International Scholars Journals

African Journal of Crop Science ISSN 2375-1231 Vol. 3 (6), pp. 190-195, August, 2015. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Assessment of the influence of morphological traits to variability in some accessions of rice

***[1]Olagunsoye Momodu, [1]Tamarabo B. Onyitaremi and Oviri T. Jerry[2]**

[1]Department of Crop Production, Faculty of Agriculture, University of Ibadan, Ibadan, Nigeria.
[2]Department of plant Breeding, Faculty of Agriculture, Obafemi Awolowo University, Ife, Nigeria.
*Corresponding Author. Email: olagunsoye.mm@gmail.com

Accepted 16 July, 2015

Field experiment was conducted at Edozhigi, National Cereal Research Institute experimental field, to assess the contribution of morphological traits to variability in some accessions of rice. The field was laid out in a randomized complete block design with three replicates. Thirty nine entries collected from farmer's field and National Cereals Research Institute gene Bank were planted in a plot size of 5 × 1 m. The experiment was conducted in 2009 and 2010 cropping seasons. Data were collected on twelve morpho-physiological traits. The results of the principal component analysis showed that the first 5 principal component axes explained 68.9% (first year) and 61.6% (second year) of the total variations in the rice population. The combined results showed that 65.4% of the variations were accounted for by the first 5 principal components axes. Number of grains per panicle loaded more on the component loading correction plot using the combined results. It accounted for about 17.8% of the variation in the population. High levels of variability were expressed among the varieties and the characters studied which will allow further improvement in the varieties.

Key words: Variation, principal component, rice, variety.

INTRODUCTION

Rice, *Oryza* species is a grass belonging to the Poaceae family. The plant is annual with the height of about 36 – 150 cm. It is the world's most consumed cereal after wheat (FAO, 2004) and are cultivated in most countries of the world. There are about 20 different species, of which the cultivated varieties are *Oryza sativa* and *Oryza glaberrima* (Vaughan and Morishima, 2003). The major resource of plant breeders is the genetic variability in gene pool accessible to the crop of interest (Thottappily et al., 1996). The successes of crop improvement programs are highly reliant on the efficient manipulation of that genetic variability. Morphological markers have played an essential role in crop improvement since the beginning of modern breeding programs (Mignouna et al., 1996). When more sophisticated attributes are required, isozyme, restriction fragment length polymorphism (RFRP) and other molecular level analysis are used (Ng and Padulosi, 1992; Flavel, 1991). Information from these studies are used by breeders and taxonomists to study genetic diversity with the aim of identifying differences and interrelationships among living organisms (Ng and Padulosi, 1992). The evaluation of germplasm frequently includes recording traits of agronomic interests, such as resistance to pests and diseases and tolerance to physiological stresses that are influenced by environment. These data are most sought about by plant According to Ng and Padulosi (1992) breeders (Peters and Williams, 1984). Continuous evaluation of germplasm should be done to broaden the

Table 1. List of varieties used for the experiment.

S/N	Varieties	Remark
1	FARO 19)	Improved
2	FARO 37	Improved
3	FARO 30	Improved
4	FARO 27	Improved
5	FARO 44	Improved
6	FARO 12	Improved
7	FARO 15	Improved
8	FARO 39	Improved
9	FARO 48	Improved
10	FARO 29	Improved
11	FARO 51	Improved
12	FARO 49	Improved
13	FARO 22	Improved
14	NERICA L20	Improved
15	ROK 5	Improved
16	FARO 40	Improved
17	FARO 52	Improved
18	NERICA L36	Improved
19	FARO 21	Improved
20	CK 73	Improved
21	WITA 8	Improved
22	FARO	Improved
23	Manbechi	Local
24	Ebagichi	Local
25	Ndawozdufugi	Local
26	Bokuchi	Local
27	Dokochi	Local
28	Tomawawagi	Local
29	Babawagi	Local
30	Mass	Local
31	Shagari	Local
32	Eyewawagi	Local
33	Finiko	Local
34	Damanle	Local
35	Danboto	Local
36	Ibrahim Tsadu	Local
37	Ekach	Local
38	Toma	Local
39	Suakoko	Local

genetic base of the species and identification of additional genes or alternative source that control a particular trait for use in crop improvement.

Genetic variability in crop species should be exploited so as to develop new rice varieties with high stability to resist or tolerate adverse environments and biotic conditions (Gana, 2006). Awopetu and Gana (1997) studied the genetic relationship of some rice varieties and observed that origin, habitat and breeding background contributed to variation in the rice population. Therefore this study is conducted to show variation among the varieties and identify traits that contribute to variability in this population and for their possible exploitation in breeding programs.

MATERIALS AND METHODS

The experiment was carried out at Edozhigi, longitude 5^{o} $50^{!}$E and latitude 9° $05^{!}$ N, one of the experimental fields of the National Cereal Research Institute Baddegi, to assess the morphological variations that exist among 17 traditional rice varieties and 22 improved rice varieties (Table 1). The experiment was conducted during the 2009 and 2010 cropping seasons in a rainfed lowland ecology. The traditional varieties were collected from farmers' field and the improved varieties were gotten from the germplasm unit, National Cereals Research Institute Badeggi, in Central Nigeria. The field was laid out in a randomized complete block design replicated 3 times. Data were analysed using Genstart version 2004. Entries were planted in a plot size of 5 × 1 m and spaced 20 cm × 20 cm. N_2, P_2O_5; K_2O fertilizer were applied at the rate of 80 : 40 : 40 kg/ha.

RESULTS

Variability amongst the morphological characters

The result of analysis of the variance (ANOVA) for the quantitative characters for 2009 and 2010 trials are presented in Tables 2 and 3. There were highly significant differences amongst the entries in 2009. Plant height, leaf width, Gall count, and total grain yield per plot were significantly different at <1% level of probability. Panicle length, leaf length and 1000 grains weight were significantly different at <0.05 probability level. Iron score and phenotypic acceptability show no significant differences.

Result of 2010 revealed that leaf length, panicle length, iron score , Days to 50% flowering, leaf width, 1000 grain weight, and total grain yield per plot were significant at <1%. Gall count at 62 DAT and NGP showed significant difference at <0.05 probability level.

Principal component analysis

Table 4 presents the principal component and percentage contribution of each component to the total variation in the entries tested in the first year. The first principal component accounted for 19.1% of the total variation in the population (Table 4). Leaf length contributed more to the variation (0.12), followed by phenotypic acceptability (0.03). All other characters contributed negatively to the first component (Table 4). Second principal component contributed 16.1% of the total variation. Characters that contributed to the component include Phenotypic acceptability (0.45), leaf length (0.38), Number of tillers (0.36), Panicle number per

Table 2. Mean square result of the morphological characters 2009.

Parameter	Df	PHT	LL	PL	AfRGM	PAM	IRON	DFF	PA	LW
Block	2	387.69	6.32	74.72	78.22	33486.00	0.42	0.00	0.62	0.07
Trt	40	905.20**	3.98**	22.89*	48.17ns	12013.24	0.53ns	175.46ns	2.17ns	0.05*
Error	80	135.80	0.57	9.12	14.14	7614.68	2.55	214.69	1.24	2.48
G/Mean	-	111.00	10.41	24.49	8.46	331.26	1.26	77.36	5.57	0.99
CV (%)	-	10.50	7.26	12.33	44.44	26.86	51.60	0.00	19.27	13.31

Table 3. Mean square result of the morphological characters 2010.

Parameter	Df	PHT	LW	PL	AfRGM	PAM	IRON	DFF	PA	LL
Block	2	102.81	0.14	70.68	8.85	1683.13	1.13	0.01	0.91	2.72
Trt	40	495.17	0.04	27.74**	8.89*	1571.50	1.51ns	178.99**	2.53ns	3.63**
Error	80	166.63	0.02	9.89	5.04	1096.05	0.99	0.01	2.51	0.57
G/Mean	-	108.80	0.99	22.99	3.63	220.66	2.31	77.89	5.26	9.69
CV (%)	-	11.86	13.25	13.68	61.76	15.01	43.24	0.12	30.12	7.81

Table 4. Eigen value, factor scores and contribution of the first five principal component axes to variation in rice varieti

Parameter	PC1	PC2	PC3	PC4	P
Weight of 1000 grains	-0.20	-0.42	-0.15	-0.11	0.
Total yield/plot	-0.30	0.22	-0.34	-0.28	0.
Number of grains/panicle	-0.03	-0.10	0.28	-0.47	0.
Days to 50% flw	-0.23	0.17	-0.20	0.18	-0.
Phenotypic acceptability	0.03	0.47	-0.21	-0.12	-0.
Leaf width	-0.38	-0.17	-0.05	0.31	0.
Panicle number/m^2	-0.41	0.35	0.28	0.01	0.
Plant height	-0.04	0.07	-0.60	0.20	-0.
Leaf length	0.12	0.38	-0.20	0.14	0.
Panicle length	-0.09	-0.22	0.10	0.61	0.
Iron score	-0.33	-0.17	-0.31	-0.26	-0.
Gall midge count	-0.39	-0.03	0.33	0.17	-0.
Number of tillers	-0.48	0.36	0.07	-0.14	0.
Eigen value	2.49	2.10	1.73	1.45	1.
Percentage	19.1	16.1	13.3	11.2	9.
Cumulative	19.1	35.3	48.6	59.7	68

Table 5. Eigen value, factor scores and contribution of the first five principal component axes to variation in rice varieties.

Parameter	PC1	PC2	PC3	PC4	PC5
Weight of 1000 grains	0.33	-0.50	0.07	-0.07	-0.01
Total yield/plot	-0.39	-0.35	0.12	-0.41	0.06
Number of grains/panicle	0.25	-0.24	0.46	0.24	-0.01
Days to 50% flw	-0.15	0.33	-0.14	-0.05	-0.20
Phenotypic acceptability	-0.30	0.33	0.23	-0.24	0.34
Leaf width	0.01	0.43	0.36	-0.25	0.23
Panicle number/m^2	-0.24	-0.10	-0.01	0.39	0.57
Plant height	-0.37	0.16	-0.06	-0.25	-0.24
Leaf length	-0.26	0.28	-0.19	0.52	0.23
Panicle length	-0.15	-0.10	-0.48	-0.10	0.18
Iron Score	-0.38	-0.05	-0.11	-0.02	-0.33
Gall midge count	0.13	-0.23	-0.07	-0.54	0.44
Number of tillers	-0.34	-0.00	0.53	0.010	-0.14
Eigen value	2.58	1.62	1.41	1.29	1.11
Percentage	19.9	12.4	10.8	10.0	8.50
Cumulative	19.9	32.3	43.1	53.1	61.60

meter square (0.35), Total yield per plot (0.22), Days to fifty percent flowering (0.17) and Plant height (0.07). The third principal component accounted for 13.3% of the total variation in the population. Gall count contributed the highest (0.34) while number of tiller contributed less. Panicle length (0.61) contributed more to the variation in principal component 4. Gall count (0.17) and panicle per meter square (0.01) contributed low to the variation. Number of grains per panicle (-0.47), total yield per plot (-0.28), number of tillers (-0.14) and weight of 1000 grain weight contributed negatively. The fifth principal component accounted for 09.2% of the total variation with leaf length (0.46) given the highest contribution. Cumulatively, these 5 principal components showed 68.9% of the total variation in the population.

The component loading correction plot of first and second principal component using variables from 2009 trial revealed that leaf length and phenotypic acceptability score loaded more heavily on the first principal component than others. While weight of 1000 grains average leaf width and panicle length loaded negatively loading on the first component. In the second component number of panicles per meter square, number of tillers and phenotypic acceptability loaded more to the second component.

In the second year trial the first principal component accounted for 19.9% of the total variation observed (Table 5). Number of grains per panicle contributed more to the variation than others. Gall midge count (0.13) and leaf width (0.01) contributed least to the variation. The second component contributed 12.4% of the total variation with the leaf width (0.43) contributing highest. Other major characters that contributed to the variation include Weight of 1000 grains (0.33), days to fifty percent flowering (0.33) and leaf length (0.26). The third principal component contributed 10.8% of the total variation in the entire population. The fourth principal component contributed 10.0% to the total variation. The major characters that contributed highly to the variation include Leaf length (0.52) and Panicle number per meter square (0.39) while Number of grains per panicle (0.24) and Number of tillers (0.10) contributed least to the variation. The fifth principal component accounted for 08.5% of the total variation. Panicle number per meter square (0.57), gall midge (0.44) Phenotypic acceptability (0.34) contributed highest in the variation while leaf width (0.32), leaf length (0.23), and total grain weight (0.06), contributed least. The 5 principal components showed 61.6% of the total variation in the population.

The loading plot of first and second component showed that gall count and number of grains per panicle loaded more on the first component and accounted for more variation compared to the other parameters. Leaf length and phenotypic acceptability, number of tillers and panicle per meter square loaded more on the second component (Figure 2).The principal component analysis and percentage contribution of each component to the total variation in the 2 years combined (Table 6) showed that the first principal component accounted for 17.8% of the total variation with only number of grains per panicle (0.138), contributing positively to the variation. The remaining variables contributed negatively to the variation. The second principal component showed 14.20% of the total variation. The major characters that contributed to the second component include leaf length (0.35), phenotypic acceptability (0.44) and leaf width (0.34). The third principal component accounted for 12.8% of the variation.

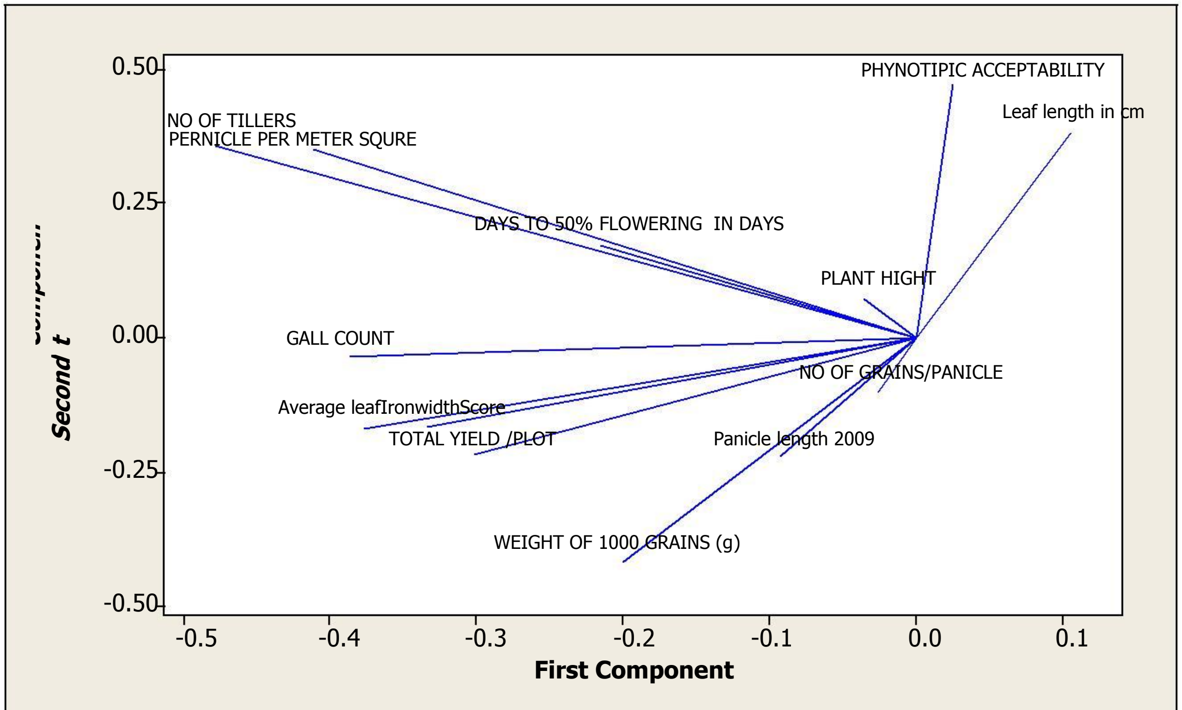

Figure 1. Loading plot of morpho-agronomic traits, 2009.

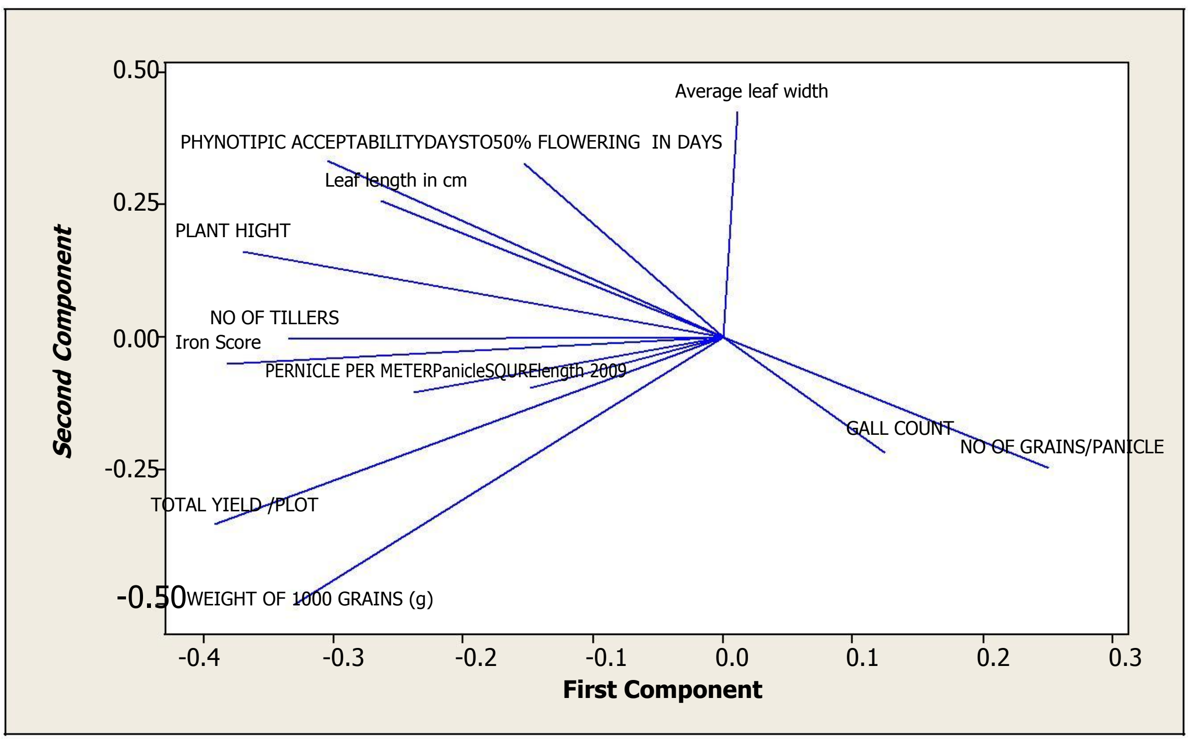

Figure 2. Loading plot of morpho-agronomic traits, 2010.

Plant height (0.39), leaf length (0.23), panicle length (0.20) and iron score (0.15) are the major contributors to the variation. The fourth principal component showed 10.9% of the total variation in the population. 1000 grain weight, total yield per plot, number of grains per panicle, number per meter square, and number of tillers contributed positively to the variation. Days to fifty percent flowering, phenotypic acceptability, leaf width, plant height, panicle length, Iron and Gall midge count contributed negatively to the variation. The fifth component

Table 6. Eigen value, factor scores and contribution of the first five principal component axes to variation in rice varieties

Parameter	PC1	PC2	PC3	PC4	PC5
Weight of 1000 grains	0.24	-0.49	0.05	0.06	-0.16
Total yield/plot	-0.42	-0.35	-0.01	0.06	-0.20
Number of grains/panicle	0.14	-0.13	-0.44	0.31	-0.25
Days to 50% flw	-0.25	0.16	-0.02	0.27	0.29
Phenotypic acceptability	-0.30	0.44	-0.06	-0.12	-0.17
Leaf width	-0.01	0.34	-0.22	-0.40	-0.20
Panicle number/m^2	-0.28	-0.01	-0.41	0.26	0.43
Plant height	-0.36	0.12	0.39	-0.15	-0.06
Leaf length	-0.19	0.35	0.23	0.50	0.22
Panicle length	-0.00	-0.25	0.20	-0.11	0.62
Iron Score	-0.40	-0.21	0.15	-0.16	-0.23
Gall midge count	-0.00	-0.19	-0.37	-0.51	0.32
Number of tillers	-0.43	0.12	-0.42	0.01	0.02
Eigen value	2.32	1.85	1.67	1.42	1.25
Percentage	17.8	14.2	12.80	10.90	9.60
Cumulative	17.8	32.1	44.90	55.89	65.40

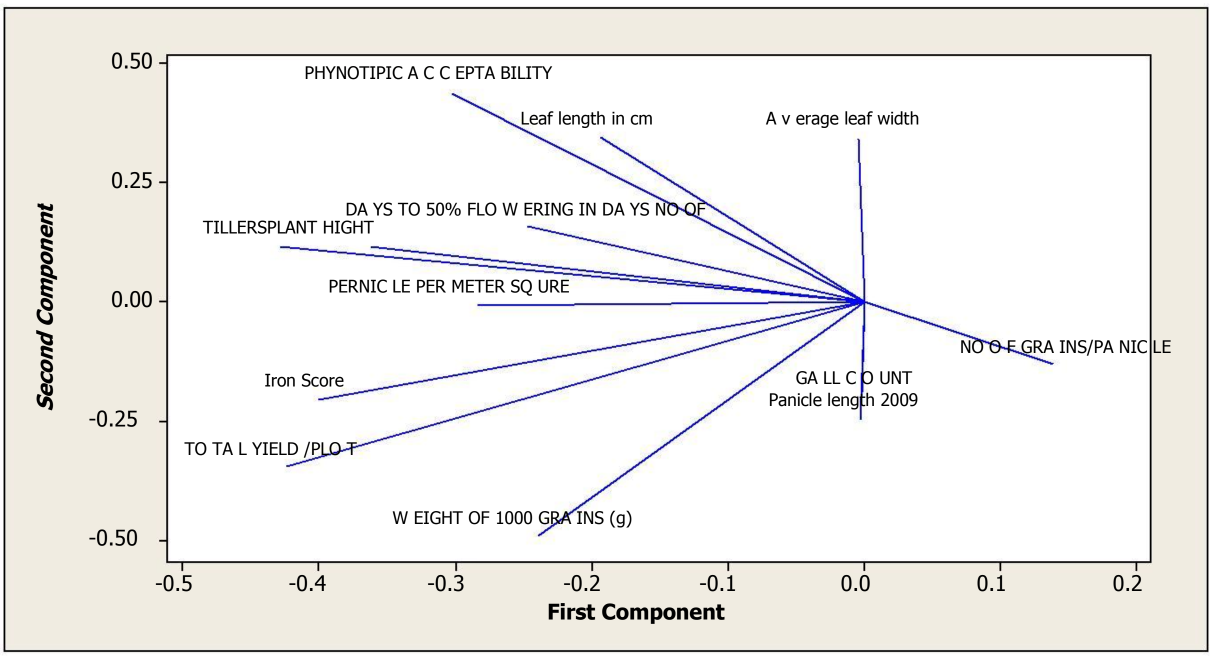

Figure 3. Loading plot of morpho-agronomic traits, two years combined.

contributed 9.6% of the total variation. Variables like days to fifty percent flowering, panicle per meter square, leaf length, and panicle length and number of tillers contributed positively to the variation. The entire 5 principal components accounted for 65.4% of the total variation observed.

The loading plot of first and second component using morphological trait showed that leaf width, Number of grains per panicle, Gall count and average leaf width showed more degree of variation compared with the other other parameters (Figure 3). Most of the characters loaded more in the second principal component.

DISCUSSION

The result of the means square analysis showed that there were highly significant differences among the varieties. This explains the variation existing among the cultivars studied. The principal component analysis (PCA) of the 2 years combined reveals the total contribution of characters to the variation. The first 5 components accounted for 65.4% of the total variation. Characters with high variability are expected to provide high level of gene transfer during breeding programs (Gana, 2006; Aliyu et al., 2000). Also the loading plots of the first and second component showed the degree of variation that exists within the components. Leaf width, number of grains per panicle, gall count and panicle length showed more variation. In the 2 years combined, panicle length, no of grains per panicle and gall count loaded more on the first principal component. High level of variability existing within the varieties and the characters will make room for further improvement of the cultivars in breeding programs.

REFERENCES

Aliyu B, Akoroda MO, Padulosi S (2000). Variation within *Vigna reticulata* Hooke FII Nig. J. Gene. pp. 1-8.

Awopetu JA, Gana, AS (1997). A Numerical Analysis of Genetic relationship within rice accessions. Nig. J. Gene X11:1-8.

FAO (2004). Species description *Oryza sativa* L http://www.fao.org/ag/AGP/AGPC/doc/GBASE/data/pf000274.htm Flavel RB (1991). Molecular biology and genetic conservation programs. Biol. J. Linnean Soc. 43:73-80.

Gana AS (2006). Variability studies of the response of rice varieties to biotic and abiotic stresses. Unpublished Ph.D Thesis, University of Ilorin.

Mignouna HD, Fatokun CA, Thottappily G (1996). Choice of DNA marker system In DNA assisted improvement of the stable crops of sub-Saharan Africa. Proceedings of the workshop on DNA markers at IITA. Ibadan pp. 9-15.

Ng NQ, Padulosi S (1992). Constraints in the accessibility and use of germplasm collection. In Biotechnology enhances research on tropical crops in Africa edited by Thottappily, L. M. Monti D. R. Mohan Raj. A. W. Moore IITA Ibadan.

Peters JP, Williams JT (1984). Towards better use of gene bank with special reference to information. FAO/IBPGR Plant genetic resources Newsletter 60: 22-31.

Thottappily G, Crouch JH, Quin FM (1996). Overview of DNA marker research at IITA: Proceedings of the workshop on DNA markers at IITA. Ibadan Ed by J.H. Crouch and Tenkuoano A pp. 3-8.

Vaughan DA, Morishima H (2003). Biosystematics of the genus *Oryza*. Chapter 1.2. In: CW Smith, RH Dilday, eds. Rice. Origin. History. Technology. And production. John Wiley and Sons Inc., Hoboken, New Jersey. pp. 27-65.