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ON- FARM EVALUATION OF INTERSPECIFIC RICE HYBRIDS FOR STABLE PERFORMANCE IN FERTILIZER AND NO FERTILIZER ENVIRONMENTS.

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ABSTRACT

Nineteen rice genotypes (Oryza Sativa) were grown in fertilizer and no fertilizer environments using four farmers field in 2000 and 2001. The yield data were subjected to Additive Main Effects and Multiplicative Interaction model (AMMI) and modified rank sum analyses. ITA 321, WAB450-HB, ITA150, OS6, WAB249-1 and WAB384-7-1 had positive interaction and adaptable to no fertilizer (E4), environment. OS6, WAB337-H2, ITA301, WAB384-7-1, WAB189-13-HB, WAB35-FX, WAB450-HB, and WAB 450-1-HB with low IPCA score of near zero and smallest rank sums respectively, were considered stable with wide adaptation to fertilizer and no fertilizer environments. This indicated that high yield of rice could be obtained even without fertilizer application. AMMI and modified rank sum were similar in selecting WAB384-7-1 as most desirable genotype but differed in choice of other genotypes for stability of performance.

Keywords; AMMI, fertilizer, GXE, Modified ranksum, no fertilizer, *Oryza Sativa*, ,

INTRODUCTION

Rice is a major food item with large amount of usable carbohydrate for energy source. The technological options for increasing rice yield include development of modern rice cultivars, exploitation of hybrid vigour and improvement of plant types among others, (Miah and Sarma, 2002). Development of new hybrids is targeted towords yield improvement with low input technologies which include overcoming environmental stress of low fertility, drought. Few farmers in Western and Central Africa use fertilizers because the cost of fertilizer input is more than no fertilizer input. As such, hybrids which can withstand the low soil fertility environmental problems are preferred by farmers (Okeleye et al., 2001). The active participatory roles of farmers in on-farm research reduce the time in identifying desirable cultivars that have stable performance. To this end, the integration of cultivar stability with yield is important for the purpose of selecting high yield and stable genotypes (Singh, 2000). The study of genotype stability in diverse environments including fertilizer or no fertilizer environments requires the use of efficient statistical technique. The study evaluates the performance of rice genotypes grown under fertilizer and no fertilizer environments with a view to selecting high yielding and stable genotypes in each environment and determines the effectiveness in use of AMMI and modified rank sum techniques in genotype stability analysis.

MATERIALS AND METHODS

Nineteen upland rice genotypes were planted in farmers' field at Ibogun, Olaogun village near Ifo, in the early growing seasons of 2002 and 2003. Completely randomized design was used and replicated three times. Plot size was 5m X 2m and spaced 20cm within and between rows with five seeds sown per hole and thinned to two plant stands two weeks after planting (2WAP). The treatments were fertilizer applied and without fertilizer plots, in 2002 and 2003 planting seasons, respectively. Fertilizer was applied at the rate of 60kgN; 30kg.P and 30kgK per hectare. Urea was applied at the rate of 50kg/ha as top dressing at tillering and booting stages. Weeding was done manually and when due. Data were collected on grain yield in kilogramme per hectare (kg/ha) and subjected to AMMI model technique according to the procedure of Gauch and Zobel (1996), Joint regression analysis and modified rank sum technique given by Kang (1991). These techniques were used to determine the yield performance across the fertilizer and no fertilizer environments.

RESULTS AND DISCUSSION

The fertilizer environments of 2002 and 2003 recorded the highest mean yield of 646.84kg/ha and 483.30kg/ha (Table 1) respectively. The effects of genotype and environment were significant and accounted for 38.84 and 27.72% respectively of the total sum of square (TSS) Table 2. The first interaction Principal Component analysis (IPCAI) was also significant and accounted for 32.06% of the sum of square due to G x E interaction. It was about four times as large as the residual mean square. That the GxE interaction was not significant implied that the genotypes performed differently in the fertilizer and no fertilizer environments. The joint and genotype regression analysis were significant this further justifies the fact that the environment greatly influenced genotype performance. Mean yields, unbiased estimator, stability ratings and rank sums of the genotypes are presented in Table 3. WAB-384-7-1 produced the highest yield of 623.75kg/ha followed by WAB 340-B-HB (604.26 kg/ha), ITA 321 had 504.00kg/ha yield, WAB 35-Fx (496.01kg/ha), WAB 450-HB (487.50kg/ha) and WAB 99-1 recorded 484.00kg/ha mean yield.

WAB 337-H2 produced the least means yield of 296.00kg/ha. Similarly, WAB 384-7-1had the lowest rank of 1and followed by WAB 340-B-B-HB.WAB 337-H2 ranked the highest. The stability variances were highly significant for ITA 321, ITA 150, ITA 301, WAB 249-1,WAB 99-1 and WAB 99-47 with each of this genotype carrying a score of 8.The scores of 4 were assigned WAB 450-HB,WAB 337-H2, WAB384-HI, WAB340B-HB and WAB 450-1-HB whose stability variances were significant only at 5% level of probability. The remaining genotypes were scored zero as their stability variances were not significant. Kang's (1991) modified rank sum method integrated stability with high yield leading to successful selection of high yielding and stable genotypes whereby genotypes with lowest rank sums are considered stable. This therefore implied that WAB 35-Fx, WAB 384-7-1, WAB 340-B-HB and WAB 224-HB with lowest rank sums are considered stable. These four genotypes identified by rank sum method had above average mean yield far in excess of the overall mean grain yield. The scores of First interaction Principal Component Axis (IPCAI) for genotype and environment mean yield are presented in Table 4. Mean yield of each genotype in each of the fertilizer and no fertilizer environments and their respective IPCA scores as analysed by AMMI, revealed WAB 450-HB, WAB 384-7-1 and WAB 340-B-HB with above average mean yield and low IPCA scores (1.03, 0.13 and -0.32) to be stable respectively. According to Gauch and Zobel (1996), genotypes with zero or near zero IPCA scores are considered stable. WAB 450-HB with IPCA near zero (0.83) interacted positively with fertilizer environment of 2002 and 2003. This reveals this genotype was adaptable with stable performance only to fertile soil environment. WAB 387-7-1 and WAB 340-B-HB yielded consistently above average in fertilizer and no fertilizer environments of 2002. Okeleye *et al.* (2003) identified some hybrids of rice to produce higher yield than some local checks. High yields inspite of the reduced precipitation in 2002 suggest that selecting these genotypes for drought prone environments, would be a worthwhile effort. Moreover, ability to with stand moisture stress is an important characteristic desired by farmers (Brar 1995). That WAB- 384-7-1 (G15) and WAB 340-B-HB yielded above average with low IPCA scores even under minimum rainfall, indicated the stability of these genotypes. Furthermore, the consistent performance of these genotypes in 2002 environments revealed that crop performance was influenced by year effect. According to Ariyo and Ayo-vaughan (2000), year effect is more important for genotype performance than environment or location effect. It follows that rice performance is determined by year and environment effects. However, it is worthy of note that year effects are not repeatable; hence justify the reliability of testing rice genotypes in diverse environments to ensure successful and reliable rice selection (Ojo and Vange 1997). In this case, successful selection and cultivation for high yield of rice can be made for WAB450-HB, WAB96-1, WAB384-7-1 and WAB340-B-HB for fertilizer environment and WAB35-Fx, WAB 384-7-1, WAB189-13-HB for no fertilizer environment. However, the performance of ITA 321 (G1), WAB 35-Fx (g11), WAB 224-HB (G16) and WAB 99-49 (G18) with large interaction IPCA cannot be predicted even though their respective mean yields were above average. Although AMMI and modified rank sum method agreed that WAB 384-7-1 (G14) and WAB 340-B-HB (G15) were most desirable, there were discrepancies in the choice of other genotypes. While rank sum method selected genotypes based on high yield and stable performance across environments AMMI model specified each genotype adaptation to specific environments as shown in Fig.1. Therefore, where reliable information is needed on genotype performance, adaptation and G x E interaction, an effective statistical tool such as AMMI becomes more efficient than modified rank sum method.

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Table 1. Rice average grain yield across the four environments and Weather co-ordinates.

Environment	Mean yield	Mean Temp.(0°)	Max. Temp(0°)	Mean Rainfall(mm)	Relative Humidity	Year
E_1	646.84	20.05	27.9	54.2	53.4	2002
E_2	421.20					
E_3	483.30	22.3	25.8	71.6	86.6	2003
E_4	325.73					

E1= fertilizer environment
E2 = No fertilizer environment

Table 2. Sources of variation of AMMI and Joint regression analysis

Source	**Df.**	Ms
Genotype	18	29317.11*
Environment	3	25518.28**
G x E	54	25158.56
IPCAI	20	211912.37**
Joint regession	1	515257.73*
Genotype regression	17	176271.96**
Environment regression	2	16640.90
Total	75	121192.19
Residual	34	5740.57

Table 3. Genotype and environment mean yield (kg/ha), rank, unbiased estimator, stability rating, and rank sum value of 19 rice genotypes

Genotype	Mean yield (kg/ha)	Rank	Unbiased estimator	Rating	Rank sum
ITA 321	504.00	3	370719.96**	8	11
WAB450-HB	487.50	5	63264.14*	4	9
WAB 340-H1	432.00	9	36718.78	0	9
WAB96-1	389.00	13	27720.19	0	13
ITA 150	444.50	10	141404.82**	8	18
OS6	354.00	17	280442.940	0	17
WAB337-H2	296.00	19	46494.55* 4	23	
ITA 301	360.25	16	145347.74**	8	24
WAB249-1	368.75	15	236476.37**	8	23
WAB 99-1	484.00	6	261094.57**	8	14
WAB 35-Fx	496.25	4	33604.43	8	4
WAB450-38-HB	390.25	12	53805.59*	0	16
WAB 384-HI	447.25	9	31614.23	4	9
WAB 384-7-1	623.75	1	97404.37*	0	5
WAB 340-B-HB	604.25	2	12252.68	4	2
WAB 224-HB	476.50	7	19807.82	0	7
WAB 189-13-HB	347.75	18	13533.37	0	18
WAB 99-47	466.50	8	275584.92*	8	16
WAB 450 -1-HB	775.50	14	219440.21*	4	18

Table 4. Genotypes and environment mean yield and IPCA scores

Genotype	E1	E2	E3	E4	PCA score
ITA 321	858.00	400.0	493.3	250.2	3.0
WAB450-HB	670.3	405.1	525.3	445.1	0.83
WAB 340-H1	680.4	212.6	580.2	282.0	-1.65
WAB96-1	525.4	375.5	406.0	260.1	-0.38
ITA 150	678.63	410.0	400.4	290.0	2.44
OS6	505.2	394.0	346.0	210.3	0.97
WAB337-H2	460.0	314.2	300.2	110.0	-1.50
ITA 301	521.5	380.5	329.0	220.1	-3.62
WAB249-1	570.0	305.9	386.0	214.0	4.70
WAB 99-1	656.1	400.3	460.3	420.0	6.01
WAB 35-Fx	600.5	440.1	540.5	425.3	-2.43
WAB450-38-HB	371.2	330.6	360.2	370.2	6.48
WAB 384-HI	756.8	420.7	502.0	200.3	-1.56
WAB 384-7-1	1150.1	520.6	600.0	320.5	0.13
WAB 340-B-HB	922.5	400.3	630.2	371.0	-0.32
WAB 224-HB	550.7	447.0	595.3	356.4	-3.63
WAB189-13-HB	255.4	545.2	320.3	400.2	0.85
WAB 99-47	760.1	200.7	548.0	346.0	-3.92
WAB 450 -1-HB	301.2	302.0	450.7	310.3	0.20
Mean yield	646.8	421.20	483.5	325.75	
IPCA	1.25	-1.70	4.51	1.68	

E1 = Fertilizer environment 2002
E2 = No fertilizer environment 2002
E3 = Fertilizer environment 2003
E4 = No fertilizer environment 2003