STABILITY ANALYSIS OF YIELD AND YIELD RELATED TRAITS OF RAINFED RICE (*Oryza sativa* L.) IN AN UPLAND ULTISOL IN OWERRI.

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ABTRACT: An experiment was conducted during the early seasons of 2004 and 2005 in Owerri to assess the stability of yield and yield components in fourteen genotypes of rice (*Oryza sativa* L.) collected from four states of Eastern Nigeria. Genotypic stability analysis was performed on yield and the most related traits to yield using mean yield coefficient of variation (C.V.). All the yield components were significant ($P<0.05$) and positively correlated with yield in both years with the exception of number of tillers/plant in 2004 and 1000 seed weight in 2005. The genotype Fadama significantly ($p<0.05$) produced highest grain yield as well as number of tillers/plant. Genotype Nerica 1 statistically ($P<0.05$) produced the same grain yield with Fadama but had the highest grain % fertile spikelets. Genotypes independently expressed their traits in different stability groups formed. Four groups of yield estimates established were: high yield and low variation, high yield and high variation, low yield and low variation and low yield and high variation. This study has shown that yield traits are complementary in action therefore selection for high and stable yield in an upland condition should include such traits as high percentage spikelets, number of tillers/plant and 1000 seed weight. [The Journal of American Science. 2009;5(2):69-73]. (ISSN: 1545-1003).

Keywords: Rainfed rice, *Oryza sativa*, stability analysis, yield parameters.

INTRODUCTION:

Rice (***Oryza sativa* L**) is speedily overtaking the regular staple foods in its consumption in Nigeria. On this account, there is an increasing demand for rice in Nigerian markets. The performance of wetland rice is constrained by limitation in nutrient availability. Plant development and yields are severely affected by soil conditions such as moisture, acidic, alkaline and saline. Water requirement is larger in rice than any other annual crops. El-Hissewy *et al* (1997) reported that rice water requirement vary with variety, soil, climate and cultivation practices. Rice production under irrigation is expensive and many farmers in Nigeria cannot afford it. The most possible option would be reduction of water requirements through breeding. To achieve this, it is imperative to identify stable yield contributing characters prior to commencing the breeding programme. Rice production in Nigeria had previously been concentrated in lowland rainfed conditions. Inspite of an an increased production of upland rice in Nigeria which has improved rice production; it is yet to attain self-sufficiency (Courtois, 1988). Therefore this study was undertaken to assess the stability parameters of some rainfed rice genotypes in South Eastern Nigeria in an upland condition.

MATERIALS AND METHODS:

The experiments were conducted at the Teaching and Research farm of the Federal University of Technology, Owerri, Nigeria (5º 27/ N and 7º 02/ E) on an elevation of 5.75m above sea level. The meteorological data collected from Owerri meteorological center showed that the experimental field had mean annual rainfall of 2334.40mm and 2397mm in 2004 and 2005 cropping seasons respectively. The experimental sit had a mean annual temperature of 31ºC and relative humidity of 89%.The mechanical laboratory soil analysis showed that the soil had a sand value of 84.1%, silt 9.6% and clay fraction of 6.3% while the chemical soil analysis revealed a PH of 4.86, organic matter was 1.78, total nitrogen 0.103%, 9.62ppm Bray 2-P and exchangeable cations magnesium, potassium and calcium of 0.88, 0.52 and 0.48Cmol (+) kg^{-1}.

Table 1 describes the rice genotypes used in the study. The lines included five lines collected from the National Cereal Research Institute, Baddegi, the other nine lines were collected from farmers fields in Abia, Ebonyi, Enugu and Imo States all in South Eastern Nigeria. The planting materials for the 2005 cropping season were seeds harvested from 2004 plantings.

The field was ploughed and harrowed and laid out in a complete block design with three replications. Each plot measured Im having 5 rows with spacing of 0.25m. The rice seeds were sown directly in the field on May 25, 2004 and5th June,2005 by seed-drilling four seeds in each planting hole and later maintained at two stands per hole at three weeks after planting (WAP). The soil was fertilized with 120kg NPK ha^{-1} in split - application as boost application after planting and as top dressing at booting stage. The experimental field was weeded at 5 and 10 WAP. The field was secured by fencing with wire mesh to protect the rice from grass-cutter and other rodents and bird scaring was done also. Post harvest operations of threshing and winnowing were done to obtain the paddy yield.

Data collected included number of days from planting to anthesis (DA),number of productive tillers per plant(PTP),plant height at flowering(PH), percentage fertile spikelets(PFS),Flag leaf area(FLA), Spikelets per panicle(SP), Spikelets per branch of panicle(SB), a thousand seed weight(TSW) and grain yield(GY).The data were collected according to standard evaluation systems for rice SES, IRRI(1988).Ten randomly selected plants in the middle rows of each plot.

Combined analysis of variance for the two years was carried out for each of the yield and yield components. Genotypic correlation(r_g) between yield and yield related traits was obtained from the genotypic covariance between two traits and the geometric of their genotypic variance (Obi, 1990).

$$r_g = \frac{0^{-2}g\ (XY)}{\sqrt{O^{-2}g(XX)\ (0^{-2}(YY)}}$$

Where:

$O^{-2}g$ (xy) is genotypic variance of cross production of the traits x and y,

$0^{-2}g$ (xx) is the genotypic variance traits of x and

$0^{-2}g$ (yy) is the genotypic variance of the trait y.

The genotypic stability of yield and those of the two most related traits to yield were estimated by mean CV approach as described by Francis and Kannerberg (1978). Using mean CV and grand mean of yields obtained, four groups were obtained as follows:

Group 1- high yield and low variation

Group 2- high yield and high variation

Group 3- low yield and low variation

Group 4- low yield and high variation.

Stable genotypes for traits are those whose cvs are below the mean cv and yield higher than the grand mean yield.

RESULTS AND DISCUSSION

Significant genotypic variation (P< 0.05) was observed for all the yield and yield attributes measured (Table 2). Fadama gave the highest mean grain yield of 2.78t ha^{-1} for both years and performed equally with GB9O, WAB96-1-1, WAB450-NERICA3, Mass and NERICA 1. Genotype Fadama equally produced the highest number of productive tillers which was significantly different (P<0.05) from those of R5, NERICA 2, WAB96-1-1, NERICA 3, NERICA 1 and WAB450-1-. NERICA 1 had highest percentage fertile spikelets and was statistically the same (P<0.05) with genotypes NERICA 3, WAB450-1-, WAB 96-1-1 and NERICA 2. Percentage fertile spikelets and productive tillers per plant partitioned the genotypes used for the study into two parallel groups with the upland rice genotypes having significantly higher percentage fertile spikelets while the lowland ones had more tiller numbers than the upland genotypes .Genotype R_8 produced the least grain yield of 0.91t ha^{-1} and was statistically the same with some of the genotypes.

Table 2 shows the mean square of yield and yield attributes of the genotypes studied for the two years. There was significant year effect on three of the yield attributes but not on grain yield t ha^{-1}, number of productive tillers per plant and number of spikelets per hectare . Highly significant (P<0.01) year effect was observed for the yield attributes with exception of number spikelets per branch of panicles which varied only at P<0.05, thus indicating genotypic variation for both years.The genotype by year (GxY) interaction was significant for half the number of yield attributes recorded and no effect on others. The variation experienced may be as a result of varietal differences.

The characters that showed non significance for GXY effect indicated stable performance inspite of differing environmental conditions for both years and thus agree with Kang (1998). Table 4 shows multiple genotypic correlation coefficients (r_g) of the rice yield and related yield traits.

All the yield attributes were significantly and positively correlated with yield in 2004 with exception of number of productive tillers (PTP) which negatively correlated with yield in 2004 but positively correlated with it in 2005 and was highly significant. It is thought that the environmental conditions prevailing in 2004 may have affected this trait. On the other hand, the number of spikelets per branch of panicle was significant and positively correlation with yield in the first year but not in the second year. Most of the traits studied also inter-correlated positively with others.

Number of fertile spikelets per panicle and % fertile spikelets had highest correlation values for both years and thus agrees with Lavanya et al (1997) who observed positive contribution of grains to high yield. Sharma and Hore (1997) reported that seed weight correlated negatively with tillers per plant and panicle per plant. This agrees with the present finding where tillers per plant had no effect on 1000 seed weight for the two years.

Genotypes independently expressed their traits to yield in the different stability groups (1-4) Table 5. The table shows these genotypes NERICA 1, NERICA 3, WAB 450 -1- and WAB 96-1-1 with 2.68, 2.28, 2.41 and 2.66 t ha^{-1} had high yields and were stable for the years under consideration. They contrasted with genotypes Fadama, SML and GB90 which though had high yields of 2.78, 1.94, and 2.19 t ha^{-1} but were unstable for the two years. Fadama also produced highest number pf productive trillers but was unstable for both years. It is the opinion of this study that this might be as a result of their natural lowland adaptation since they were being tried in an upland environment. Other genotypes performed variably for the traits studied thus indicating their high contribution to yield. This agrees with Mishra and Dash (1997) and Agbo and Obi (2005) who had earlier reported similar results.

This study shows that selection for better grain yields and adaptation under upland rice conditions, the genotypes to be grown must be stable in expression of percentage fertile spikelets, high number of spikelets per panicle, high tillering ability and high number of grains.

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