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Diversity Analysis of Local Land Races and Improved Germplasm of Rice (Oryza Sativa L.) Under Allahabad Agro-Climatic Conditions

KEYWORDS: Genetic variability, heritability, coefficient of variation, Principal component analysis, Words cluster dendrogram and genetic advance.

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ABSTRACT *Dynamic era of agricultural development and rapidly changing climatic conditions necessitate to continuous evaluation of rice germplasm and local rice land races. In this regard, 40 rice accessions were selected including eleven local land races and one local check NDR 359 evaluate in Allahabad agro-climatic reason to study available variation in the population. Analysis of variance revealed highly significant differences for all morph agronomical traits studied. In general, Phenotypic Coefficient of Variation (PCV) was higher than (GCV) for various characters. Highest Phenotypic Coefficient of Variation (%) and Genotypic Coefficient of Variation (%) were observed in grain yield per hill (g) and number of spikelet's per panicle whereas, lowest in days to maturity, test weight (g) and days to 50% flowering. However, lowest difference between GCV and PCV was observed in most of the traits studies. Highest of heritability were observed for number of spikelets per panicle and test weight and high genetic advance were observed for number of spikelet's per panicle and plant height (cm). The estimates of phenotypic coefficient between pairs of characters revealed that seed yield has a strong positive significant association Tillers/ Hill, Panicles/ Hill, Panicle Length (cm), Biological Yield (gm), harvest Index (%), Spikelet's/ Panicle, Test Weight (gm). Hence, Main focused should be given on these traits during selection to improve lines. Wards minimum cluster diagram and principal component analysis was used to estimation the pattern of variation in the population. First four PC scored 78.6% variation and cluster diagram represent five different clusters. Cluster I contained 12 accessions, cluster II contained 1 accession, Cluster III contained 3 accessions, Cluster IV contained 10 and Cluster V contained 14. the present study conclude that improved rice germplasm accounted more variability in comparison to local land races therefore, required improvement in local land races.*

Introduction

Rice is life' (Oryza sativa L.) is the staple food for more than half of the world's population. About 90% of the world's rice is grown and consume in Asia. Rice is economically important food crop with nutritional diversification and helps in poverty alleviation. Grain quality has always been an important consideration in rice variety selection and development. The physico-chemical characteristics of rice grain are important indicators of grain quality .The consumer mainly prefers good quality rice. The cooking quality is a complex character which is very much influenced by physic-chemical characteristics of rice grain (Tomar and Nanda 1981, Hussain et al. 1987).

Genetic improvement in crop plant is always depends on available variation in the population. It is plays vital role in genetic makeup in base population. Knowledge of agro-morphological diversity and the distribution pattern of variation among conserved accessions could be an invaluable aid in germplasm management and crop improvement strategies Sanni, Kayode A. et al. (2008). Improved rice germplasm and local land races both are rich in genetic variation Such as morphologically basis. Local land races perform better in respect to yield and other economic characters. Landraces of rice (Oryza sativa L.) are valuable sources of genetic variation that have been lost in advanced cultivars Kobayashi, Asako et Al. (2006). Fukuoka, Shuichi 1 et al (2006) suggested that only small differences were found in agronomic characters among the populations, including populations containing different varieties. Local land races are great source of genetic variation it can be utilized in plant breeding.

Genetic parameters viz. coefficient of variation, heritability and genetic advance provided initial information amount of variability present in the germplasm and predicting the resultant effect in selection of the best genotypes for yield and its attributing traits. Words minimum variance Dendrogram and Principle component analysis are provides quit preciously information of Diversity pattern in the base population. The main aim of this investigation is to evaluate the performance of rice germplasm and rice land races in same environmental condition and compare them to understand the genetic variation in local rice land races and improved rice germplasm.

Materials and Methods

The experiment was conducted at Department of Genetics and Plant Breeding, SHIATS, Allahabad in Randomized Block Design (RBD) with three replications during Kharif

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2011 & 2012. A total no. of 42 accessions including 11 land races and one local check NDR 359 was included in this present study. In which 24 accessions were obtained from IRRI, Manila, Philippines, 6 accessions were obtained from DRR, Hyderabad and 11 local land races were collected from local framers at Firozabad district, UP, India and one local check namely NDR 359 obtained from local market Allahabad district UP, India. Twenty eight days old seedlings were transplanted with a spacing of 20 cm and 15 cm between rows and hills, respectively. Five representative hills for each genotypes in each replications were randomly selected to record the observations for thirteen quantitative traits viz., days to 50% flowering, plant height, flag leaf length, flag leaf width, number of tillers per hill, number of panicle per hill, panicle length, number of spikelet's per panicle, days to maturity, biological yield per hill, harvest index, test weight, grain yield per hill. The data were analyzed by using ANOVA and genetic parameters such as PCV and GCV were calculated by the formula given by Burton (1952), heritability in broad sense (h^2) by Lush (1949), and genetic advance in percent of mean (genetic gain) were work out as suggested by Johnson et.al. (1955). Pearson correlation coefficient was analyzed through SAS 9.2 Software to find out the associations between the traits. Wards minimum variance dendrogram and Principal component analysis was analyzed by using SAS 9.2 software.

Table:-1 Martials and their obtain source of all rice accessions and land races.

SN	Accessions/ land races	Source
1	NIAW SANPAHTAWNG, IR72, OM2516, WAS173-B-B-2-1-4, IR64, OM5637, IN79-2-1-3-3-M, IR77959-35-15-3-2-1, OM2505, IR50, OM2502 IRN1054-UL-3, IR7829-59-2-5-1-2, IR71113-BF 4B-30-5, WAS63-22-1-1-3-3, OM5240, IR77542-90-1-1-1-1-5, OM5239, IR73930-41-5-3-1, WAS57-B-B-17-7-2-3, IR78091-62-3-1-1, OM2718	IRRI, Manila, Philippines
2	CR2699, CR2707, AVT2E TP 1002, AVT2E TP 1008, 25P25, KJT-1-11-15-23-26-22	DRR, Hyderabad, India
3.	KRANTI, SUGHANDHA, J.K., DHANIYA, P-10 NARENDRA, MAHAMAYA, KAMAL, RAGINI BASMATI, OFF TYPE 51	Firozabad district, UP, India
4.	NDR 359	Allahabad, India

Result and Discussion

Ago-morphological evaluation:-

A wide range of variation was observed among all the rice genotypes for all the traits studied. The perusal of data revealed that variance due to treatment was highly significant for all the characters. This suggested that there were inherent genetic differences among the genotypes. Significant genetic variation in various component characters exhibited by the genotypes indicated these characters might be effective. The estimation of mean, range and CV (%) of all the characters were studied presented in table 1. Highest CV (%) value were recorded in Grain Yield/ Hill (g), Spikelet's/ Panicle, Harvest Index (%) whereas, lowest in Days to 50% Flowering, Days to Maturity and Test Weight (g). Rice improved germplasm were showed highest CV (%) value in harvest index (%), grain yield/ hill (g), test weight (g), spikelet's/ panicle, tillers/ hill and plant height (cm) over the rice land races studied. Likewise, rice land races scored over CV (%) value the rice improved germplasm in days to 50% flowering, flag leaf length (cm), flag leaf width (cm), panicles/ hill, panicle length (cm), days to maturity and biological yield (g). Phenotypic variance was higher than the genotypic variances for all the characters thus indicated the influences of environmental factor on these traits. The Genotypic Coefficient of Variation provides a measure to compare of genetic variability present in various quantitative characters.

Table-2 Estimation of Mean, Range and CV of land races and improved germplasm of Rice

SN	Traits	Mean ± SE	min	max	CV	Mean ± SE	min	max	CV
1	Days to 50% Flowering	100.3 ± 1.7	90.8	107	5.4	88.1 ± 1.1	81.3	105	7.1
2	Plant Height (cm)	132.7 ± 6.8	111.5	182	16.1	113.0 ± 2.2	91.4	145.4	10.4
3	Flag Leaf Length (cm)	44.95 ± 1.5	32.5	51.8	10.5	36.6 ± 1.0	28.2	52.6	14.5
4	Flag Leaf Width (cm)	1.9 ± 0.08	1.5	2.3	13.7	1.5 ± 0.0	1.2	2.2	16.0
5	Tillers/ Hill	12.1 ± 0.59	10.3	16.3	15.4	13.0 ±0.3	10.2	18.4	13.0
6	Panicles/ Hill	10.2 ± 0.32	8.7	12.4	10.0	11.4 ± 0.2	9.4	15.9	11.9
7	Panicle Length (cm)	25.9 ± 0.80	21.7	29.5	9.8	26.8 ± 0.3	21.8	30.9	7.2
8	Spikelets/ Panicle	131.5 ± 14.1	80.8	249	34.0	146.7 ± 4.6	110.7	215.4	17.2
9	Days to Maturty	130 ± 1.7	120	137.3	4.0	117.7 ± 1.0	111.0	132.2	4.6
10	Biological Yield (g)	52.1 ± 3.2	33	65.3	19.5	70.4 ± 3.1	37.6	101.8	24.2
11	Harvest Index (%)	26.7 ± 1.9	21.4	38.4	22.7	27.7 ± 0.5	22.3	34.6	10.5
12	Grain Yield/ Hill (g)	13.9 ± 1.3	9.2	22	29.3	19.4 ± 0.9	11.7	30.7	24.8
13	Test Weight (g)	22.5 ± 0.52	18.8	25.3	7.3	23.0 ± 0.2	20.7	24.9	5.5

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The highest value of Genotypic Coefficient of Variation was recorded for grain yield per plant (29.20), biological yield per hill (26.63), number of spikelet's per panicle (22.81) and flag leaf width (19.32) whereas lowest genotypic coefficient of variation value was observed in test weight (6.02), days to maturity (6.39), panicle length(7.97) and days to 50% flowering (8.92). The higher value clearly indicates high degree of genotypic variability in these quantitative characters in rice. Phenotypic Coefficient of Variation which measure total relative variation was highest for grain yield per plant (29.75), biological yield per hill (26.84), number of spikelets per panicle (22.93) and flag leaf width (16.37). While lowest for test weight (6.26), days to maturity (6.46), panicle length (8.10) and days to 50% flowering (8.98). The magnitude of PCV and GCV was moderate to high for number of grains per panicle, test weight (g) and grain yield per plant (g) (Roy et al., 2001; Rao and Srivastava, 1994 and Tripathi et al., 1999). Heritability is a measure of extent of phenotypic variation caused by the genes action. For making effective Improvement in the characters for which selection is practiced, heritability has been adopted by genetic variability, which is transmitted from parent to offspring is reflected by heritability. In the present study high heritability coupled with high genetic advance was recorded for traits viz., flag leaf length (99.7 and 33.64), plant height (99.6 and 30.36), number of spikelet's per panicle (99.00 and 46.76), biological yield per hill (98.9 and 54.69) and days to 50% flowering (98.7 and 18.26). V. Thirumala Rao et al. were also recorded high heritability coupled with genetic advanced in plant height. Johnson et al., (1955) also reported that high heritability along with high genetic advance as present of mean were more desirable. The high heritability of the above characters indicated that the influence of the environment of these characters is negligible or low. Hence, It is indicated that the improved rice accessions were perform superior in most of the important agro-morphological trait in comparison to local land race. However, local land races of rice may be improved by introgression with improved rice germplasm. These traits may be useful in rice improvement programme by plant breeders.

Table 3: Genetic parameters studies for 13 characters of rice genotype and land races

S. No.	Traits	GCV (%)	PCV (%)	h2(bs)	GA	GA as % of mean
1	Days to 50% flowering	1.01	8.92	8.98	98.7	16.77
2	Plant height (cm)	0.98	14.77	14.81	99.6	36.12
3	Flag leaf length (cm)	0.87	16.35	16.38	99.7	13.15
4	Flag leaf width (cm)	3.68	19.32	19.67	96.5	0.64
5	No. of tillers/hill	7.23	13.22	15.06	77.0	3.04
6	No. of panicle/ hill	9.85	11.04	14.80	55.7	1.87
7	Panicle length (cm)	1.46	7.98	8.11	96.8	4.29
8	No. of spikelets/ panicle	0.98	6.39	6.47	97.7	15.81
9	Days to maturity	2.81	26.70	26.84	98.9	35.48
10	Biological yield / hill	4.55	14.57	15.27	91.1	7.85
11	Harvest index (%)	2.32	22.82	22.93	99.0	66.45
12	Test weight (g)	5.70	29.20	29.75	96.3	10.48
13	Grain yield/ hill (g)	1.71	6.02	6.26	92.5	2.73

Principal Component analysis

Principal component analysis was used to estimation of available variability in rice improved germplasm and land races. 13 quantitative traits were studied. First four Principle components explained 78.6% variation with >1 Eigenvalue presented in Table 2. The first PC explained 41.6 % of the total variance. In which traits namely days to 50% flowering, flag leaf length (cm), flag leaf width and days to maturity were indicated highly positive vector loading whereas, grain yield per hills was indicated highly negative vector loading. PC 2 explained 15.94% of total variance. In this PC traits Viz. Panicle length (cm) and No. of spikelet's per panicle were Indicated highly positive vector loading whereas, No. of tillers per hill and No. of panicle per hill were indicated highly negative vector loading. PC 3 explained 11.85% of total variation. In which traits biological yield per plant (g) and test weight (g) was indicated highly positive vector loading whereas, harvest index (%) was indicated highly negative vector loadings and PC 4 explained 9.25% of total variation. In which only plant height (cm) was explained highly positive vector loading. PC 1 was evident to highest positive vector loading for more traits in comparison to other three remaining PCs. PC biplot diagram grouped all the accessions and land races based on available variations. Three major groups were formed in PCA Biplot diagram. Land races were grouped into one circle A, most of the rice germplasm obtained from Maila, Philippies were grouped into very closely in circles B and those accession which were obtained for DDR, Hyderabad was groped into circle C. Other remaining six accessions were found distinct placed individually. It is indicated the pattern of diversity in local land races and improved rice germplasm.

Table – 4 Eigenvalue, Eigen vector loading and percentage variations of all the important agro-morphological traits of rice accessions and local land races

Traits	PC1	PC2	PC3	PC4
Days to 50% Flowering	0.39	-0.06	-0.03	0.16
Plant Height (cm)	0.20	0.25	0.32	0.50
Flag Leaf Length (cm)	0.36	0.12	0.26	0.23
Flag Leaf Width (cm)	0.35	0.05	0.12	0.01
Tillers/ Hill	-0.19	-0.48	0.13	0.45
Panicles/ Hill	-0.29	-0.42	0.08	0.29
Panicle Length (cm)	-0.02	0.32	0.26	0.00
Days to Maturty	0.40	-0.04	0.00	0.15
Biological Yield (gm)	-0.33	0.15	0.40	0.13
harvest Index %	-0.11	0.31	-0.52	0.27
Spikelets/ Panicle	-0.17	0.42	-0.27	0.20
Grain Yield/ Hill (gm)	-0.34	0.29	0.13	0.26
Test Weight gm	-0.13	0.16	0.45	-0.42
Eigenvalue	5.40	2.07	1.53	1.20
Percent	41.6	15.94	11.84	9.25
Cum. Percent	41.6	57.55	69.39	78.64

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Cluster analysis

Words minimum cluster dendrogram was grouped the population into five clusters presented in Fig.1.In which cluster I, Cluster IV and Cluster V contained highest no. of rice accessions or land races. First three clusters contained sequentially 12, 1 and 3 improved rice accessions and on the other hand cluster IV contained 10 improved accession/ land races (8 rice germplasm and 2 land races) and Cluster V contained 12 landraces and 2 accessions. The pattern og grouping Most of the land races were grouped into one cluster indication the strong interrelationship among them based on morphological bases. Improved rice accessions were more diverse in comparison to local land races studied. Hence, there is necessitating to improved land races. This study is evident to required interrogation of local land races with improved rice accession to improve their performance.

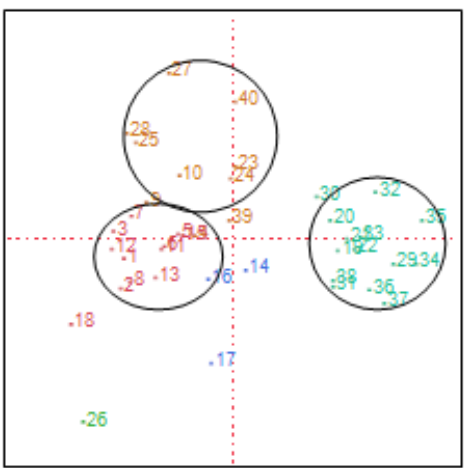

Fig.1 PCA Biplot diagram of 40 rice improved germplasm and land races

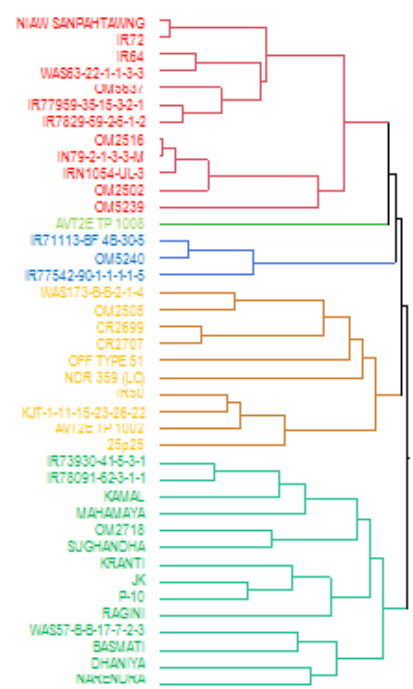

Fig.2 Denodogram for 40 rice accessions including 11 land races and one local check generated through ward's cluster technique.

Pearson correlation coefficient

Pearson's correlation is measure of strength of linear relationship in between two variables. Associations between characters are presented in Table 5. Strong positive significant association was found between: the Plant Height and days to 50% flowering, flag leaf length (cm), flag leaf width (cm), days to maturity; between flag leaf length (cm) and flag leaf width (cm), days to maturity; between flag leaf width (cm) and panicle length (cm); between tillers/ hill and panicles/ hill, biological yield (gm), grain yield/ hill (gm); between panicles/ hill and biological yield (gm), grain yield/ hill (gm); between panicle length (cm) and biological yield (gm), grain yield/ hill (gm); between biological yield (gm) and spikelets/ panicle, grain yield/ hill (gm), test weight (gm); between harvest index (%) and spikelets/ panicle, grain yield/ hill (gm); between spikelets/ panicle and grain yield/ hill (gm); between grain yield/ hill (gm) and test weight (gm). whereas, negative significant association between days to 50% flowering and tillers/ hill, panicles/ hill, biological yield (gm), harvest index (%), spikelets/ panicle, grain yield/ hill (gm), test weight (gm); between plant height (cm) and panicles/ hill, biological yield (gm); between flag leaf length (cm) and tillers/ hill, panicles/ hill, biological yield (gm), harvest index (%), spikelets/ panicle, grain yield/ hill (gm); between flag leaf width (cm) and tillers/ hill, panicles/ hill, panicle length (cm), spikelets/ panicle, grain yield/ hill (gm); between days to maturty and tillers/ hill, biological yield (gm), harvest index (%), spikelets/ panicle, grain yield/ hill (gm),test weight (gm). Therefore, yield contributing traits were positively strong associated with important agro morphological traits indicated that selection may be in positive direction based on these traits towards crop improvement program.

Table:-5 Pearson phenotypic correlation coefficient between 13 agro-morphological traits of rice

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	0.40**	0.73**	0.69**	-0.24**	-0.40**	-0.10	0.98**	-0.66**	-0.21*	-0.26*	-0.67**	-0.33**
2		1	0.66**	0.37**	-0.14	-0.30**	0.16	0.42	-0.04*	-0.05	-0.02	-0.05	-0.07
3			1	0.77**	-0.27**	-0.44**	0.12	0.74**	-0.41**	-0.20*	-0.30*	-0.45**	-0.12
4				1	-0.29**	-0.43**	-0.02	0.72**	-0.51**	-0.16	-0.25*	-0.54**	-0.05
5					1	0.80**	-0.16	-0.27*	0.26*	-0.07	-0.17	0.20*	-0.07
6						1	-0.13	-0.43**	0.38**	0.00	0.01	0.32**	0.06
7							1	-0.11	0.18*	0.05	0.02	0.19*	0.06
8								1	-0.64**	-0.22*	-0.27*	-0.66**	-0.28*
9									1	-0.07	0.34**	0.89**	0.42**

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10									1	0.49**	0.38**	-0.15
11										1	0.56**	0.07
12											1	0.30**
13												1

**significant at P = 0.01, * significant at P = 0.05, 1. Days to 50% Flowering, 2. Plant Height (cm), 3. Flag Leaf Length (cm), 4. Flag Leaf Width (cm), 5.Tillers/ Hill, 6. Panicles/ Hill, 7. Panicle Length (cm), 8. Days to Maturity, 9. Biological Yield (gm), 10. harvest Index (%), 11. Spikelets/ Panicle, 12. Grain Yield/ Hill (gm), 13.Test Weight (gm)

Conclusion: - This investigation can be concluded that significant variation was found in both improved rice germplasm and local land races of rice. Local rice land races were performed quit low in comparison to improved rice germplasm in some morphological traits studied. PCA and Word's cluster dendrogram were elaborated the variation pattern among all the rice germplasm and local land races. Hence, there is need to improved local land race through introgression with rice improvement germplasm. These collecting materials may be good source for the breeders to use to rice improvement program.

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