PERFORMANCE EVALUATION AND GENETICS OF EXOTIC RICE VARIETIES IN A NIGERIA AGRO-ECOLOGY

ABSTRACT

Aim: The research focused on the performance of six exotic rice genotypes from Malaysian Agricultural Research and Development Institute (MARDI) in a Nigerian agro-ecology.

Study design: The varieties were evaluated in randomized complete block design replicated three times.

Place and Duration of Study: The study was conducted at the research field of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria on Latitude 7^0 28^1N, Longitude 5^0 44^1 E, altitude 423m above sea level during the dry season of 2012/2013.

Methodology: During the period the rice varieties were planted to test for their ability to adapt to a Nigerian eco-system. The characters measured include plant height, number of tillers/hill, effective tillers with panicle, tillers without panicle, flag leaf length, panicle length, panicle weight, number of grains per panicle, number of spikelet per panicle, 1000_grain weight, number of filled grains per panicle, number of unfilled grains per panicle, grain length, grain width, number of days to heading, number of days to maturity and grain yield per hill.

Results: Grain yield exhibit significant correlations with number of tillers per hill (0.733), effective tillers with panicle (0.826), panicle length (0.305) and panicle weight (0.339) which is a useful guide for selection in further breeding studies.

Conlusion: This study revealed the significant contributions of number of tillers per hill, effective tillers with panicle, panicle length and panicle weight as the sole determinant of total yield.

Keywords: MARDI, characters, Exotic rice, agro-ecology, correlations, selection

1. INTRODUCTION

Consequent upon the stoppage of rice importation and the need to increase self- sufficiency level of rice production in Nigeria, efforts are being made by the Federal Government as part of her transformation agenda to strengthen agricultural production especially in rice farming as a result of its importance in the diets of her citizens. It is on this basis that every available crop land is being prepared for rice production utilizing lowland, upland, swamp and waterlogged agro ecologies.

Before now Nigeria is the second largest importer of parboiled rice from Asia throughout the continent of Africa, therefore, breeding work had been developed in ensuring that improvement of the local low yielding varieties is raised up with the incorporation of desirable qualities of the exotic varieties. Asian rice *Oryza sativa* had its peculiar characteristics in terms of aroma, slender grains and long, intermediate to high amylose content, medium to hard gel consistency with low alkali spreading value but high gelatinization temperature.

An information on genotype x environment interaction leads to successful evaluation of stable genotype, which could be used for general cultivation (1). Yield is a complex quantitative character and is greatly influenced by environmental fluctuations, hence, the selection for superior genotypes based on yield per se at a single location in a year may not be very effective, and thus, evaluation of genotypes for stability of performance under varying environmental conditions for yield has become an essential part of any breeding programme (2; 3).

An understanding of the causes of genotype x environment interaction can help in identifying traits and environment for better cultivar evaluation. (4) Opined that yield components breeding to increase grain yield would be most effective, if the component involved are highly heritable and genetically independent or positively correlated with grain yield. However, knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of character into future generations (5). It was reported that grain yield per plant was significantly correlated with the number of panicles per plant and 1000_grain weight (6).

Therefore, the present investigation was carried out to evaluate the performance of rice varieties from Asia in different environment of tropical Africa in particular Nigeria and to estimate the inherent high yield status under similar conditions of optimum soil fertility and water regimes.

2. MATERIALS AND METHODS

2.1 Source of Materials

The experimental materials for the research work consist of varieties from Malaysian Agricultural Research and Development Institute (MARDI), Pulau Pinang, Malaysia. The genotypes are MR 269, MR 263, MR 253, MR 220, MRQ 74 and MRQ76.

2.2 Experimental Site

They were evaluated in a randomized complete block design with three replications at the research field of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria on Latitude 7^0 28^1N, Longitude 5^0 44^1 E, altitude 423m above sea level during the dry season of 2013.

2.3 Nursery Practices

The seeds were raised in the nursery after subjecting them to pre-germination test by soaking in water for 24- 36 hours and incubated for another 24 hours before it is sown in the nursery.

2.4 Transplanting

Three weeks after sowing, the seedlings were transplanted into the field. The plot size used was 2m x 2m with spacing of 20cm x 20cm row to row and plant to plant with two seedlings per hill. The estimated plant density per hectare was 250,000 plants/ha. Recommended fertilizer application was done according to IRRI specification and adequate crop care was maintained especially water supply, pesticide application, weed and rodent control.

2.5 Soil Analysis

Prior to transplanting, soil analysis of the field was done and the results are as follows: P^H 6.4, organic matter 1.25%, total nitrogen 0.26%, phosphorus 3.89ppm, CEC 3.45cmol.kg^{-1} and EC 2.54cmol.kg^{-1} to ascertain the suitability of the experimental field.

2.6 **Data collection**

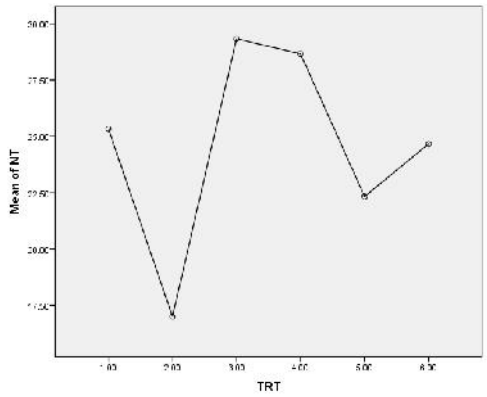
Data collections were taken on the following quantitative traits: Plant height, number of tillers/hill, number of productive tillers i.e. effective tiller with panicle (ETP), tiller without panicle, flag leaf length, panicle length, panicle weight, number of filled grains/panicle, number of unfilled grains/panicle, 1000_grain weight, grain length, grain width, number of days to panicle initiation, number of days to maturity and grain yield per hill.

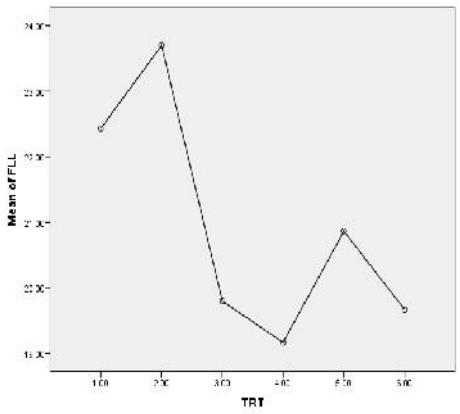
2.7 **Statistical Analysis**

The data were subjected to statistical analysis using the general lineal model (GLM) procedure for randomized complete block design in SPSS 2.0 version. Phenotypic correlation coefficients were generated from the analyzed data, genetic advance as percent of mean and heritability in broad sense was computed according to the procedure of Allard (7) to estimate the performance analysis of the varieties.

3.0 **RESULTS AND DISCUSSION**

The mean performances of six exotic rice genotypes for seventeen agronomic traits were presented in Table 1. The plant heights of the genotypes were somehow short statured compare to the parental types, with the values ranging from56.43cm to 65.23cm. the tillering was excellent with the least of 17 tillers per hill and this is effectively justified with the least effective tillers with panicle of 14 tillers per hill of MR 269 and the highest of 26 tillers in MRQ 74. The flag leaf length corresponds to panicle length with the least flag leaf length of 19.17cm and 23.70cm for the highest and this trait is responsible for panicle length formed at heading/booting stage of the rice plant. The number of days to heading, number of days to maturity and grain yield per hill were repeatable characteristics of the varieties of at least 82 days, 112 days and 25.17g because the same results were obtained in Malaysian agro-ecology. These traits must be selected for yield improvement programmes, similar results were obtained in the findings of (4; 8; 3).





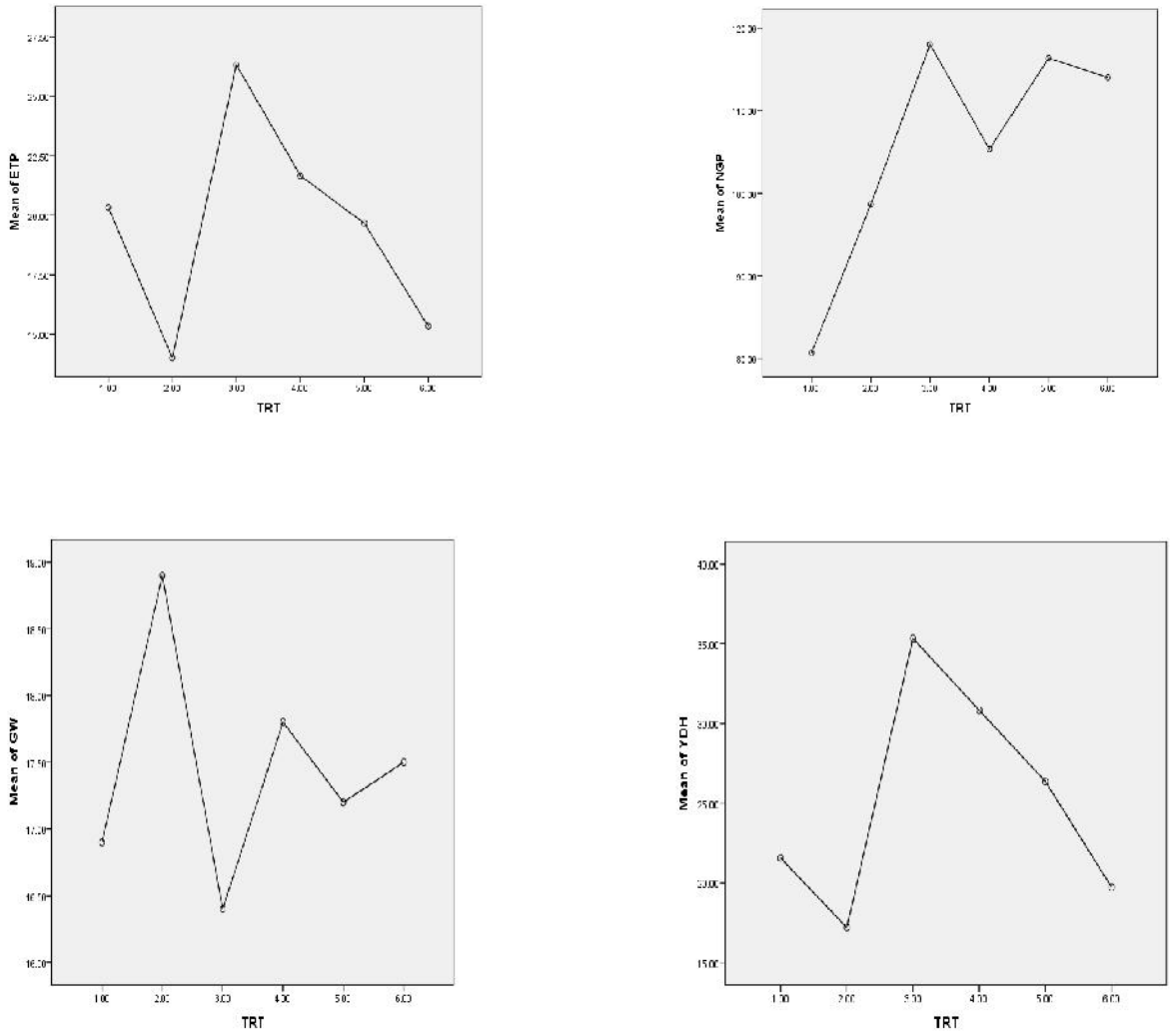


Fig 1: Graphical presentation of some yield components.

Table 1: Mean Perfomance of six exotic rice genotypes for seventeen agronomic traits

Genotypes	Plant height (cm)	No of tillers/ hill	Effective tillers with panicle	Tiller without panicle	Flag leaf length	Panicle length
MRQ 76	56.43	25.33	20.33	5.00	22.43	17.57
MR 269	65.23	17.00	14.00	3.00	23.70	20.23
MRQ 74	60.13	29.33	26.33	3.00	19.80	18.40
MR 220	61.67	28.67	21.67	7.00	19.17	20.17

116	MR 263	56.17	22.33	19.67	2.67	20.87	18.43
117	MR 253	60.07	24.67	15.33	9.33	19.67	18.83
118	GX	59.95	24.56	19.56	5.00	20.94	18.94
119	S.E	1.19	1.31	1.28	0.64	0.67	0.29
120	CV	7.8	17.4	21.4	22.6	13.1	4.8

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122 Table 1 (cont'd)

123 124 Genotypes	Panicle weight(g)	No of spikelet/ panicle	No of grains/ panicle	1000_grain weight(g)	No of filled grains/ panicle	No of unfilled grains/panicle
125 MRQ 76	1.30	8.67	80.67	16.90	60.00	20.67
126 MR 269	1.83	9.00	98.67	18.90	63.00	35.67
127 MRQ 74	1.93	10.00	118.00	16.40	89.33	28.67
128 MR 220	1.87	9.33	105. 33	17.80	82.00	23.33
129 MR 263	2.00	10.00	116.33	17.20	80.67	35.67
130 MR 253	1.63	10.00	114.00	17.50	89.33	24.67
131 GX	1.76	9.50	105.50	17.45	77.39	28.11
132 S.E	0.09	0.15	3.58	0.20	4.00	2.42
133 CV	19.6	3.5	8.2	1.6	18.4	35.3

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136 Table 1 (cont'd)

137 138 Genotypes	Grains length (cm)	Grain width (cm)	No of days heading	No of days to maturity	Grain yield/hill (g)
139 MRQ 76	0.83	0.20	66.00	95.33	21.57
140 MR 269	0.80	0.20	71.67	102.33	17.20
141 MRQ 74	0.90	0.30	89.67	119.67	35.33
142 MR 220	0.80	0.20	84.67	115.33	30.83
143 MR 263	0.80	0.30	89.00	119.67	26.37

MR 253	0.83	0.20	89.67	119.67	19.73
GX	0.83	0.23	81.78	112.00	25.17
S.E	0.01	0.01	2.31	2.35	1.86
CV	3.8	0.0	s1.7	1.2	20.8

Genetic variability parameters for quantitative traits in rice were presented in Table 2; of which the analysis of variance revealed highly significant differences in all the characters measured. Hence, the heritability of the traits shows low, moderate and high values, although the heritability estimate for grain yield per hill was low probably because of the period of the year the research was conducted and the environment the genotypes were subjected, the genotypes were supposed to be evaluated under *sawah* condition just like its own country but here in Nigeria it was purely upland situation with irrigation provided everyday. Genetic advance which is the total genetic gain of the genotypes over varying conditions, the least value was observed in grain length 0.05% and highest 22,87% in number of grains per panicle which is the target of the research, farmers and economic returns.

The phenotypic correlations among the component traits shows the appearance of agronomic and yield components as it is showned on the field. Table 3 revealed that grain yield/hill positively and significantly correlates with number of tillers/hill (0.733) this is in line with the result of (4).

Table 2: Genetic variability Parameters for Quantitative traits in rice

Characters	Mean Squares	Vg	Ve	Vp	GCV	PCV	h^2B	GA	GAM
Plant height (cm)	34.55**	7.28	21.85	29.13	4.50	9.01	25.0	2.78	4.64
No of tillers/Hill	61.42**	14.38	18.28	32.66	15.48	23.33	44.0	4.38	17.87
Effective Tillers /panicle	59.82**	14.13	17.44	31.57	19.28	28.81	44.8	5.21	26.72
Tillerswithout panicle	21.73**	6.82	1.20	8.10	52.23	56.92	84.2	4.93	98.5
FlagLeaf length(cm)	9.55**	0.68	7.52	8.20	3.94	13.68	8.3	4.89	23.35
Paniclelength (cm)	3.37**	0.85	0.83	1.68	4.88	6.86	50.6	1.36	7.21
Panicle Weight (g)	0.20**	0.03	0.12	0.15	9.84	22.01	20.0	1.60	90.91

No of spikelet /panicle	1.03**	0.31	0.11	0.42	5.86	6.82	73.8	1.00	10.32
No of grains /panicle	605.57**	117.06	74.39	251.45	12.61	15.03	70.4	22.87	21.68
1000_grain weight (g)	2.22**	0.71	0.08	0.79	4.89	5.08	89.9	1.65	9.42
No of filled grains/panicle	496.06**	98.13	201.67	299.80	12.80	22.37	32.7	11.78	15.21
No of unfilled grains/panicle	122.76**	8.20	98.17	106.37	10.20	36.70	7.7	1.70	6.05
Grain length (cm)	0.01**	0.001	0.001	0.002	3.81	5.39	50.0	0.05	6.21
Grain width (cm)	0.01**	0.002	0.000	0.002	19.44	19.44	100.0	0.10	43.48
No of days to heading	321.69**	106.6	1.89	108.5	12.62	12.73	99.1	21.24	25.97
No of days to maturity	335.20**	111.18	1.67	112.85	9.42	9.49	98.5	21.67	19.34
Grain yield /Hill (g)	145.72**	39.41	27.49	66.89	24.94	32.49	58.9	9.94	39.49

Effective tillers with panicle (0.826) as corroborated by the result of (9; 10), panicle weight (0.305), number of grains per panicle (0.339), number of spikelet per panicle (0.445) the work of (11) also confirms these result, number of filled grains per panicle (0.328), grain length (0.407), grain width (0.524),number of days to heading (0.434) and number of days to maturity (0.443) but had negative and highly significant correlation with 1000_grain weight(-0.586). The flag leaf length which shows the degree of light transmission into the rice plant is a yield enhancing factor and is rightly positioned for photosynthetic process, this trait significantly correlate positively with panicle length (0.302) and number of unfilled grains per panicle (0.363), meanwhile, it negatively and significantly correlates with panicle weight (-0.413), number of filled grains per panicle (-0.498), number of days to heading (-0.484).

The graphical presentation of some of the yield component traits were presented in the above figures. The number of tillers had a mean performance ranging from 17.5 to 28.5, the flag leaf length with mean values from 19 to 23, effective tillers per panicle 15 to 27 across the varieties number of grains per

209 panicle ranged from 80 to 120, 1000_grain weight 16.5g to 19.0g and grain yield 16.5g to 35g per hill,
210 based on the mean performance of the grain yield it was estimated that the mean yield per hectare of
211 each of the genotypes ranged from 4.3 metric tons to 8.8 metric tons this shows the degree of similarity
212 with the Malaysian agro-ecology with average yield of 4.5metric tons to 8.5metric tons.

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215 **Table 3: Phenotypic Correlation coefficients among agronomic and yield component traits**

Characters	PLT HT	NT	ETP	TWP	FLL	PAN L	PAWT	NGP	NSP P	1000 _WT	NFG P	NUF GP	GLT	GW DT	NDTH	NDM	GYD/H
Plant height(cm)		0.135	0.178	-0.083	0.615**	0.793**	-0.110	0.148	-0.031	0.407**	-0.047	0.296**	-0.054	-0.259	0.061	-0.037	0.101
No of tillers/hill			0.880**	0.278**	-0.033	-0.017	-0.230	0.090	0.359**	-0.579**	0.168	-0.143	0.280	0.167**	0.296	0.293	0.733**
Effective tillers with panicle				-0.211	0.152	-0.038	-0.103	0.105	0.313**	-0.612**	0.029	0.107	0.379**	0.458**	0.211	0.215	0.826**
Tiller without panicle					-0.376**	0.043	-0.265	-0.026	0.106	0.047	0.286**	-0.511**	-0.189	-0.584**	0.182	0.168	-0.163
Flag leaf length (cm)						0.302**	-0.413**	-0.311	-0.225	0.251	-0.498**	0.363**	-0.085	-0.155	-0.484**	-0.459**	-0.137
Panicle length (cm)							-0.018	0.216	-0.034	0.593**	-0.079	0.190	-0.334**	-0.302**	0.065	0.105	0.032
Panicle weight (cm)								0.446**	0.340**	0.084	0.179	0.364**	-0.036	0.396**	0.435**	0.446**	0.305**
No of grains/panicle									0.742**	-0.152	0.802**	0.153	0.198	0.559**	0.848**	0.839**	0.339**
No of spikelet/panicle										-0.357**	0.541**	0.204	0.310**	0.588**	0.835**	0.848**	0.445**
1000_grain weight(g)											-0.320**	0.304**	-0.615**	-0.563**	-0.299	-0.270	-0.586**
No of filled grain/panicle												-0.468**	0.301**	0.326**	0.695**	0.668**	0.328**
No of unfilled grains/panicle													-0.206	0.287**	0.105	0.136	-0.040
Grain length (cm)														0.351**	0.184	0.166	0.407**
Grain width(cm)															0.561**	0.558**	0.524**
No of days to heading																0.997**	0.434**
No of days to maturity																	0.443**
Grain yield/hill																	

216 **Significant at P=0.01

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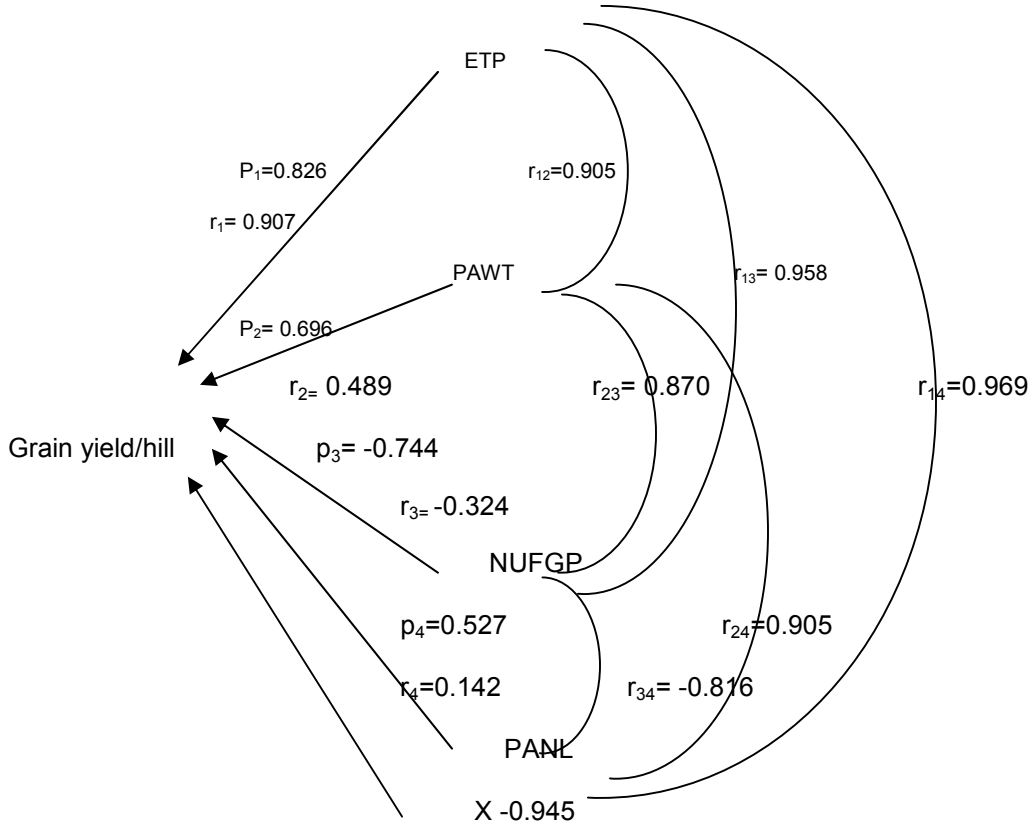

Fig.2: Path diagram for yield and its components

The path diagrams above shows the direct and indirect contribution of the components of yield on grain yield. Though correlation analysis indicates the association pattern of the components traits with yield, they simply represent the overall influence of a particular trait on yield rather than providing cause and effect relationhip. It does not give an exact position of the relative importance of direct and indirect effects of various yield attributes. The path coefficient analysis, a method developed by (12) and demonstrated by (13) as well as (3) is a potent and efficient technique in this regard. The direct and indirect effects of four characters on grain yield revealed that out of the four characters; effective tillers with panicle, panicle weight and panicle length where their correlation with grain yield were significantly high and positive except number of unfilled grains per panicle which is negative. This indicates that the characters which had positive direct path and correlations with grain yield had true relationship and direct selection for this characters is the desirable direction for improvement of rice.

4.0 CONCLUSION

The present findings indicate that the yield component traits contributed immensely to total yield in all the plot evaluated for the research work and subsequent breeding programme should be focused on tillers per hill, effective tillers with panicle, panicle length and panicle weight.

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