

## ASSESSMENT OF GENETIC DIVERSITY OF RICE (*Oryza sativa* L.) UNDER PRA YAGRA JAGRO-CLIMATIC CONDITIONS

### **Abstract**

The goal of the current study was to assess the genetic variability parameters and correlation in 40 rice genotypes for 13 quantitative traits in the Kharif, 2022 Season at the field experimentation center, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Uttar Pradesh. Analysis of variance indicated high significant differences among the genotypes for all the traits. Considerable variability existed in the genotypes for all the characters studied. These were the genotypes with high mean values in desirable direction i.e., From the present investigation it is concluded that among 40 genotypes of rice, Nellore Dhanyarasi showed early flowering (77 days), IR-64 had characters like early maturity (108 days), High Grain Yield per Plant is seen in Shuats Dhan-6 (62.1 g), JHARA SEL showed high plant height (185 cm) and high Biomass is seen in Shuats Dhan-6 (123.6 g), Swathi showed high Panicle Length (43.7 cm). Highest GCV and PCV were depicted for Grain Yield per Plant, Biological Yield, Harvest Index and Number of Spikelets per Panicle. The highest Heritability was observed for Grain Yield per Plant followed by Harvest Index, Flag Leaf length, Biological Yield and Number of Spikelets per Panicle. The Genetic Advance in percent of mean is high for Grain Yield per Plant, Biological Yield, Harvest Index and Number of Spikelets per Panicle. Based on  $D^2$  values 40 genotypes grouped into 7 clusters. Among 6 clusters, cluster I had a greater number of genotypes (26) followed by cluster II (8), III (2), IV, V, VI and VII (1) genotype each. cluster VI and cluster III (365.72) followed by cluster VII and cluster V (363.6), were most diverse from each other and the genotypes present in these clusters provide a broad spectrum of variability in segregation and may be used as parents in the future hybridization program to develop desirable genotypes for grain yield improvement in rice genotypes. The trait Grain yield per hill had maximum contribution towards to genetic divergence followed by biological yield, Harvest Index, Test Weight. Therefore, all these characters should be given due consideration during selection for crop improvement.

**Keywords:** Genetic Variability, Heritability, Genetic Advance, Diversity, Rice

## Introduction

Rice (*Oryza sativa* L.) belongs to the genus *Oryza* of the *Poaceae* family *Graminae* and is a true diploid with chromosome number  $2n=24$ . Rice has been cultivated by mankind for more than 10,000 years. The cultivated varieties of *Oryza sativa* are grouped into three sub-species, *indica*, *japonica* and *javanica*. Where *Indica* are grown through the tropical and subtropical regions and *japonica* varieties are grown throughout the temperate zone and *javanica* are grown mainly in the part of Indonesia.

Rice is an important role in India economy being a staple food for two-thirds of the overall population. The nutrient content of rice is 80% carbohydrates, 7-8% protein (The amino acid profile shows that it is rich in glutamic acid and Aspartic acid, highest quality cereal protein being rich in lysine (3.8%), 3%, fiber, iron 1mg and zinc 0.5 mg (Juliano *et al.* 1985). Rice is a short-day autogamous crop.

Rice is a crop that self-pollinates and has short days. The crop needs a hot, humid climate with average temperatures between 20 and 30°C for the entirety of its life cycle. In India, rice is predominantly a Kharif crop and is widely grown in regions with abundant yearly precipitation.

In areas with little rainfall, it is also grown under irrigation. In the eastern and southern parts of India, rice is a common ingredient in food.

The direct and indirect impacts of numerous independent variables on dependent variables are measured using path analysis. Selection becomes more successful when the cause-and-effect relationship is understood. The path coefficient, which measures the direct effect of a predictor variable on its response variable, is one component of path analysis; the indirect effect(s) of a predictor variable on the response variable through another predictor variable is the second component (Dewey and Lu, 1959). Path analysis has been used in plant breeding to help find features that can be used as selection criteria to boost crop output. (Surek and Beser, 2003).

## Objectives

1. To estimate genetic variability, heritability and genetic advance for grain yield component characters of rice
2. To assess genetic diversity in different accessions of rice for different quantitative characters
3. To identify divergent parents for future hybridization programme

## 2. Materials and Methods

The present investigation was carried out at the Field Experimentation Center of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P. during *Kharif*, 2022. The university is situated on the left side of Allahabad Rewa National Highway, about 5 km from Prayagraj city. All types of facilities necessary for cultivation of successful crop including field preparation inputs, irrigation facilities were provided from the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P.

Prayagraj (Allahabad) is located in South Eastern part of Uttar Pradesh state of India. The site of experiment is located at 25.57°N latitude, 81.56°E longitude and 98 meters above mean sea level. This region has subtropical climate with extreme of summer and winter. The temperature falls down to as low as 1°C-2°C during Rabi season especially in the month of December and January. The mercury rises up to 46°C-48°C during Zaid. The average rainfall in this area is around 1013.4 mm annually with maximum concentration in kharif during July to September with few showers and drizzles during winter also shows the meteorological data recorded for the experimental period. Experimental material:

The experimental material for present study is obtained from the Department of Genetics and Plant Breeding, SHUATS, Prayagraj (Allahabad). The details of experimental material are as follows:

**Table 1 List shows the name of genotypes.**

S.NO	NAME OF GENOTYPES	S.NO	NAME OF GENOTYPES
1	AGNISAL	21	SWATHI
2	BOICHI	22	NELLOREMAHSURI
3	JHARASEL	23	C.SEL-3
4	PULE	24	NELLURE SUGANDHA
5	LALBHUNA	25	BHARINI
6	JALDHAYAPA-3	26	IR -64
7	KHAYAMDHAN	27	RDR-1140
8	TALMUNFAR	28	RNR-15459
9	BALAM	29	RNR-29325
10	LALMALA	30	RNR-15098
11	UBL-4	31	PUSHYAMI
12	LAGEDHAN	32	VARMA
13	KAUKASEL	33	MTU-1280
14	BINNI	34	MTU-1212
15	SITALKUCHI-6	35	MTU-1281
16	PAHARIBOICHI	36	SHUATSDHAN2
17	CHAPKACHAKLAO	37	SHUATSDHAN 3
18	NELLURED HANYARASI	38	SHUATSDHAN4
19	B.D.O.NAGRA	39	SHUATSDHAN6
20	NELLORESONA	40	NDR-359(CHECK)

## STATISTICAL ANALYSIS

- Analysis of variance (**Fisher, 1918**)
- Genetic Variability (**Burton, 1952**)
- Coefficient of variation (**Burton and De vane, 1953**)
  - a. Genotypic coefficient of variation (**GCV**)
  - b. Phenotypic coefficient of variation (**PCV**)
- Heritability broad sense (**Burton and Devane, 1953**)
- Genetic advance (**Johnson et .al, 1955**)
- D<sup>2</sup> analysis (**Mahalanobis, 1928**)

## 3 Results and Discussion

### Analysis of variance

The analysis of variance for seed yield and its contributing traits has been presented. The mean squares due to genotypes were highly significant for all the characters indicating the presence of considerable amount of genetic variability in the material.

This study attempted to assess the mean values, range, coefficient of variation and critical difference of 40 rice genotypes for all 13 quantitative characters that are presented in which had revealed a range of variation for all the characters studied.

Grain Yield per Plant ranged from 8.1 to 62.1 g per plant, with a grand mean of 23.2 g. SHAUTS DHAN-6 (62.1 g) had the highest Grain Yield per Plant per plant, followed by SHAUTS DHAN-2 (51.5 g) and SHAUTS DHAN-3 (45.3 g). RNR-15459 (8.1 g) had the lowest minimum grain yield per plant, followed by C.SEL (10 g) and Lalmala (10.2 g).

Highest PCV were depicted for Grain yield per plant (53.4%) followed by biological yield (41.3 %). Among the 13 quantitative characters, high estimates of GCV and were recorded highest for Grain yield per plant (52.2 %) followed by biological yield (39.8 %) and Harvest Index (29.8). Moderate estimates of PCV were recorded for Number of Spikelets per panicle (27.9), followed by number of tillers per hill (26.9) and number of panicles per hill (25.9). Lowest estimation of PCV were recorded for Day to maturity (8.7) and Day to 50% flowering (12.2). Highest GCV were depicted for Grain yield per plant (52.2%) followed by biological yield (39.8%).

**Table2: Analysis of Variance of thirteen traits in 40 promising rice lines for agronomic trait evaluated under field condition in Kharif 2022, at SHUATS, Prayagraj**

Sr.No.	Trait	Mean sum of squares		
		Replications	Treatments	Error
	Degrees of freedom	2	39	78
1	Day to 50% flowering	10.008	540.83**	47.17
2	Day to maturity	5.70	478.20**	61.22
3	Plant height (cm)	113.967	1798.89**	121.96
4	Panicle length (cm)	10.398	54.43**	5.21
5	Flag leaf length	14.124	256.45**	6.08
6	Flag leaf width	0.01	0.13**	0.006
7	Number of tillers per hill	1.79	17.64**	0.79
8	Number of panicles per hill	1.86	15.15**	0.81
9	Number of spikelets per panicle	863.349	10216.7**	376.34
10	Biological yield per plant (g)	125.58	1624.53**	41.79
11	Test weight (g)	8.933	69.24**	3.98
12	Harvest Index	3.311	446.12**	8.40
13	Grain yield per plant	17.22	445.81**	7.05

\*\*indicates significance at 1% level of significance

**Table 3: Genetic parameters of yield and yield components of 40 promising rice lines for agronomic traits evaluated under field condition in Kharif 2022, at SHUATS, Prayagraj**

SR.NO	Trait	GCV %	PCV%	$h^2$ (Broad sense)	GA(5%)	GA% (5%)
1	Days to 50% flowering	12.2	13.8	77.7	23.3	22.1
2	Daystomaturity	8.7	10.5	69.4	20.2	15.0
3	Plant height(cm)	16.1	17.7	82.1	44.1	30.0
4	Panicle length(cm)	15.1	17.4	75.9	7.3	27.2
5	Flag leaf length	22.1	22.9	93.2	18.2	44.0
6	Flag leaf width	16.9	18.0	88.2	0.4	32.8
7	Number of tillers per hill	26.9	28.7	87.6	4.6	51.9
8	Number of panicles per hill	25.9	28.0	85.5	4.2	49.3
9	Spikelets per panicle	27.9	29.4	89.7	111.7	54.4
10	Biological yield per plant(g)	39.8	41.3	92.7	45.5	78.9
11	Test weight(g)	22.7	24.7	84.5	8.8	43.1
12	Harvest Index	29.8	30.7	94.6	24.2	59.7
13	Grain yield per plant	52.2	53.4	95.4	24.3	104.9

**GCV:** Genotypic Coefficient of Variation, **PCV:** Phenotypic Coefficient of Variation,  **$h^2$ :** Heritability, **GA:** Genetic Advance, **GA% of Mean:** Genetic Advance at percent of mean

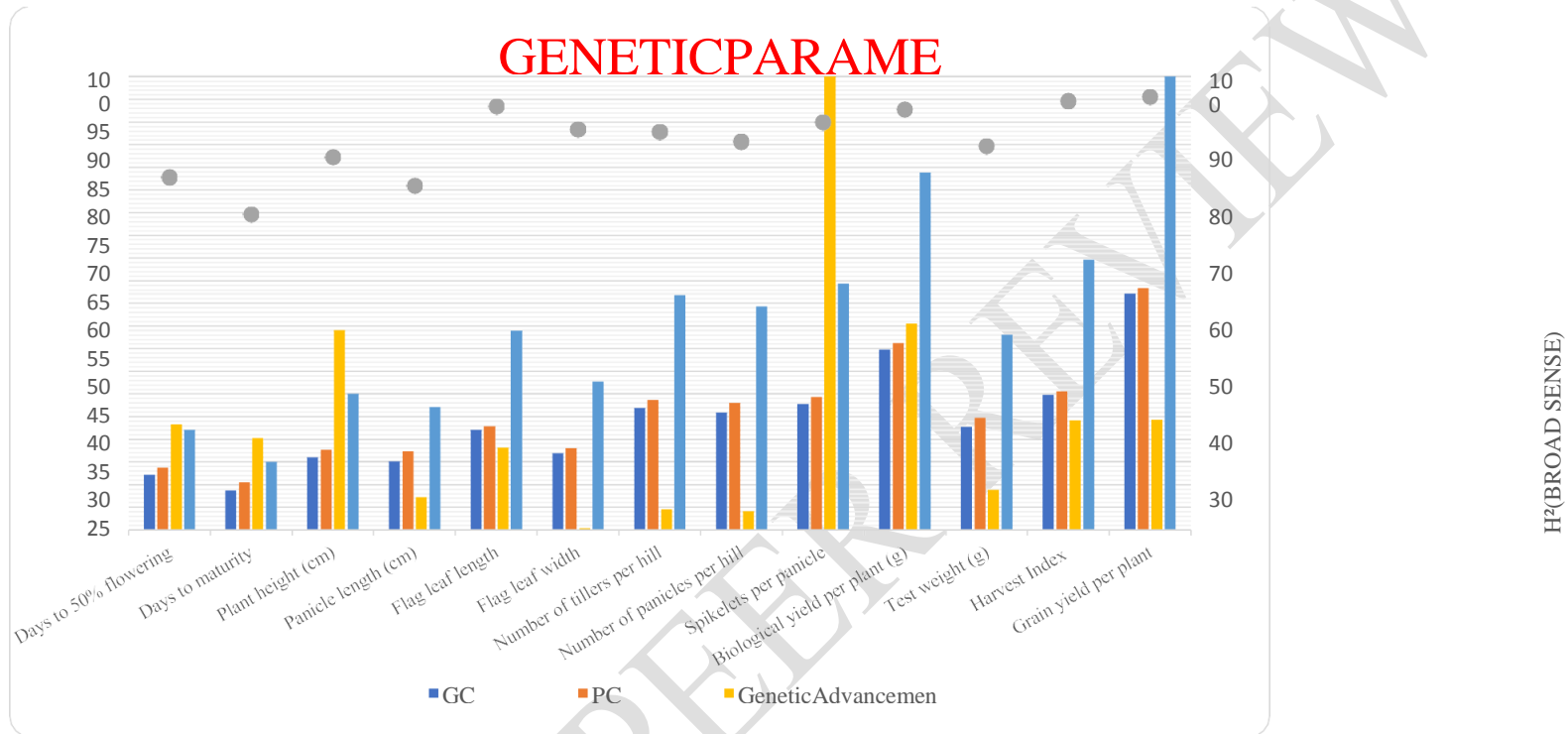


Fig.1 Bar diagram depicting GCV, PCV, heritability and genetic advance for 13 quantitative characters of rice.

## Heritability

The traits with high heritability estimates showed that variation in these traits predominantly governed by heritable factors, whereas both genetics and environment played equivalent roles in the expression of traits with moderately high heritability indicated that the expression of the trait was mostly influenced by environment rather than genetic. Traits with high heritability estimates in broad sense can be utilized for genetic improvement as they are least influenced by the environmental effects and thus having a potential for large genetic determination.

The estimates of heritability from present investigation are presented in (Table 3). In the present study, heritability (broad sense) ranged from 95.4% to 69.4%. The highest heritability (above 60% is seen in all parameters) was observed for Grain Yield Per Plant (95.4%), Harvest Index (94.6%), Flag Leaf Length (93.2%), Biological yield (92.7%).

## Genetic advance

In the present study a perusal of genetic advance (Table 3) showed that it was high for Number of spikelets per Panicle (111.7) followed by biological yield (45.5), Plant Height (44.1) and Grain Yield Per Plant (24.3) respectively. Genetic advance showed that it was low for Flag leaf width (0.4), Number of panicles per hill (4.2), Number of tillers per hill (4.6). Genetic advance as percent mean

Heritability does not alone does not provide any indication of the amount of genetic improvement that would result from the selection of individual genotypes. Thus, to arrive at more reliable conclusion high heritability should be accompanied by high genetic advance (Johnson *et al.* 1955). Thus, knowledge of heritability and genetic advance of the character indicate the scope for the improvement through selection. In the present investigation, high genetic gain was recorded for Grain Yield Per Plant (104.9 %), Biological yield (78.9 %), Harvest Index (59.7%), Number of spikelets per panicle (54.4%), Number of tillers per hill (51.9 %), Number of panicles per hill (49.3%), Flag leaf length (44%), Test Weight (43.1%), Flag leaf width (32.8%), Plant height (30%), Panicle Length (27.2%), Days to 50% flowering (22.1%) and Day to maturity (12%).

ClusterGroup	No.of Genotypes	List ofGenotypes
1Cluster	26	Khayamdham, Talmunfar, Lalmala, Balam, Ubl-4, Kaukasel, Lagedhan, Plue, Lalbhuna, Jaldhay Apa-3, Mtu-1212,Boichi,ChapkaChaklao,PahariBoichi,Varma,NelloreDhanyarasi,Pushyami,NelloreSona,RNR-15098,NelloreMahsuri,Bharini,Binni,C.Sel-3,JharaSel,RNR-29325&RNR-15459
2Cluster	8	Ir-64,Rdr-1140,ShautsDhan-3,ShautsDhan-2,Mtu-1280,ShautsDhan-6,ShautsDhan-4&Mtu-1281
3Cluster	2	Swathi,NelloreSugandha
4Cluster	1	B.D.O.NAGRA
5Cluster	1	Agnisal
6Cluster	1	SitalKuchi-6
7Cluster	1	NDR-359(Check)

Table4 Grouping of 40 Rice genotypes in to different clusters

Clusters	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Cluster1	<b>63.67</b>	120.80	108.49	117.92	130.94	176.48	160.36
Cluster2		<b>105.07</b>	136.13	186.38	167.26	254.63	199.62
Cluster3			<b>15.84</b>	254.19	202.34	365.72	192.72
Cluster4				<b>0.00</b>	211.40	42.05	123.10
Cluster5					<b>0.00</b>	246.31	363.60
Cluster6						<b>0.00</b>	221.70
Cluster7							<b>0.00</b>

Table5 Inter and intra cluster distance of 40 genotypes of Rice

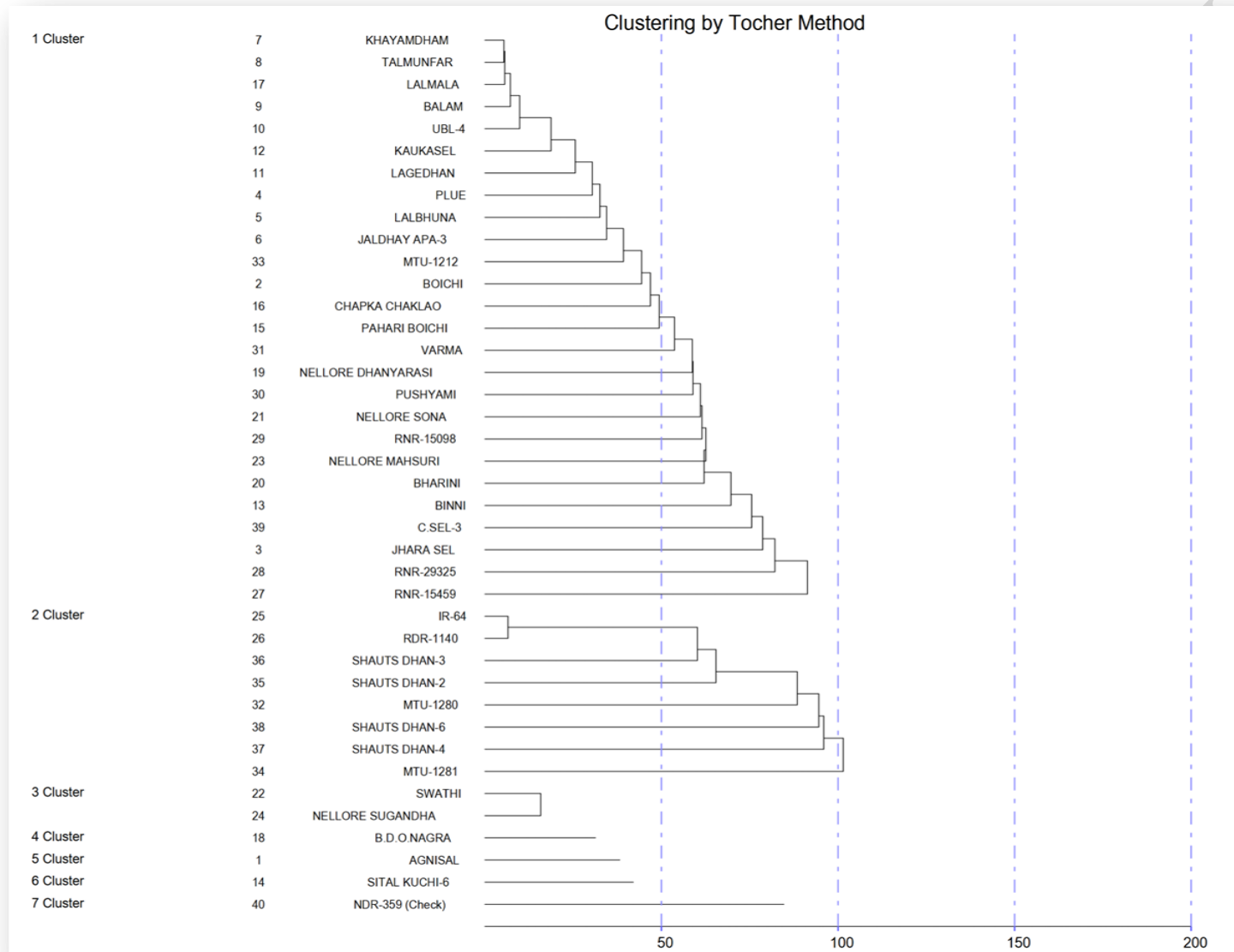


Fig.2 Dendrogram for 13 biometrical traits of 40 genotypes of rice towards genetic divergence

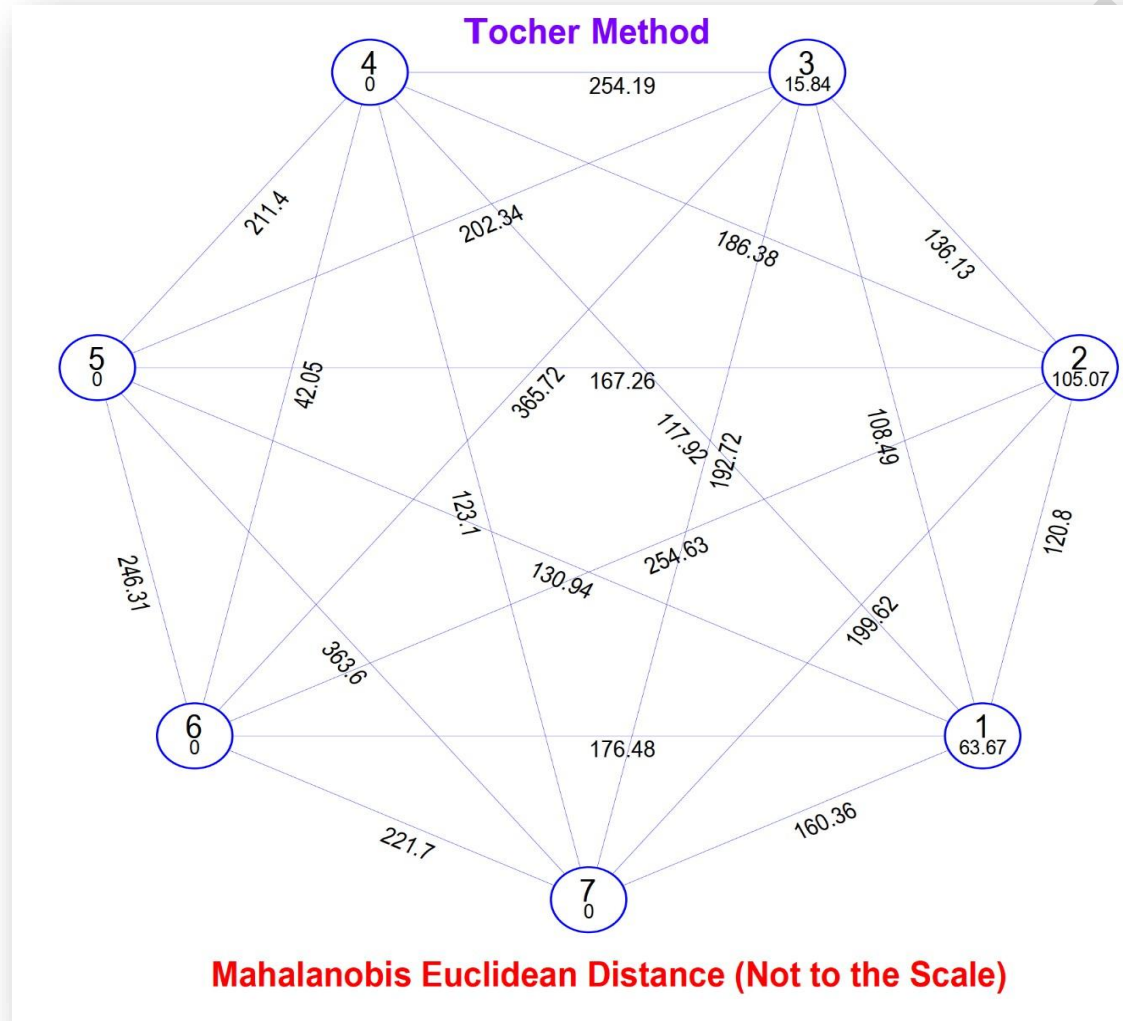


Fig.3 Inter and intra cluster distance of 40 genotypes of rice

**Table 6 Cluster Mean of 13 biometrical traits of 40 rice genotype**

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
<b>DF50</b>	108.9	98.54	82.83	115.33	107.33	118.67	105.00
<b>DM</b>	138.55	125.92	117.00	142.33	141.63	145.33	131.00
<b>PH</b>	151.94	134.91	113.84	163.28	177.68	159.59	125.00
<b>PL</b>	25.50	27.89	39.03	24.30	29.80	24.43	27.97
<b>FLL</b>	40.59	41.69	24.24	55.25	45.13	78.59	35.81
<b>FLW</b>	1.17	1.34	1.17	0.88	1.00	0.97	1.83
<b>NTH</b>	7.89	10.96	8.40	9.33	7.94	9.80	15.60
<b>NPH</b>	7.64	10.50	8.40	7.73	7.40	9.00	14.00
<b>NSPP</b>	196.59	234.94	228.90	191.73	204.93	167.80	210.60
<b>BYH</b>	50.49	78.85	35.43	60.53	114.00	68.80	51.50
<b>TW</b>	19.67	23.40	26.00	13.73	15.34	17.36	23.10
<b>HI</b>	36.93	52.40	52.85	33.42	32.57	25.75	44.00
<b>GYH</b>	17.96	40.68	18.67	20.13	37.14	17.80	22.66

**DF50:** Days to 50% flowering, **DM:** Days to maturity, **FLL:** Flag leaf length (cm), **FLW:** Flag leaf width (cm), **PH:** Plant height (cm), **NTH:** Number of tillers per Hill, **NPH:** Number of Panicles per Hill, **PL:** Panicle length (cm), **NSPP:** Number of Spikelets per Panicle, **BY:** Biological Yield (g), **HI:** Harvest index (%), **TW:** Test weight (g), **GYPP:** Grain Yield per Plant (g)

### **Interandintraclusterdistance**

InterandintraclusterdistancesarefurnishedinTable5Theintraclustervaluesrangedfrom0to 105.07. The maximum intra cluster distance was observed in cluster II (105.07). The minimumintra cluster distance for cluster IV, V, VI and VII exhibited zero. The inter cluster distance differfrom 42.05 (between IV and VI) to 365.72 (between III and VI). Other inter cluster distance werebetweenthesevalues.ThehighestinterclusterdistanceobservedbetweenclusterVI andclusterIII(365.72) followed by cluster VII and cluster V (363.6), cluster VI and cluster II (254.63), cluster IVand cluster III (254.19) and cluster VI and cluster V (246.31). The minimum intercluster distanceobserved between cluster VI and IV (42.05), cluster III andcluster I (108.49), and cluster IV andclusterI(117.92).

### **Interandintraclusterdistance**

Inthepresentstudy,thehighestinterclusterdistanceobservedbetweenclusterVIandclusterIII(365.72)followedbyclusterVIIandclusterV(363.6),clusterVIandclusterII(254.63),cluster IV and cluster III (254.19) and cluster VI and cluster V (246.31). Therefore, thegenotypes belonging to the clusters VI and III followed by cluster VII and V may be usedasparentstoproducetransgressive segregants.

### **Clustermeans**

Theresultsofclustermeanwere furnishedinTable6.

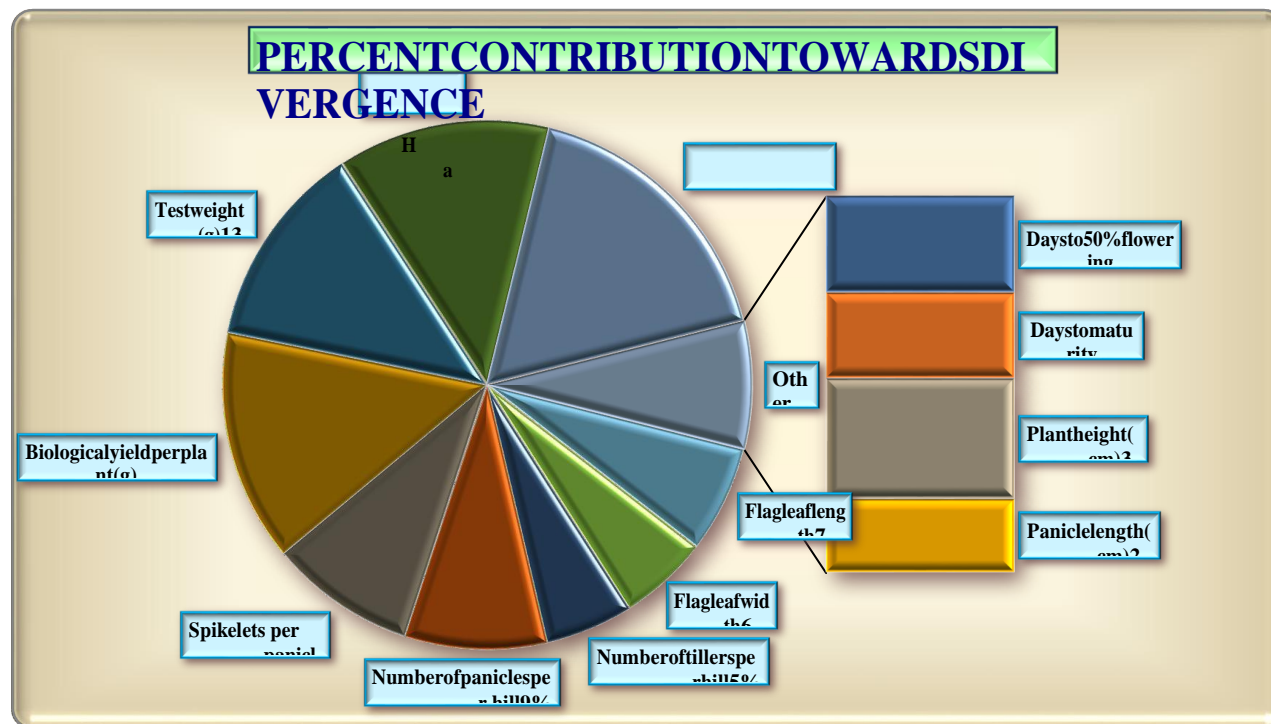
### **Contributiontowardsdivergence**

Thepercentcontributionof13biometricaltraits of40ricegenotypestowardsgenetic divergencewasestimatedandgiveninTable7andFigure4.The traitGrainyieldperhill(17.3)had maximum contribution towards to genetic divergence followed by biological yield (14.2),Harvest Index (13), Test Weight (12.6), Number of spikelets per panicle (8.96), Number ofpaniclesperhill (8.67),Flagleaflength(6.54),Flagleafwidth(5.54),Numberoftillersperhill (5.36),Plantheight(2.5),Daysto50%flowering(2),Daystomaturity(1.79),Paniclelength(1.54)

**Table.7** Percent contribution of 13 biometrical traits of 40 rice genotypes towards genetic divergence

<b>SL.NO.</b>	<b>Source</b>	<b>Contribution%</b>	<b>Times ranked 1st</b>
1	Day to 50% flowering	2.00	16.00
2	Day to maturity	1.79	14.00
3	Plant height (cm)	2.50	19.00
4	Panicle length (cm)	1.54	12.00
5	Flag leaf length	6.54	51.00
6	Flag leaf width	5.54	43.00
7	Number of tillers per hill	5.36	42.00
8	Number of panicles per hill	8.67	68.00
9	Number of spikelets per panicle	8.96	70.00
10	Biological yield per plant (g)	14.20	111.00
11	Test weight (g)	12.60	98.00
12	Harvest Index	13.00	101.00
13	Grain yield per plant	17.30	135.00

Fig:4PiechatPercentcontributionof13biometricaltraits of40ricegenotypestowardsgeneticdivergence



## 4. CONCLUSION

Considerable variability existed in the genotypes for all the characters studied. These were the genotypes with high mean values in desirable direction i.e., From the present investigation it is concluded that among 40 genotypes of rice, Nellore Dhanyarasi showed early flowering (77 days), IR-64 had characters like early maturity (108 days), High Grain Yield per Plant is seen in Shuats Dhan-6 (62.1 g), JHARA SEL showed high plant height (185 cm) and high Biomass is seen in Shuats Dhan-6 (123.6 g), Swathi showed high Panicle Length (43.7 cm). Highest GCV and PCV were depicted for Grain Yield per Plant, Biological Yield, Harvest Index and Number of Spikelets per Panicle. The highest Heritability was observed for Grain Yield per Plant followed by Harvest Index, Flag Leaf length, Biological Yield and Number of Spikelets per Panicle. The Genetic Advance in percent of mean is high for Grain Yield per Plant, Biological Yield, Harvest Index

and Number of Spikelets per Panicle. Based on  $D^2$  values 40 genotypes grouped into 7 clusters. Among 6 clusters, cluster I had a greater number of genotypes (26) followed by cluster II (8), III (2), IV, V, VI and VII (1) genotype each. Cluster VI and cluster III (365.72) followed by cluster VII and cluster V (363.6), were most diverse from each other and the genotypes present in these clusters provide a broad spectrum of variability in segregation and may be used as parents in the future hybridization program to develop desirable genotypes for grain yield improvement in rice genotypes. The trait Grain yield per hill had maximum contribution towardstogenetic divergence followed by biological yield, Harvest Index, Test Weight. Therefore, all these characters should be given due consideration during selection for crop improvement.

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