

EFFECT OF CULTIVARS AND TRANSPLANTING DATES ON SOME GROWTH PARAMETERS OF RICE (*Oryza sativa L.*) IN SOUTH EASTERN NIGERIA

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Abstract

A field experiment was conducted at the Federal College of Education, Eha-Amufu located within Southern Guinea Savanna Zone to examine the effect of cultivars, transplanting dates and sampling periods on some morphological traits of rice. The experimental treatments were two improved rice varieties (FARO 44 and FARO 52) and a local cultivar which served as standard check. The rice cultivars were planted at three different transplanting dates (June 10, June 20 and June 30) while three sampling periods of 6 weeks after transplanting (6 WAT), 9 WAT and 12 WAT were imposed across the three transplanting dates. The experiment comprised of 9 treatments, V1W1 (FARO 44 and 6 WAT), V1W2 (FARO 44 and 9 WAT), V1W3 (FARO 44 and 12 WAT), V2W1 (FARO 52 and 6WAT), V2W2 (FARO 52 and 9 WAT), V2W3 (FARO 52 and 12 WAT), V3W1 (local cultivar and 9 WAT), W3W2 (local cultivar and 9WAT) and V3W3 (local cultivar and 12 WAT) which were laid out in split plot design with three replications. Observation was taken on some growth parameters such as days to flowering, plant height, leaf area index, number of tillers and panicle length. The data collected were analysed using GENSTAT version 8.1 and means were separated by Duncan multiple range test. The result showed that, transplanting dates and cultivar differences influenced most of the morphological traits sampled. All the cultivars recorded taller plants in June 30 transplanting across all the sampling periods. Among all the transplanting dates, June 20 transplanting gave higher number of productive tillers hill⁻¹ with FARO 44 producing significantly higher number of productive tillers during the June 20 transplanting and at 12 WAT sampling period. FARO 44 also gave the highest leaf area index at 9 WAT in June 30 transplanting and was the earliest to flower. The result further revealed that all the cultivars took lesser days to attain bloom in June 30 transplanting. It was therefore recommended that FARO 44 having exhibited better expression of most of the yield contributing variables should be further studied to determine the relative contribution of other traits to its paddy yield.

Key words: Growth parameter, rice, sampling periods, transplanting date

Introduction

Rice (*Oryza sativa L.*) is one of the most important staple food crops of the world, accounting for more than 20% of daily calorie intake of about 3.5 billion people (Asma *et al.*, 2015). The world population is expected to reach 8 billion by 2030 and rice production must be increased by 50% in order to meet the growing demand (Khalid *et al.*, 2015). Sub Saharan African countries produce about 21.6 million tons of rice annually and they contribute 32% to the global rice market to fill the gap between their productions and demand (FAO, 2007, Somado & Guei, 2018). Nigeria produces about 3.7 million tonnes and consumes about 6 million tonnes of rice annually (Udemezue, 2018). In order to reduce the demand-supply deficit, it is imperative to focus on strategies to increase farm productivity. This supply gap was as a result of population growth and the increasing consumer preference in favour of rice in urban area (Atera *et al.*,

2011). In order to bridge this supply gap domestic rice production must be doubled through applied research (Busari and Idris, 2015). Nigeria has a total estimated potential rice area of over 1.9 million hectares (AfricaRice, 2010). If this area is properly utilized for rice production it would be sufficient to produce enough rice to meet domestic demand and for export. Nigeria has comparative resource advantage in terms of favourable climate, edaphic and ecological conditions in the production of rice however, local production has not been able to meet the growing demand (Akiritayo *et al.*, 2011).

Rice production constitutes the major economic activity and a key source of employment for the rural population in Nigeria. Low rice yield (0.5-1.5t ha⁻¹) is common which is mainly due to use of traditional methods, local cultivars and high cost of inputs (AfricaRice, 2015). Muhammad *et al.*, (2019)

recommended that for successful rice production, transplanting at optimum time, appropriate control of vegetative growth throughout the duration of the crop, selection of cultivars possessing optimum productive tillers, are essential for improving morphological variables responsible for high paddy yield.

Among the various packages of rice production technologies, transplanting dates plays a pivotal role in the development of rice crop (Soomro, *et al.*, 2001). Time of transplanting any field crops depends on environmental conditions that are required for its optimum growth and development. The effects of transplanting dates vary between regions, which can affect plant initial growth and grain yield (Vange and Obi, 2006). BIRRI (2018) reported that rice plants require a particular temperature for its phenological affair such as panicle initiation; flowering, panicle exertions from flag leaf sheath and maturity and these are very much influenced by the planting dates. Planting rice at the optimum period is therefore critical to achieving high rice productivity. Early transplanting produces more tillers, biomass, taller plants, bolder grains with higher 1000 grain weight and grain yield (Khalifa AABA, 2009). On the other hand, late transplanting limits growth period which further reduces the leaf surface area, panicle length and the mean number of kernels per panicle (Bashir *et al.*, 2010). Muhammad *et al.*, (2015) reported a significant interaction between sowing date and cultivars on yield and days to maturity.

In South-eastern Nigeria rice is transplanted from early June to mid-July depending upon the variety, availability of water, land and labour for rice cultivation. Optimum rice planting dates varies with location and genotypes (Bashir *et al.*, 2010). The present study was, therefore carried out to determine the effect of cultivars and transplanting dates (June 10, June 20 and June 30) at three sampling periods (6 weeks after transplanting, 9 weeks after transplanting and 12 weeks after transplanting) on some morphological traits of rice grown in South Eastern Nigeria.

Materials and Methods

Location of the experimental site and climatic condition

This study was carried out in the research field of the Federal College of Education, Eha-Amufu, Enugu State, Nigeria (latitude of 06° 52'N, longitude of 07° 24'E, altitude 113m above mean sea level) in Southern Guinea Agro-Ecological Zone. Eha-Amufu is endowed with suitable ecology that supports lowland and upland rice production and it is one of the major rice producing communities in Enugu state. The site has a tropical climate with mean annual rainfall varying between 1700

to 2001mm, yearly average temperature ranges from 28 to 34°C while yearly average relative humidity ranges between 61 to 77% (Ezeaku, 2013).

Soil Status

The experimental site was silty clay loam, with total Nitrogen of 0.16%, Phosphorus (ppm) of 39.11, Potassium Meq/1000soil of 0.38 and pH of 4.91 (Table 1).

Nursery Preparation

Nursery was prepared by adopting the use of raised bed separately for each of the cultivars with each area measuring 1m x1m. The cultivars were broadcasted on the raised bed on same day. Procedure adopted in transplanting seedlings from nursery site to the experimental site include, careful uprooting of the seedlings with the aid of garden fork to avoid root damage.

Experimental Design

The experiment comprised of 9 treatments, V1W1 (FARO 44 and 6 WAT), V1W2 (FARO 44 and 9 WAT), V1W3 (FARO 44 and 12 WAT), V2W1 (FARO 52 and 6 WAT), V2W2 (FARO 52 and 9 WAT), V2W3 (FARO 52 and 12 WAT), V3W1 (local cultivar and 9 WAT), W3W2 (local cultivar and 9 WAT) and V3W3 (local cultivar and 12 WAT) which were laid out in split plot design with three replications. Main plot was cultivars while sub plot treatment was transplanting dates.

Field Preparation Procedure and Transplanting

The experimental site was prepared by first applying non-selective herbicide (total weed killer), followed by clearing of dead weeds, ploughing the site and transplanting of seedlings as recommended by Nwite and Okorie (2021). Twenty one days old seedlings of the 3 rice cultivars were transplanted to the experimental site on the 3 transplanting dates. Transplanting of seedlings was done using 20cm x 20cm spacing. Initial fertilizer dose was applied at the rate of 75-30-30kg NPK ha⁻¹ while urea (46-0-0) was applied at panicle initiation stage. Weeds were controlled chemically using a post emergence herbicides combination of 300g of propanil and 200g of 2,4-D acid per litre formulation applied at the rate of 6litres ha⁻¹. Subsequent weeding was manually carried out as the need arose during the advanced crop growth stage.

Data Collection and Measurement

Shortly before the start of experiment a composite soil sample from random points was collected. The soil sample was air-dried, carefully sieved with metal sieve of 20mm mesh size and bagged. Soil analysis was carried out at the Soil

Science Laboratory of the University of Nigeria, Nsukka, Enugu State, Nigeria. Days to 50% flowering was recorded as number of days from sowing to when 50% of the plants in the plot had produced panicles. The rest traits sampled were carried out on 5 randomly selected plants and the mean determined. Plant height (cm) was measured using measuring tape as distance from the surface of the topsoil to the panicle base. Number of tillers was sampled by counting the number of tillers per hill. Panicle length (cm) was measured from the panicle base to the tip of the grain awns. Leaf area index (LAI) was measured in using leaf area meter and expressed in cm².

Statistical Analysis

The data collected were analysed using GENSTAT version 8.1 and means were separated by Duncan multiple range test.

Results and Discussion

Table 1 shows the soil physical and chemical properties of the site used for the experiment. The soil of the experimental field was silty clay loam in texture with neutral pH, low in total nitrogen, medium in phosphorus and cation exchange capacity but high in electrical conductivity. Effect of cultivars and sampling

periods in June 10, June 20 and June 30 transplanting periods (Tables 2-4) revealed that plant height differed significantly among the cultivars studied. The results indicated that local cultivar (control) produced the tallest plants across the three transplanting dates and its height progressively increased from 6 WAT to 12 WAT while FARO 44 produced the shortest plants height across the 3 transplanting periods and sampling regimes. This finding is consistent with that of Muhammad *et al.*, 2019 and Kushwaha *et al.*, 2016 who found significant differences for plant height among cultivars planted at different dates. All the cultivars recorded taller plants in June 30 transplanting across the sampling periods compared to June 10 and June 20 transplanting dates. Contrary to our result, Reza *et al.*, (2011) found out that tallest plant height was obtained in June 12 transplanting date. The finding in this present study may be attributable to more favourable weather conditions in June 30 transplanting date especially rainfall leading to maximum soil moisture saturation since adequate soil moisture enhances vegetative growth in rice. Furthermore, Patter *et al.*, 2001 observed that temperature variation causes rice plants to exhibits diverse morphological attributes.

Table 1. Soil physical and chemical properties of the site used for this study

Physical Properties	Value
Clay (%)	15.48
Silt (%)	31.28
Fine Sand (%)	53.24
Textual Class	Silty clay loam
Chemical Properties	
pH in Kcl	4.91
Organic Carbon (%)	4.07
Organic Matter (%)	7.02
Total Nitrogen (%)	0.16
Total Phosphorous (ppm)	39.11
Exchangeable Cations in Meq/100g Soil	
Sodium	0.57
Potassium	0.38
Calcium	7.88
Magnesium	2.91
CEC	11.3
EA	0.28
EC	60

CEC - Cation Exchange Capacity

EA - Exchangeable Acidity

EC - Electrical Conductivity

Leaf area index increased progressively as sampling period increased from 6 WAT to 12 WAT across the transplanting dates. This is as expected since crop growth rate including leaf area expansion increases as growth period progresses with time. Sampling made 12WAT gave higher LAI but statistically similar in all the 3 transplanting dates. Although, all the cultivars expressed statistically similar LAI at 12WAT, FARO 44 gave relatively higher LAI at 9WAT while local gave the least LAI. Thakur and Patel, 1998 reported that leaf area index varies with cultivars and that higher leaf area index contributes to higher grain yield of rice. Lu *et al.* 1999 obtained higher yield of rice due to higher and better distribution of leaf area index after heading.

Highest number of tillers was recorded in V1W3 (FARO 44 at 12WAT) in June 10, 20 and 30 transplanting periods. FARO 44 an improved rice variety produced significantly higher number of productive tillers while local cultivar produced the least. This difference in number of tillers among the cultivars might be due to biological variability and /or changes in the prevailing environmental conditions at the time of this study. June 20 transplanting produced relatively higher number of tillers while it decreased in transplanting made in June 10 and June 30. This result is consistent with the result obtained by Mohammad *et al.*, (2015). Mir *et al.*, 2014 reported that higher paddy yields were attributed to more productive tillers.

Table 2: Effect of cultivars and sampling periods on some morphological traits of rice transplanted in June 10

Treatment	Plant Height (cm)	Leaf Area Index	Number of Tillers Hill ⁻¹
V1W1	48.5abc	0.19b	6.7c
V1W2	71.8ab	0.39b	13b
V1W3	91.0b	0.62a	18a
V2W1	55.8abc	0.17b	6.0c
V2W2	78.18ab	0.17b	6.0c
V2W3	90.0b	0.62a	12b
V3W1	61.37ac	0.15b	4.6ab
V3W2	86.52c	0.18b	4.6ab
V3W3	103.2a	0.62a	11.3b

Means in the same column followed by different letter(s) are significantly different at $P < 0.05$ (V1- FARO 44, V2- FARO 52, V3- local check, while W1- 6weeks after transplanting, W2- 9 weeks after transplanting, W3-12weeks after transplanting)

Means in the same column followed by different letter(s) are significantly different at $P < 0.05$ (V1- FARO 44, V2- FARO 52, V3- local check, while W1- 6weeks after transplanting, W2- 9 weeks after transplanting, W3-12weeks after transplanting).

Table 3: Effect of cultivars and sampling periods on some morphological traits of rice transplanted in June 20

Treatment	Plant Height (cm)	Leaf Area Index	Number of Tillers Hill ⁻¹
V1W1	52.7cd	0.17ab	7ab
V1W2	73.7bc	0.36b	14b
V1W3	88.4c	0.63a	21a
V2W1	55.4cd	0.17ab	6.8ab
V2W2	79.05abc	0.17ab	6.8ab
V2W3	94.0b	0.64a	13.6b
V3W1	64.9cde	0.15ab	5.4ab
V3W2	87.07ab	0.18ab	5.4ab
V3W3	103.5a	0.61a	11.3c

Means in the same column followed by different letter(s) are significantly different at $P < 0.05$ (V1- FARO 44, V2- FARO 52, V3- local check, while W1- 6weeks after

transplanting, W2- 9 weeks after transplanting, W3- 12weeks after transplanting)

Table 4: Effect of cultivars and sampling periods on some morphological traits of rice transplanted in June 30

Treatment	Plant Height (cm)	Leaf Area Index	Number of Tillers Hill ⁻¹
V1W1	54.4cd	0.17c	6.4ab
V1W2	81.2abc	0.41b	12b
V1W3	95.5b	0.64a	17a
V2W1	59.3cd	0.17c	6ab
V2W2	81.17abc	0.17c	6ab
V2W3	99.2b	0.64a	13b
V3W1	65.6bc	0.16c	4.5abc
V3W2	86.94c	0.16c	4.5abc
V3W3	104.0a	0.62a	10c

Means in the same column followed by different letter(s) are significantly different at $P < 0.05$ (V1- FARO 44, V2- FARO 52, V3- local check, while W1- 6weeks after transplanting, W2- 9 weeks after transplanting, W3- 12weeks after transplanting)

The rice varieties tested differed in their days to bloom (50% flowering) across the three transplanting dates (Figure 1) with local cultivar being the latest to flower (65 days) while FARO 44 was the earliest to flower (56 days). All the cultivars took lesser days to attain bloom during June 30 transplanting while June 20 transplanting took longer days to attain bloom in all the cultivars. This observation could be attributed to the influence of day length and temperature variation as reported by Bruns and Abbas (2006). Early flowering cultivars such as improved FARO 44 rice will be preferred by rain fed rice farmers especially those

operating in a low rainfall environment. Climate smart crops that can fit into narrow environmental niche of short rainfall duration are being advocated as they tend to escape negative weather variables.

Figure 2 showed that local cultivar produced longer panicle while FARO 44 produced the least panicle length in all the transplanting dates. The variability observed among the cultivars for bloom and panicle length across the 3 transplanting dates an indication that the planting materials used for this study are genetically diverse from one another for the two traits. Yoshida (1993) reported that different rice plants require a particular temperature for phenological responses such as panicle initiation, flowering, panicle exertion from flag leaf sheath and maturity, and these responses are very much influenced by the dates of planting.

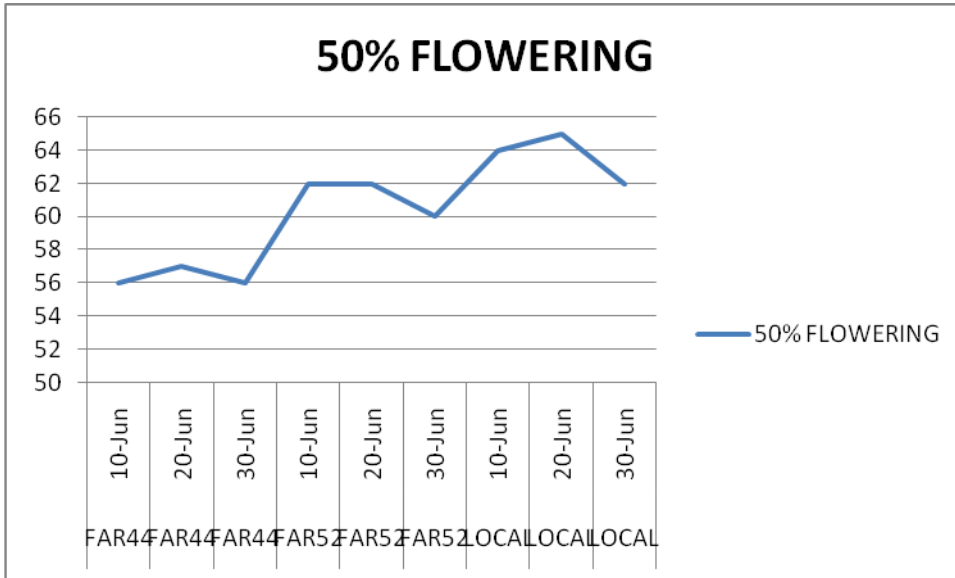


Figure 1: Effect of cultivars and transplanting dates on days to 50% flowering

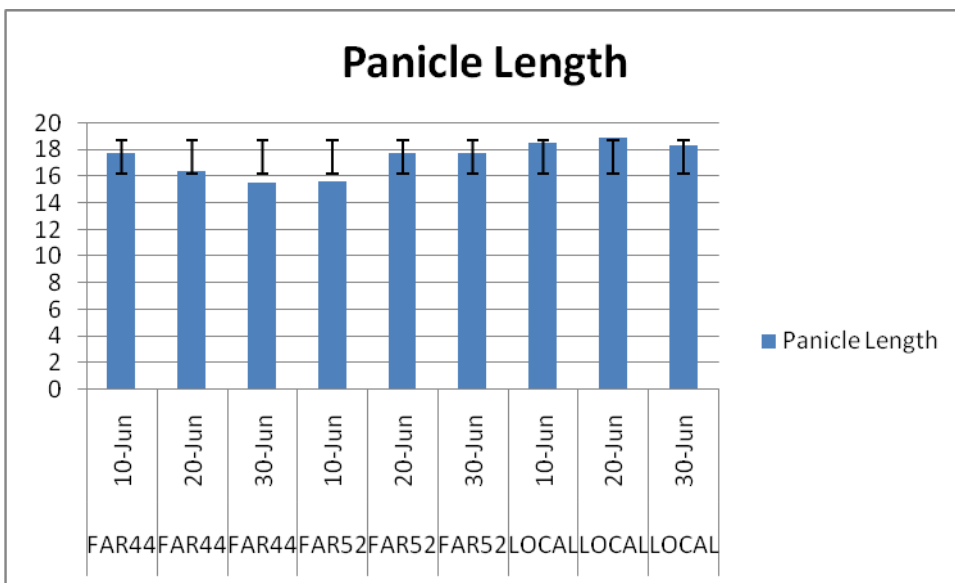


Figure 2: Effect of cultivars and transplanting dates on panicle length (cm)

The result revealed that there was significant effect of cultivars and days to transplanting on morphological traits of the 3 rice cultivars studied. June 30 transplanting reduced days to flowering but increased plant height. Transplanting made in June 20 produced

higher number of productive tillers with FARO 44 expressing significantly higher number of productive tillers and LAI. FARO 44 was found to flower earlier than the rest cultivars. Consequently, FARO 44 having exhibited better expression of these yield contributing

variables should be further studied to determine the relative contribution of other traits to its paddy yield.

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Disclosure of Conflict of Interest

The authors have declared that no conflict of interest exists.

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