EFFECT OF DIFFERENT DOSES OF NITROGEN PHOSPHORUS AND POTASSIUM ON GROWTH AND YIELD OF RICE CULTIVARS

ABSTRACT

The experiment was conducted at the screen house of the Department of Biological Science Abubakar Tafawa Balewa University Yelwa Campus Bauchi State, Nigeria, located at 10º16’ 52’’ N 9º 19’’ longitude and latitude. The objective of this research is to determine rice genotypes nutrient use efficiency under low NPK fertilizer treatments. The whole experiment was randomized using Microsoft excel in completely randomized block design (CRBD) with four replication, the germinated seedlings of each cultivar from the petri-dish were planted into two each in plastic pots measuring 30cm with drainage holes at the bottom and the soil of 1.5kg was filled into the pot. For the NPK treatments, two levels of fertilizer adopted were 200kg/ha NPK, which was considered as full dose (FD), and the control, while the 100kg/ha NPK was considered as half dose (HD), and the other experiment tag CF, and without application of fertilizer. The whole experiment was given continuous water flooding throughout period. The experimental data collected of plant height, tillers, shoot mass, root mass, and grain yield on FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 were subjected to analysis of variance, from the results obtained, and the outcome showed was no significant difference between the treatments. This could suggest the rice cultivars resilience to NPK. However, continuous flooding (CF) without fertilizer application performed minimal.

KEY WORDS: NPK, Continuous flooding, growth, yield and Rice (*Oryza sativa)*

Introduction

With nearly half of all calories consumed worldwide coming from rice (*Oryza sativa* L.), it is one of the most significant staple food crops for the majority of human populations. In addition to being high in calories, rice is generally known for its high nutritional benefits, which include high fiber, vitamins, and minerals as well as low cholesterol and sodium levels, indicating that it is a healthy source of energy (Khush, 2005; Sellamuthu *et al*., 2011). Nigeria's consumption of rice was ranked 12th in the world in 2009, while its production was ranked 17th worldwide, third in Africa, and first in West Africa (FAO, 2011). According to the literature that is currently available, the annual production of rice raised from 5.5 million tons in 2015 to 5.8 million tons in 2017 (Udemezue, 2018).The increase in rice production was due to increased land being used for rice farming, not an increase in yield. However, at roughly 1.5 t/ha, the usual rice production is consistently low (RIFAN, 2017). There has been a well-documented surge in demand for rice as per capita consumption in Nigeria has increased. As a result, Nigeria's meager domestic production is frequently augmented at various points by massive imports, both in terms of quantity and value (Udemuzue, 2018).

The management of plant nutrients is a crucial component in increasing agricultural productivity. N, P, K, and S are the nutrients that directly affect the growth and yield of rice. To reduce loss and boost nutrient utilization efficiency, it is crucial to apply these nutrients effectively. However, our farmers' use of unbalanced or excessive fertilizer to maintain production levels has led to the contamination of the land and water, which must also increase the cost of food goods on the market. It has a direct impact on crop growth, leading to low yield. However, boosting the production of rice has been made possible in large part through balanced fertilization. Plant height, tiller number, shoot, and root biomass, and other growth characteristics directly affect the rice crop's yield. With the intention of using fertilizers wisely to give nutrients for productive rice production (Khan *et al*., 2004). Proper nitrogen application can markedly enhance the mean grain filling rate, maximum grain filling rate, and grain weight during the active grain filling phase of subpar grains, ultimately leading to a higher overall rice yield Jiang, et al., (2016). A healthy agricultural soil is one that can support the production of food and fiber at a level and quality sufficient to meet human needs and can continue to support those functions necessary to preserve biodiversity and the quality of life for humans. Kibble White et al., (2008).

Effective fertilizer management techniques are required to boost crop yield and nitrogen use efficiency while minimizing unfavorable environmental effects. To maintain rice production at a lower cost and reduce the harmful effects of nitrogen on the environment, such as nitrate pollution, eutrophication, and emission of greenhouse gas nitrous oxide and atmospheric pollutants nitric acid, management practices in rice should be focused on the best times and low fertilizer rates (Gaihre *et al*., 2015).The objective of this research is to determine rice genotypes nutrient use efficiency under low NPK fertilizer treatments.

MATERIAL AND METHODS

Experimental Site

The experiment was conducted at the screen house of the Department of Biological Science Abubakar Tafawa Balewa University Yelwa Campus Bauchi State, Nigeria, located at 10^{o}16’ 52’’ N 9^{o} 19’’ longitude and latitude. From June 2021 to September 2021. Bauchi is located at an elevation of 600.1 meters (1968.83 feet) above sea level, Bauchi has a Tropical wet and dry or savanna climate (Classification: Aw). The city’s yearly temperature is 28.97ºC (84.15ºF). Bauchi typically receives about 85.87 millimeters (3.38 inches) of precipitation and has 115.72 rainy days (31.7% of the time) annually, annual average temperature of 33.23°C (91.81°F) (https://en.wikipedia.org/wiki/Bauchi_State 2021).

Seeds sample collection

A total of thirteen rice cultivars for the research was randomly collected from Bauchi State Agricultural Development Programme (BSADP) and National Cereal Research Institutes (NCRI) Bhadeggi. The following were the rice cultivars used for the experiment.

Table 1: Rice cultivars sample selected, and ecology

Cultivar name	Species	Source	Ecology
FARO 37	*O. sativa*	NCRI	Lowland
FARO 38	*O. sativa*	NCRI	Upland
FARO 45	*O. sativa*	NCRI	Upland
FARO 47	*O. sativa*	NCRI	Upland
FARO 48	*O. sativa*	NCRI	Upland
FARO 51	*O. sativa*	BSADP	Lowland
FARO 52	*O. sativa*	BSADP	Lowland
FARO 60	*O. sativa*	NCRI	Lowland
FARO 61	*O. sativa*	NCRI	Lowland
FARO 62	*O. sativa*	NCRI	Lowland
FARO 64	*O. sativa*	NCRI	Upland
FARO 65	*O. sativa*	NCRI	Upland
FARO 66	*O. sativa*	NCRI	Lowland

Source: Bauchi State Agricultural Development Programme

(BSADP, 2021) National Cereal Research Institutes (NCRI, 2021)

Experimental procedure

Seed preparation and planting

The rice seed was sterilized in 10% Na-hypochlorite solution for 20 minutes to prevent fungal growth, and it was then washed with distilled water (Di salvatiCarafa *et al*., 2008). Seeds was then pre-germinated in a petri-dish. The whole experiment was randomized using Microsoft excel in completely randomized block design (CRBD) with four replication, the germinated seedlings of each cultivar from the petri-dish were planted into two each in plastic pots measuring 30cm with drainage holes at the bottom and the soil of 1.5kg was filled into the pot.

Treatments

Three treatments were stated as follows:-

NPK treatments

For the NPK treatments, two levels of fertilizer adopted from Bauchi State Agricultural Development Programme i.e 200kg/ha with nutrient ratio of N=100, P=50, K=50 was considered as full dose (FD), which was the control, while the 100kg/ha with N=50, P=25, K=25 was considered as half dose (HD) (BSADP, 2019).

Soil preparation and analysis

The soil sample was collected from a school farm at Yelwa campus of Abubakar Tafawa Balewa University Bauchi, and processed using a 2mm sieve, properties of the soil for the study will be analyzed following standard protocols for tropical soil Anderson *et al*.,(1993).

Table 2: Soil Sample Analysis

Parameter/ID	RESULT
pH	6.7
E/Conductivity (μs/cm)	30
N (mg/kg)	6.89
NO3 (mg/kg)	30.50
P (mg/kg)	0.01
PO4 (mg/kg)	0.02
TOC (%)	0.635
TOM (%)	0.758
CECmeq/100g	10.45
Zinc Zn (mg/kg)	0.08278
Magnesium Mg (mg/kg)	2.575
Sodium Na (mg/kg)	2046.8
Calcium Ca (mg/kg)	280.44
Potassium K (mg/kg)	51.56
Soil Texture Class	Loamy Sand
Sand %	73.77
Silt %	12.29
Clay %	13.93

Fertilizer Application

Compound fertilizer (NPK 15-15-15) corresponding to 200kg/ha^{-1}and 100kg/ha^{-1}in two applications (2weeks after transferring to the pots and at panicle initiation stage). The rice seedlings were kept weeds free throughout the experiment by regular hand weeding.

Layout of the treatments

The thirteen rice cultivars were given the following treatments:-

i. T_1=CF

ii. T_3= CF+NPK(200kg/ha^{-1})

iii. T_5=CF+NPK(100kg/ha^{-1})

Evaluating effects of low NPK on yield and yield components.

To determine the effect of NPK treatments, water deficits, and AMF on rice plants, the plant height, and tiller numbers were recorded at the interval 14 days of each. Data on plant height was measured by a meter ruler from the base of the plant to the tip of the longest leaf, while data collection for tillers was counted manually. After grain harvests the seeds, and rice plants were harvested and the soil was washed off the roots and separated from the shoots with a sharp knife; and put into brown envelop and were oven drying at 70^{o} C to a constant weight for 24hrs, shoot and root dry weight was recorded using an electronic weighing balance (Model:EK3000i, and company) (Vasant, 2012). Hundred grain yields were recorded per gram per pots, and weighting, thereby taking their mean and then the data was converted into kg ha^{-1}. All the procedures above were adopt from SES (IRRI, 2002).

Statistical Analyses.

Data collected was subjected to ANOVA using Minitab 16. The difference between (i.e T_1= CF+FD (Full dose), T_2=CF+HD (Half dose), T_3=CF and within treatments will be compared on the agronomic traits and yield of all the rice cultivars.

RESULTS

EFFECTS OF LOW NPK ON PLANT HEIGHT OF RICE CULTIVARS

The results depicts in Table 3 showed the effects of low NPK fertilizer on the plant height in FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66. Statistical analysis of the results showed that plant height under the NPK applications had not varied significantly ($p<0.05$) between the treatment with application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD). In FARO 37, CF+HD (Half dose) produce higher plant height of 106.88cm than CF+FD (Full dose) treatment with 103.60cm, and 59.05cm for the CF treatment. While FARO 38, the maximum plant height was measured as 72.00cm for CF+FD, 70.20cm for CF+HD, and 66.55cm for CF. FARO 41 produced higher plant height under CF+HD which measured 84.00cm, CF+FD measured 82.00cm, and CF measured 72.43cm. CF+HD recorded 70.90 cm, CF+FD recorded 70.88 cm, and CF treatment recorded 62.75cm in FARO 45. Consequently, CF+HD measured 73.35 cm, CF+FD 68.20 cm, and in CF treatment, plant height was 42.30 cm in FARO 48. Whereas, FARO 51 under CF+HD measured 94.47cm, CF+FD 86.15cm, and in CF treatment, plant height was 36.90cm. In the experiment with FARO 52, CF+HD recorded 87.33cm, CF+FD recorded 83.55cm, and CF treatment recorded 77.20cm. Additionally, FARO 60 recorded appreciable plant height in CF+HD with a mean of 87.13 cm, CF+FD measured 85.65 cm, and CF treatment recorded 81.98cm. Furthermore, FARO 61 under CF+HD measured 69.83 cm, CF+FD measured 69.18cm, and CF treatment measured 43.00 cm. CF+HD measured 86.65cm, CF+FD measured 76.58cm, and CF treatment measured 73.93cm in FARO 62 rice cultivar. Also, FARO 64 experiment with application of CF+HD measured 94.78 cm, CF measured 94.30cm, and CF+FD measured 93.03cm. The comparison further showed that FARO 65 under CF+HD measured 114.28 cm, CF+FD 11.70cm, and CF treatment 88.30cm, While FARO 66 with NPK application CF+FD had a plant height measurement of 84.45 cm, followed by CF with 83.68 cm, and CF+HD with 76.30cm. However, the continuous flooding (CF) treatment without NPK application recorded lower plant height in FARO 37, FARO 41, FARO 45, FARO 48, FARO 61, FARO 62, and FARO 65 rice cultivars.

Table 3:Effects of low NPK on plant height on rice cultivars

	Treatments		
Cultivar	**CF+FD**	**CF+HD**	**CF**
FARO 37	103.60[a]	106.88[a]	59.05[b]
FARO 38	72.00[a]	70.20[a]	66.55[a]
FARO 41	82.00[ab]	84.63[a]	72.43[b]
FARO 45	70.88[a]	70.90[a]	62.75[a]
FARO 48	68.20[a]	73.35[a]	42.30[b]
FARO 51	86.15[a]	94.47[a]	36.90[b]
FARO 52	83.55[ab]	87.33[a]	77.20[b]
FARO 60	85.65[a]	87.13[a]	81.98[a]
FARO 61	69.18[a]	69.83[a]	43.00[b]
FARO 62	76.58[ab]	86.65[a]	73.93[b]
FARO 64	93.03[a]	94.78[a]	94.30[a]
FARO 65	111.70[a]	114.28[a]	88.30[b]
FARO 66	84.45[a]	76.30[a]	83.68[a]

Means that do not share a letter are significantly different.

EFFECTS OF LOW NPK ON TILLERS OF RICE CULTIVARS

Data present in Table 4 showed effects of low NPK on FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 rice cultivars., from of the results of analysis of variance it showed that tillers under the NPK applications had not varied significantly ($p<0.05$) between the treatment with application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD). Application of 200kg/ha NPK (CF+FD) produce maximum tillers compared to 100kg/ha NPK (CF+HD). Hence, FARO 37 average tiller counts for CF+FD was 6.25, higher when compared to CF+HD which recorded 6.50, and CF treatment recorded 5.25. In the experiment with FARO 38, maximum tillers counts were recorded as 6.00, for CF+FD, and CF+HD, 4.25, for CF treatment. For FARO 41, the values recorded for CF+HD were 8.25; for CF+FD, they were 7.00; and for CF treatment were 6.75. while FARO 45 produced appreciable tiller numbers of 6.00 in CF+FD, 5.75 in CF+HD, and 4.00 in CF treatment. Similar to this, in FARO 48 tiller numbers, CF+FD gave 9.25, CF+HD recorded 6.75, and CF treatment recorded 2.50. Whereas FARO 51 tiller values were recorded as 9.75 for CF+FD, 7.33 for CF+HD, and 6.75 for CF treatment. In the experiment with FARO 52, the tiller numbers for CF+HD were 7.00 CF+FD was 6.00 and CF treatment was 5.50. Additionally, it was discovered that 6.75 tillers were counted in CF+HD treatments, 6.25 in CF, and 5.75 in CF+FD treatments in FARO 60. However, in FARO 61, tiller data from the trial showed that CF+FD recorded 11.00, CF+HD recorded 8.25, and CF treatment recorded 4.00. According to the trial on tillers with FARO 62, CF+HD recorded 7.75, CF+FD recorded 6.25 tiller numbers, and CF treatment recorded 4.00 tiller numbers. According to the trial, FARO 64, CF+FD recorded 3.75, CF+HD recorded 3.50, and CF treatment recorded 2.75 tiller numbers. Tiller values for CF+FD recorded 4.00, CF+HD recorded 3.50, and CF treatment recorded 2.00 in FARO 65. For FARO 66 tiller counts, CF+FD recorded 7.25, followed by CF+HD with 5.00, and CF with 4.00.

Table 4: Effects of low NPK on tillers of rice cultivars

	Treatments		
Cultivar	CF+FD	CF+HD	CF
FARO 37	6.25^{a}	6.50^{a}	5.25^{a}
FARO 38	6.00^{a}	6.00^{a}	4.25^{a}
FARO 41	7.00^{a}	8.25^{a}	6.75^{a}
FARO 45	6.00^{a}	5.75^{a}	4.00^{a}
FARO 48	9.25^{a}	6.75^{a}	2.50^{b}
FARO 51	9.75^{a}	7.33^{a}	6.75^{a}
FARO 52	6.50^{a}	7.00^{a}	5.50^{a}
FARO 60	5.75^{a}	6.75^{a}	6.25^{a}
FARO 61	11.00^{a}	8.25^{a}	4.00^{b}
FARO 62	6.25^{ab}	7.75^{a}	4.00^{b}
FARO 64	3.75^{a}	3.50^{a}	2.75^{a}
FARO 65	4.00^{a}	3.50^{a}	2.00^{b}
FARO 66	7.25^{a}	5.00^{ab}	4.00^{b}

Means that do not share a letter are significantly different.

EFFECTS OF LOW NPK ON SHOOT MASS OF RICE CULTIVARS

Table 3 contain the data for trials conducted of shoot mass with low NPK application on FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 rice cultivars., from of the results of analysis of variance it suggests that shoot mass under the NPK applications had not varied significantly ($p<0.05$) between the treatment with application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD). Application of 200kg/ha NPK (CF+FD) produce maximum shoot mass compared to 100kg/ha NPK (CF+HD). In the shoot mass experiment, CF+FD recorded higher mean of 10.75g, than CF+HD which recorded a mean of 8.58g, and CF recorded 1.67g in FARO 37. While CF+HD weight 9.43g which was higher than CF+FD recorded 7.68g, in FARO 38, While the weight of the shoot recorded for FARO 41 was 4.13g for CF and 10.90g for CF+HD, 8.50g for CF+FD, also, CF+FD weight is 9.50g, CF+HD 4.95g, and CF treatment 5.25g in FARO 45. FARO 48 recorded 6.85g in the CF+FD treatment, 5.95g on average was recorded in CF+HD, and 2.38g in CF. Whereas in FARO 51, the shoot weight in the CF+FD treatment was 7.88g, in CF+HD was 6.00g, and the shoot weight in CF was 2.05g. Also in FARO 52 it was discovered that CF+HD recorded 8.83g shoot mass, 6.03g in CF+FD, and 1.55g in CF treatment. For FARO 60, 10.46g was weighted in the CF treatment, 7.88g in the CF+HD treatment, and 7.18g in the CF+FD treatment. In FARO 61, it was found that CF+FD recorded 8.58g, CF+HD weighted 8.08g, while CF treatment registered 4.30g. FARO 62, CF+FD measured 7.48g, CF+HD measured 7.20g, and CF treatment measured 6.13g. Furthermore, FARO 64, CF+FD recorded 6.50g in shoot mass, followed by CF+HD with 3.38g and CF treatment with 1.75g. FARO 65, CF+HD recorded 5.73g, 5.63g in CF+FD, and 3.23g in CF treatment. Then in FARO 66, CF+FD weight 9.78g, CF+HD measured 9.50g, and CF treatment measured 3.50g.

Table 5: Effects of low NPK on shoot mass of rice cultivars

	Treatments		
Cultivar	**CF+FD**	**CF+HD**	**CF**
FARO 37	10.75[a]	8.58[a]	1.75[a]
FARO 38	7.68[a]	9.43[a]	3.38[a]
FARO 41	8.50[a]	10.90[a]	4.13[a]
FARO 45	9.50[a]	4.95[a]	5.25[a]
FARO 48	6.85[a]	5.95[a]	2.38[b]
FARO 51	7.88[a]	6.00[ab]	2.05[b]
FARO 52	6.03[b]	8.83[a]	1.55[c]
FARO 60	7.18[a]	7.88[a]	10.28[a]
FARO 61	8.58[a]	8.08[a]	4.30[a]
FARO 62	7.48[a]	7.20[a]	6.13[a]
FARO 64	6.50[a]	3.38[ab]	1.75[b]
FARO 65	5.63[a]	5.73[a]	3.23[a]
FARO 66	9.78[a]	9.50[a]	3.50[a]

Means that do not share a letter are significantly different.

EFFECTS OF LOW NPK ON ROOT MASS OF RICE CULTIVARS

In Table 4 the data depicts the trials conducted of root mass with low NPK application on FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 rice cultivars. The analysis of variance showed that root mass viz., NPK applications had not varied significantly ($p<0.05$) between the treatment with application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD). Application of 200kg/ha NPK (CF+FD) produce higher root mass compared to 100kg/ha NPK (CF+HD). FARO 37 given CF+HD accumulated dry root mass of 6.97g which was higher than 5.55g recorded in CF+FD, and 1.67g recorded in CF treatment, For FARO 38, CF+HD recorded higher mean of 6.23g, CF+FD 5.95g, and CF treatment weighted 5.23g of the dry root mass. Also, in FARO 41, CF+HD recorded 9.39g, CF+FD recorded 3.30g, and CF treatment recorded 2.19g. For FARO 45 CF+FD measured 10.17g, followed by CF+HD at 6.11g and CF had 3.29g. Similarly, FARO 48 under CF+FD recorded 8.37g root mass, followed by CF+HD with 5.69g and CF with 5.45g. While FARO 51 with CF+FD recorded 8.62g treatment weight of root mass, 3.88g in CF+HD, and 2.43g in CF treatment., FARO 52 under CF treatment recorded 8.17g, then 7.57g in CF+HD, and 5.06g in CF+FD for dry root mass. FARO 60 with CF+FD weight 18.73g, CF+HD recorded 10.46g, and CF treatment has 9.75g. Furthermore, FARO 61, produced 5.09g in CF+HD, 2.14g for CF+FD, and 2.09g for CF treatment., FARO 62 13.72g was recorded under CF+FD, 10.08g in CF+HD, and 8.39g by CF treatment. Additionally, FARO 64 under CF recorded 6.16g, CF+HD, and CF+FD treatments 5.71g and 5.34g. Then FARO 65 recorded 7.25g for CF, 7.21g for CF+HD, and 4.82g for CF+FD treatment. FARO 66 under CF+HD measured 7.34g, CF measured 6.29g, and CF+FD measured 6.11g,

Table 6: Effects of low NPK on root mass of rice cultivars

	Treatments		
Cultivar	CF+FD	CF+HD	CF
FARO 37	5.55[a]	6.97[a]	1.67[b]
FARO 38	5.95[a]	6.23[a]	5.23[a]
FARO 41	3.30[b]	9.39[a]	2.19[b]
FARO 45	10.17[a]	6.11[a]	3.29[a]
FARO 48	8.37[a]	5.69[a]	5.45[a]
FARO 51	8.62[a]	3.88[a]	2.43[a]
FARO 52	5.06[a]	7.57[a]	8.17[a]
FARO 60	18.73[a]	10.46[a]	9.75[a]
FARO 61	2.14[a]	5.09[a]	2.14[a]
FARO 62	13.72[a]	10.08[a]	8.39[a]
FARO 64	5.34[a]	5.71[a]	6.16[a]
FARO 65	4.82[a]	7.21[a]	7.25[a]
FARO 66	6.11[a]	7.34[a]	6.29[a]

Means that do not share a letter are significantly different

EFFECTS OF LOW NPK ON GRAIN YIELD OF RICE CULTIVARS

In Table 5 the data depicts the trials conducted of grain yield with low NPK application on FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 rice cultivars. Analysis of variance showed that grain yield viz., NPK applications had not varied significantly ($p<0.05$) between the treatment with application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD). Application of 200kg/ha NPK (CF+FD) produce grain yield compared to 100kg/ha NPK (CF+HD). In FARO 37 it was found that CF+FD recorded 7.08g which was higher than 5.93g weight in CF+HD, and a mean of 1.73g recorded in CF treatment, FARO 38 CF+HD weighs 6.58g, and 5.03g was recorded in the CF treatment. While FARO 41 CF+FD weight was 6.27g, followed by the CF+HD weight of 6.00g, and the CF treatment's. In FARO 45, 4.85g was weight in CF+FD, 3.55g was recorded in the CF treatment, and 4.48g in the CF+HD treatment. The experiment with FARO 48 showed that CF+FD recorded 7.03g, followed by CF+HD with 2.80g and CF treatment with 1.80g, The yield experiments with FARO 51 showed that CF+FD recorded 5.40g, followed by CF+HD with 2.63g and CF treatment with 2.05g., FARO 52 In terms of grain yield, CF+FD recorded 4.35g, CF+HD recorded 3.35g, and CF treatment was weighted at 2.60g. FARO 60 then 4.70g in CF+FD, 4.15g in CF+HD, and 1.73g in CF treatment. However, FARO 61 with CF+FD weight 6.53g, CF+HD recorded 2.78g, and CF treatment gave 1.25g, whereas FARO 62 with CF+FD recorded 7.80g, CF+HD weight 4.40g and CF produced 1.63g grain weight. Consequently, FARO 64 under CF+FD recorded 2.60g, CF+HD recorded 1.83g, and CF treatment was weighted at 1.55g. FARO 65 with CF+FD recorded 5.35g, CF+HD 4.13g, and CF treatment 2.55g. In FARO 66, 5.50g grain was weight in CF+FD, 4.90g was recorded CF+HD, and 3.54g in CF.

Table 7: Effects of low NPK on grain yield of rice cultivars

	Treatments		
Cultivar	CF+FD	CF+HD	CF
FARO 37	7.08^{a}	5.93^{a}	1.73^{b}
FARO 38	6.73^{a}	6.58^{a}	5.03^{a}
FARO 41	6.27^{a}	6.00^{a}	2.68^{b}
FARO 45	4.85^{a}	4.48^{a}	3.55^{a}
FARO 48	7.03^{a}	2.80^{a}	1.80^{b}
FARO 51	5.40^{a}	2.63^{b}	2.05^{b}
FARO 52	4.35^{a}	3.35^{a}	2.60^{a}
FARO 60	4.70^{a}	4.15^{a}	1.73^{a}
FARO 61	6.53^{a}	2.78^{b}	1.25^{c}
FARO 62	7.80^{a}	4.40^{a}	1.63^{a}
FARO 64	2.60^{a}	1.83^{a}	1.55^{a}
FARO 65	5.35^{a}	4.13^{ab}	2.55^{b}
FARO 66	5.50^{a}	4.90^{a}	3.54^{a}

Means that do not share a letter are significantly different.

DISCUSSION

Chemical fertilizer provides nutrients that quickly dissolve in the soil solution, making them immediately accessible to plants. Among the many essential nutrients for plants, macronutrients such as potassium (K), phosphorus (P), and nitrogen (N) are critical in determining how crops grow and develop. In particular, nitrogen stands out as being essential to the growth of rice plants. It supports vital functions such vitamin synthesis, enzyme and protein synthesis, chlorophyll synthesis, and photosynthesis. Additionally, it helps plants use carbohydrates and powers their energy responses (Sara et al., 2013). Accelerating plant growth and development requires effective nitrogen control. As compared to other nutrients, figuring out the best rate to apply nitrogen fertiliser is essential to both improving crop production profitability and reducing the negative environmental effects of overuse (Bilbao et al., 2004). For better rice quality and production, it is therefore essential to determine the optimal nitrogen fertilizer level and to choose genotypes with high nitrogen usage efficiency (Mannan et al., 2009).

The study on the effects of application of 100 kg/ha NPK (CF+HD), and 200 kg/ha NPK (CF+FD) on plant height of rice cultivars showed that there was increase in the plant height under application of 200kg/ha NPK, and 100 kg/ha NPK dosage with no variation statistically. This could be due to nitrogen rate applied to the soil which can trigger plant growth, and development. Nitrogen fertilizer is an important agronomic measure to regulate rice yield and grain quality (Zhao et al., 2022). This support the finding that better nutrition at optimum level is required by the crop plants to flourish their growth and development (Bastia, 2002). This result also showed that yield and yield component under good fertilizer management strategies can increase crop production and nutrient used efficiency, while reducing negative environmental consequences are needed. However, the experiment with continuous flooding, and no NPK application produce least plant height. Similarly, the number of productive tillers was increased under application of 200kg/ha NPK, although had not varied significantly when compared with 100 kg/ha NPK dosage. Similar findings were reported by Mohammed *et al*. (2014) in a research conducted using 180kg/ha NPK, and 90 kg/ha NPK dosage. They found that there was no significant different between the tillers number under the two fertilizer dosage. Kamal et al., 2015 in their study found that better growth and development of rice by the application of NPK fertilizers at the rate of 162-120-72 kg ha-1 shows that the optimum level of fertilizers application and plant utilize maximum nutrient and reap maximum benefits at this rate when they conducted research using 108-80-48, 135-100-60, 162-120-72 and 189-140-84 kg ha-1 NPK dose. The weight of dry shoot mass was slightly increased under in the experiment with continuous flooding with the experiment with continuous flooding, and 200kg/ha NPK, compared 100kg/ha NPK dose although not significant. Mohammed and Habibu (2015) used the Faro 55 (Nerica 1), Srilanka, and Faro 44 (Sippi) rice cultivars in a screen house potted experimental study to find rice cultivars that could perform with 180 kg/ha-1 as the full dose (control) and 90 kg/ha-1 as the half dose of NPK. For each cultivar, information on the quantity of tillers was gathered and recorded weekly. Additionally, the shoot and root's biomass was calculated. It was discovered that all the cultivars had NPK resistance. For the root mass, there was not significant variation between the experiments under application of 200kg/ha NPK, and 100kg/ha NPK dose. In an experimental investigation, Kamal *et al*. (2015) examined the effects of different NPK concentrations (108-80-48, 135-100-60, 162-120-72, and 189-140-84 kg ha-1) on the growth of two rice hybrids (PHB-

71and Leader-555). The findings showed that the influence of NPK treatment at various rates had a substantial impact on the growth of both rice hybrids. Also, there was no significant variation between 200kg/ha NPK application, and 100kg/ha NPK dose applied to the rice cultivars. Experiment with 200kg/ha NPK application produce maximum yield. The outcome of our findings also support the report of Dakhane et al. (2014) who reported that the increase in the fertilizer rate considerably improves yield and yield components. However, the results of experiments with only water and no fertilizer application produce low yield.

CONCLUSION

The study focus on the effects of different doses of NPK on growth and yield of FARO 37, FARO 38, FARO 41, FARO 45, FARO 48, FARO 51, FARO 52, FARO 60, FARO 61, FARO 62, FARO 64, FARO 65, and FARO 66 rice cultivars. The results showed the rice cultivars are resilient to low NPK. The application of fertilizer dose 100 kg/ha NPK (CF+HD) performed appreciably. This results will serves as breakthrough to rice farmers in Nigeria.

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