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Evaluation of Rice Genotypes for the Agronomic Performance and Resistance against *Magnaporthe oryzae*

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Abstract
Rice blast caused by fungus Magnaporthe oryzae is one of the major fungal disease affecting rice (Oryza sativa) cultivation. Currently, the use of pesticides has proven to be successful in the control of this disease to a very large extent, but these results in increase in the cost of production and these chemicals are sometimes not eco-friendly. Therefore, the deployment of blast-resistant cultivars is the most important method of combating the disease because it is considered as a no-cost technology especially to the poor farmers. Therefore, this study was carried out to evaluate rice genotypes for resistance to natural population of blast pathogens and there agronomic performance. Fifteen NCRI advance rice breeding lines and two released (BR1-17) varieties (checks) were collected from the breeding unit of the National Cereals Research Institute (NCRI), Badeggi, Nigeria. These genotypes were screened for resistance to blast disease caused by Magnaporthe oryzae in the blast hot spot and water stress environment. The results on agronomic performance reveal different reactions. Genotype BR3 was highly resistant and has the least disease incidence of 28%. BR2 is moderately resistant and also gave the highest grain yield 6tons per hecter. The blast incidence and severity did not affect the agronomic performance of the rice genotypes as most of the genotypes yield above the average grain yield of 3tons/hectare. BR3 may therefore be utilized by incorporating it into the breeding programme strategy to control blast disease of Magnaporthe oryzae .

Introduction
Rice is an extremely important food in Nigeria with a total annual production of about 2 million metric tons. It is a staple food for both rural and urban dwellers in Nigeria and it is ranked the fourth most important cereal crop in terms of production (after sorghum, maize and millet)(Abo *et al.,* 2003). Nigeria is the largest rice importer in West Africa despite having about 5.0 million hectares of land suitable for rice cultivation (Smith, 2007). Rice production in Nigeria is faced by several biotic and abiotic limitations, and prominent among the biotic factors is yield loss due to diseases. Among these diseases, leaf blast caused by *Magnaporthe oryzae* remains a particular threat because of its unpredictable outbreaks as well as breaking down of genes in resistant cultivars over time (Jamal-U-deen *et al.,* 2012). Leaf blast is one of the most serious and widespread constraint of rice cultivation in Nigeria. It occurs in upland and rainfed rice field. Water deficiency predisposes the rice field to severe infection in all environments (Akator *et al.,* 2013). Currently, the use of pesticides has proven to be successful in the control of this disease to a very large extent, but these results in increase in the cost of production and these chemicals are sometimes not eco-friendly. Therefore, the deployment of blast-resistant cultivars is the main methods of combating the disease because it is considered as a no-cost technology especially to the poor farmers (skamnioti and Gurr, 2009). Therefore the objective of this study focused on field evaluation of seventeen rice genotypes to confirm their resistance to natural population of blast pathogen under water stress environment. The agronomic performance of the rice genotypes and their resistance to diseases will facilitate their selection and incorporation into the breeding programs in Nigeria. It is on this note that the study on evaluation of Rice Genotypes for the Agronomic Performance and Resistance against *Magnaporthe oryzae* was investigated.

Materials and Methods

Collection of Materials

Fifteen NCRI advance rice breeding lines and two released varieties (checks) were collected from the breeding unit of the National Cereals Research Institute (NCRI), Badeggi.

Study Area

The study was conducted at hydromorphic field (latitude N9°.04'02.05 and longitudes E6°.01'30.31) of the National cereals research institute, Badeggi, Niger state, Nigeria during 2017 cropping season.

Experimental Design

The experiment was laid out in a randomised complete block design and replicated 3 times and each entry was planted to a 2 x 5m^2 plot size.

Other Agronomic practices

Fertilizer application was at 80, 40, 40kg per ha of N, P_2O_5 and K_2O, with N applied in two splits at 21 and 42 days after planting. Weeds were controlled using two herbicides (propanol and 2-4-D formulation) at 4 litres per hectare of Orizo plus with supplementary hand weeding.

Data collection and Analysis

The data regarding the occurrence of the blast disease were collected at seventh week after planting using the Standard Evaluation System developed by International Rice Research Institute (IRRI, 2013) and then converting into percentage disease by using the formula thus:

$$\text{Disease (\%)} = \frac{\text{Average of the disease score X 100}}{9}$$

Other data collected include agronomic traits such as Plant Height measured using metre rule, number of tiller per metre square, number of panicle per metre square, days to 50% flowering, 1000 grain weight and yield. Data was analyzed using CropStat7.2. version. Analysis of variance was carried out and significant means was separated using LSD @0.05% probability level

Results and Discussion

The rice genotypes showed different reactions in response to blast. Scoring of 1 in the susceptible local check (FARO 52) indicated probably that there is genetic mutation of the variety against blast as the environment was suitable for disease screening. There were 2 resistant (R) varieties, 5 moderately resistant (MR) and 9 moderately susceptible (MS) varieties (Table 2). Barnwal *et al.,* (2012), singh *et al.,* (2010) and Ali *et al.,* (2003) also observed variation in the reaction of rice genotypes to leaf blast. Significant difference at 5% level of probability was also observed for percentage blast incidence and blast severity (Table 3). Significant difference at 5% level of probability was also observed for number of tiller/m^2 and grain weight across the means of all the rice lines evaluated. Means of plant height, panicle/m^2, 50% flowering and grain yield were significantly different at 5% level of probability (Table). Highest number (78.6 and 280) of plant height and tiller/m2 were recorded in BR8 respectively. BR12 recorded the highest number (450g) of panicle/m2 followed by BR6 (431) (Table 4) though has the highest percentage blast incidence 43% and severity scoring of 5 across all the genotypes (Table 3 & 4). The susceptibility of this genotype may be as result of genetic makeup from the parents. Most of the genotypes gave grain yield above 3t/ha, though BR2 significantly at 5% gave higher grain yield of 6190kg/ha than all other entries (Table 4). Lowest grain yield was recorded in BR 11.

Majority of the genotypes yield above 3tons which is the average expected yield under the natural blast infection. The resistant genotype is therefore recommended for incorporation in to the breeding program in Nigeria.

Table 1: Phenotypic Difference to Resistance

Rice Lines	Blast Host Behaviour
BR3 &FARO 52	R
BR1, BR2, BR4, BR5, BR7 & BR13	MR
BR6,BR8,BR9,BR10,BR11,BR12,BR14, BR15 & FARO 44	MS

BR-Breed Rice, R-Resistsnce, MR-Moderately Resistance &MS-Moderately Susceptible

Table 3: Blast disease incidence and severity of the rice genotypes

Treatment No	Designation	% Blast Incidence	Blast severity
1	BR1	38	4
2	BR2	32	2
3	BR3	28	1
4	BR4	32	3
5	BR5	42	2
6	BR6	43	5
7	BR7	35	2
8	BR8	32	4
9	BR9	38	4
10	BR10	37	4
11	BR11	37	4
12	BR12	40	4
13	BR13	32	3
14	BR14	33	4
15	BR15	35	4
16	FARO 44	35	4
17	FARO 52	37	1
	LSD 5%	15.1093	2.47551
	CV%	25.4	46.6

Table 4: Agronomic performance of rice genotypes/varieties under natural field infection of Blast pathogen (*Magnaporthe oryzae*) at NCRI hydromorphic field, Badeggi

Treatment No	Designation	Plant Height	Tiller No/m^2	Panicle/ m^2	50%Flowering	1000 Grain weight(g)	Grain Yield(kg)
1	BR1	56.1	207	371	62	23	3443
2	BR2	59.8	228	414	63	23	6190
3	BR3	51.3	260	390	62	23	3837
4	BR4	65.7	227	413	84	27	4387
5	BR5	59.9	217	431	90	23	3033
6	BR6	61.3	217	377	79	23	4443
7	BR7	71.4	240	403	77	27	3080
8	BR8	78.6	280	383	90	23	3730
9	BR9	58	253	398	75	27	2990
10	BR10	69.7	232	433	66	23	1650
11	BR11	58.4	212	450	70	30	4200
12	BR12	61.5	255	424	75	23	3133
13	BR13	54.9	220	422	66	23	3123
14	BR14	64.4	308	400	70	30	3243
15	BR15	49.9	163	342	64	20	3160
16	FARO 44	59.6	237	413	64	27	3167
17	FARO 52	54	259	374	72	30	4313
	Lsd 5%	13.3618	81.856	45.426	4.19056	9.53087	175.833
	CV%	13.2	20.8	6.8	3.7	22.8	2.9

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