth. Akinfasoye *et al.* (1997) also reported that different in yield of crops has been attributed to the cultivars grown and their genetic makeup. The mean yield of Faro 52 was the highest for both Doma (4574 kg/ha) and Lafia (4255 kg/ha) field trial. The reason is the variability in the genetic makeup of the cultivars. This was supported by the results of Fathelrahman *et al.,* (2015) who found high genetic variability among rice cultivars.

Response to Fertilizer Types

The significant response of various crop parameters like 1000-grain weight, more productive tillers and grain yield thus resulting in higher yields in both trials could be attributed to the role of applied N to the plants during the trials, which were essential in plant growth and development. This is supported by the findings of Place *et al.* (2010) who reported that the use of nitrogen under good environmental conditions significantly influenced the growth and yield of rice. The crop requires adequate supply of nutrients particularly nitrogen, for optimum growth and yield. This also agrees with the findings of Adediran and Banjoko. (2003) which showed that application of these nutrients (N) is important for enhanced panicle length, number of tillers and yield of rice. Another study had shown that the application of N and or NPK led to significant increase in the growth and yield of rice (Gafar, 2016). The significantly higher growth, yield and yield characters recorded due to the application of USG compared to granulated urea could be attributed to the fact that USG is a pelleted fertilizer that releases the nutrients gradually for a very long time thereby making the fertilizer use efficiency to high compared to the granulated urea that dissolves easily.

4.2.3 Response to Planting Methods

Planting methods can affect growing environment of a crop and subsequently influence its yield. Yield though is a major trait through which a cultivar is selected, there are other component factors which directly or indirectly influence the potential of a cultivar in a given situation or condition. Apart from inherent potential of a crop, the environmental influence on this potential determines how it is manifested and optimized. For instance, the mean effects of increasing plant population by different planting methods, increased competition between adjacent plants (Hay and Walker, 1989) which subsequently affect yield. This could be due to various physiological processes that affect leaf sheath and blade extension and overall development processes under varying planting methods and spacing. The tiller count was significantly affected by planting method in rice. The higher tiller count in the transplanting method could have been due to

optimal plant spacing. Planting method and growing environment are therefore among factors influencing the yield of the crop. Proper spacing is said to ensure good water management (Mazid, *et al.,* 2003) and photosynthetic activities and assimilate partitioning (Kundu, *et al.,* 1993), thereby resulting in good yield in well–spaced rice fields. In this study, transplanting methods recorded the highest and highly significant tiller count and paddy yield than other methods, followed by dibbling. This could be due to plant spacing in seedling transplanting and dibbling, resulting in limited competition as compared to broadcasting methods.

Conclusion

From the foregoing, it can be seen that the growth, yield and yield characters of rice were significantly enhanced by the planting of Faro 52 variety of rice, application of USG fertilizer and transplanting. Faro 52 variety of rice, application of USG fertilizer and transplanting is therefore recommended in this agro-ecology for higher yield.

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