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PHENOTYPIC VARIATIONS OF THREE UPLAND RICE (ORYZA SATIVA L.) GENOTYPES

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ABSTRACT

This study was conducted to assess the phenotypic variations of three rain-fed upland rice genotypes (Faro 59, 64, and 'Art'). The study was conducted at the Teaching and Research Farm of Akwa Ibom State University, Oruk Anam L.G.A., in Akwa Ibom State, Nigeria, from August- November 2021. The three upland rice genotypes were planted in a plot using a randomized complete block design in four replications. Data were analyzed using a one way analysis of variance, and means separation was done using the Fisher's Least Significance Difference. Results showed significant differences in plant height at 10 weeks after planting. Faro 64 and Art had the highest mean heights of 100.15 cm and 'Art' had 97.82 cm, while Faro 59 had the least mean height of 92.95 cm respectively. There were significant differences in primary number of tillers/plant among the three rice cultivars. Faro 59 had the highest mean primary tillers-4 tillers/plant. Similarly, Faro 59 had the highest mean values for other traits in order of: panicle weight-3.34 g; 100 grain weight- 2.90 g; and grain yield-4.2 tons/hectare. The results of this study proved that Faro 59 had a greater advantage over 'Art' and Faro 64 with respect to most phenotypic traits (grain weight, panicle weight and primary tiller numbers/plant), and therefore is recommended for further research in this study area.

Keywords: Rice, Grain weight, Phenotypic variations, Panicle weight, Tiller number

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INTRODUCTION

Rice (Oryza sativa L.) is one of the major cereal crops worldwide and is the staple food for millions of people in Nigeria. Rice production has increased significantly in Nigeria in recent years, with the country now one of the largest producers and consumers of rice in Africa (Bin Rahman and Zhang, 2023). However, there are still challenges in the production of rice in Nigeria, including limited access to high-yielding and disease-resistant varieties, poor agronomic practices, and environmental stresses. Phenotypic variations in rice genotypes play a crucial role in rice improvement and are essential for developing high-yielding

varieties. Several studies have been conducted in Nigeria and in similar agro ecological zones to evaluate the phenotypic variations of rice genotypes. A study by Abubakar and Daji (2022) evaluated the yield potential of local and improved rice varieties in Gombe State and found significant variations in reproductive traits such as number of panicles/plant, number of seeds/plant and days to 50% flowering. A study conducted by Chukwu et al. (2022) investigated the performance of different rice genotypes in Malaysia a similar agro ecological zone to Nigeria. They found variations among rice lines; approximately 50% of the lines produced yields of 5 t/ha or more. Salleh et al. (2022) reported significant variations in plant height, number of tillers per plant, panicle length, and grain yield among the genotypes.

Similarly, Oyewole, Ajayi and Ojuekaiye (2010) evaluated different NERICA cultivars for yield performance in Kogi State to recommend the most suitable for yield in the study area and observed variation in plant height and paddy yield. They recommended NERICA 6 because of its consistency in high yield in both seasons. The common ground in the above studies is that significant variations in agronomic traits such as grain yield, plant height, and panicle length are observed among varieties. Some best performing varieties based on the findings can be recommended for cultivation or selected as parent material for rice improvement in the area where the study is performed.

Although, there have been a number of phenotypic rice studies in Nigeria (Oyewole, Ajayi and Ojuekaiye, 2010; Salleh et al., 2022; Abubakar and Daji, 2022) there is a gap in the knowledge of rice performance in the geographical area of Oruk Anam, Akwa Ibom State. This study was conducted to enable farmers identify, appreciate, and cultivate an upland rice variety with the most desirable or farmer-preferred traits and possibly recommend the best for future research in crop improvement. The objective of this study was to assess the variability in agronomic traits existing in three selected upland rice varieties (Faro 59, 64, and 'Art').

MATERIALS AND METHODS

Description of Study Area

The study was conducted at the Teaching and Research Farm of Akwa Ibom State University, Obio Akpa Campus, Oruk Anam L.G.A., from August- November, 2021. The experimental plot lies between latitude 4.32˚N and 5.33˚S and longitude 7.25˚E and 8.25˚W with an altitude of 38.1 m above sea level and an annual rainfall range of 2000 – 2600 mm (SLUS – AKS, 1989). The annual (bimodal pattern) temperature ranges from 24- 30˚C being highest in the months of February- April, while the relative humidity ranges from 75 – 79%. The vegetation of the place is a tropical rain forest, although most of the forests have been destroyed and are now under arable crop production (SLUS – AKS, 1989). The plot was previously used for the cultivation of sweet potato.

Planting materials used in the experiment were seeds of three upland rice genotypes which were Faro 59, 64 and 'Art'. Rice seeds were procured from the Rice Research Institute (RRI), Owot Uta, in Nung Oku, Uyo, Akwa Ibom State, Nigeria. The seeds were short duration (100 – 120 days) upland rice varieties which thrive well in upland soils (FAO, 2007).

Experimental Layout, Planting and Other Agronomic Practices

The experiment was laid out as a Randomized Complete Block Design and with 4 replicates. The treatments included 3 rice upland varieties: Faro 59, Faro 64 and 'Art'. The size of the experimental field was 20 x 6 m², with each plot measuring 6.0 x 1.5 m². Three seeds were sown per hill using dibbling method, at a depth of 2-3 cm and at a plant spacing of 20 x 20 cm.

Two fertilizer types were applied which include NPK and Urea. A single rate of NPK fertilizer (15:15:15) was applied at the rate of 200 kg/ha at 15 days after sowing. Urea and Triple Super Phosphate was applied according to Kanyeka, Kamala and Kasuga. (2007). Urea was applied at 100 kg/ha in two splits: at tiller initiation [i.e. 30 days after planting (DAP)] and at panicle initiation i.e. 65 DAP. Application of Triple Super Phosphate (TSP) was done using the broadcasting method at the rate of 20 kg P/ha at sowing. Thinning was done at 14 and 15 days after planting to retain two (2) seedlings per hill.

Manual weeding (hand-picking and hoe weeding) was done four times at 21, 35, 49 and 70 DAP. There were no incidences of diseases. However, there was an incidence of pest (termite) infestation which was controlled by destroying the mounds they built around the rice stem base. Also, a series of threats from birds were controlled manually by scaring off the birds by throwing a handful of soil and pieces of stones at them, using scare crows, and at a later stage (i.e., the grain filling stage), the field was covered with nets to prevent birds from feeding on the fruiting rice plants.

Data Collection and Analysis

- Plant height (cm) was measured at 10 weeks after planting (WAP) by placing a meter rule at the base of the rice plant up to the apex of the plant.
- Plant population was determined during thinning by counting plants that had emerged in each plot at 21 DAP (2- 4 leaf stage).
- Number of tillers/plant was determined by counting, and recording all emerging tillers on the hills from the time of planting to when 50% of the plants were at flowering.
- Panicle weight (g) was obtained by weighing (at harvest) mature panicles from randomly selected 10 hills from the center of each plot, using a digital weighing instrument (METTLER TOLEDO, Model PL203), and the average weights were recorded.
- Panicle length (cm) was measured with a meter rule by selecting at random, 10 mature panicles from the center of each plot, and the lengths recorded.
- Grain length (mm) was determined by randomly selecting 10 grains from each variety (treatment) and measuring from one end of the grain to the other using a twine with a known length.
- The 100-grain weight (g) was determined by selecting 100 rice grains of each variety and weighing.

Data collected were subjected to a one way analysis of variance, and when differences between treatment means were significant, differences were separated using the Fisher's Least Significant Difference at a 95% probability level.

RESULTS AND DISCUSSION

Growth Parameters

The plant height results showed that Faro 64 had the highest mean height of 100.15 cm, followed by 'Art' which was 97.82 cm, while Faro 59 had the least mean height of 92.95 cm (Table 3.1). Faro 64 was significantly different from Faro 59, but not significantly different from 'Art' in their mean plant height at 10 WAP. The difference in plant heights could be attributed to variety and environmental factors. Faro 64 was the tallest among the three rice varieties studied. However, this relatively tall variety was not as tall as the African and Philippine upland varieties reported by Mattson, Leatherwood and Peter (2009) which were more than 150 cm under upland planting conditions. Local rice farmers prefer tall plants because it reduces the need to bend down during the harvesting of panicles. However, tall cultivars are more likely to suffer lodging under the typical heavy rainfall and windy conditions of the study area.

With panicle weight/plant Faro 59 had the highest mean weight of 3.34g, Faro 64 had 2.91g and 'Art' had 2.81g (Table 3.1). The above result indicated that Faro 59 was significantly different from Faro 64 and 'Art', while Faro 64 and 'Art' were not significantly different from each other. The results for number of tillers showed that Faro 59 gave a more number of primary tillers. Faro 59 had the highest mean in primary tillers which was 3.70, Faro 64 had 1.82 and 'Art' had 1.67 respectively (Table 3.1). It can be deduced that Faro 59 has a higher tillering capacity. Number of tillers have been linked to the number of panicles, and grain weight produced (Meertens, 2003; Chukwu et al, 2022), it is therefore a determinant to high grain yield in rice.

The difference in number of tillers can be attributed to certain factors such as genotype and environment (Fageria and Baligar, 2011). The high tillering capacity in Faro 59 above indicates a higher yield potential compared to other two varieties. On the other hand, 'Art' and Faro 64 which showed low tillering capacity tend to be limited in their yield potentials under the most favorable cultural conditions (Deng et al., 2015).

There was a significant difference between varieties with regards to 100 grain weight (Table 3.1). Faro 59 had the highest mean grain weight of 2.90 g, Faro 64 had 2.66g and 'Art' had 2.57g respectively. Faro 59 was significantly different from Faro 64 and 'Art' in their mean 100 grain weights but Faro 64 and 'Art' were not significantly different. Panicle length ranged from 22-24 cm; Art produced lengths of 24 cm, while Faro 59 and 64 produced lengths 22 and 23cm. For grain length, Faro 59 and Art gave the highest grain length of (8.88 and 8.73mm), and Faro 64 had the least mean grain length of 8.65 mm respectively (Table 3.1). As stated by Luo, Zhu, Chen, Duan and Zhang (2004), grain length is an important agronomic trait for breeding because it affects rice appearance, milling, cooking and rice quality. The grains of Faro 59 and Art were the longest of the three varieties studied. Therefore, as Nigerians largely prefer long-grained rice, Faro 59 and Art may the choice varieties for future research.

Faro 59 had a higher grain yield (4 tons/ha) compared to Faro 64 and 'Art' (Table 3.1). Although, the plants were cultivated under same environmental conditions, the significant variations detected among the three upland rice genotypes could be attributed to variety and environmental factors. As one of the ways to ascertain the difference in grain yield of rice plant, Luo, Zhu, Chen, Duan and Zhang (2004) stated that rice grain yield is affected by important environmental changes such as temperature, soil fertility and the percentage of sterile spikelet's. The highest yielding cultivar Faro 59, could be said to have been favored more by the environment as evident in the grain yield produced. The main components of rice grain yield include number of panicle per plant, number of grains per panicle, and grain weight.

Also, the other two varieties, Faro 64 and 'Art' had lower values in the number and size of the yield components. According to Fageria, Moreira and Coelho (2011) yield components, like number of panicle, numbers of tillers, number of spikelets and panicle length were significantly and positively associated with grain yield in upland rice. This study showed that the rice varieties with the highest tiller numbers, grain weight and grain length produced the highest grain yield.

CONCLUSION

Results obtained from this study shows that significant variations were detected among the three upland rice genotypes investigated with respect to their phenotypes. These variations will serve as a means of identification of these rice genotypes. Also, it has provided valuable information, which if further investigated, could enable local farmers in making choices as to which genotype to adopt and produce. In addition, the potential to select desired traits may be conveyed, and thus could assist breeders in crop improvement programs. From the results obtained in this study, genotype Faro 59 showed a greater advantage over Faro 64 and 'Art' with respect to the phenotypic traits assessed. Thus, it is recommended for further research in this study area.

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APPENDICES

Table 3.1 Growth and yield parameters for different rice varieties

Treatments	Plant height (10 WAP) (cm)	Panicle weight (g)	Primary tillers/plant	100 grain weight g	Grain length (mm)	Grain yield (t/ha)
Faro 59	92.95	3.34	3.70	2.90	8.88	4.0
Faro 64	100.15	2.91	1.82	2.66	8.65	3.1
Art	97.82	2.81	1.67	2.57	8.73	2.9
LSD (P<0.05)	**5.45**	**0.24**	**0.86**	**0.03**	**0.17**	**0.17**