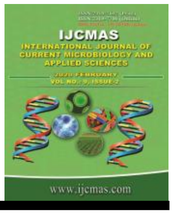
Int.J.Curr.Microbiol.App.Sci (2020) *9*(2): 1499-1507

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 2 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.902.173

Assessment of Genetic Divergence in Rice (*Oryza sativa* L.) Germplasm

Sneha Gupta*, Prashant Bisen, Sameer Upadhyay, S. R. Rathi,
Ganesh Kumar Koli, P. K. Singh and B. Sinha

Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, India

**Corresponding author*

ABSTRACT

Keywords

Rice (*Oryza sativa* L.); Genetic divergence; Mahalanobis's D^2-statistics

Article Info

Accepted:
08 January 2020
Available Online:
10 February 2020

The nature and the magnitude of genetic divergence was estimated in forty-eight germplasm of rice during two season *Kharif 2017-18* and *Kharif 2018-19*using Mahalanobis's D^2-statistics. The genotypes were grouped into 10 clusters showing a reliable degree of relationship between geographic distribution and genetic divergence. During *Kharif 2017-18*,Cluster II showed maximum intra cluster divergence and inter cluster divergence was maximum between clusters IX and X while in *Kharif 2018-19*, maximum intra cluster distance was exhibited by cluster VI and maximum inter cluster distance was between clusters VIII and X. All the minimum and maximum cluster mean values were distributed in relatively distant clusters. Traits like plant height, total grains per panicle and test weight contributed maximum towards divergence.

Introduction

Rice is the most widely consumed indispensable food for a large part of the world's human population, especially in Asia. On the global basis, rice is grown in an area of 162.50 million hectares with annual production 495.49 million metric tons and having average productivity of 4.55 metric tons per hectare. In India, 43.79 million hectares area is under rice cultivation with annual production of 112.91 million tons. Rice contributes about 45 % of India's cereal production and is the chief staple food for over 60 % of the population in the country.

To fulfill the growing demand for rice, it becomes obligatory to design new rice varieties with higher yield potential to enhance average farm yields that relies heavily on the availability and utilization of genetic diversity.Genetic diversity in crop plants is essential to sustain level of high productivity (Tripathi *et al.*, 2013).Genetic divergence serves as an important parameter for successful selection of parents for hybridization programme (Chandra *et al.*, 2007). The germplasm that belongs to different and distantly located clusters are more genetically divergent than those belonging to same cluster. Therefore, classification of genotypes belonging to different clusters will enable the breeder to identify the best parents with wide genetic divergence.

Keeping in view the above facts the present investigation will be undertaken to estimate genetic divergence of rice germplasm and selecting divergent parents for future use in improvement.

Materials and Methods

The experimental material for the study comprised of forty-eight genotypes of rice laid in randomized block design (RBD) with three replications at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif 2017-18* and *Kharif 2018-19*. The seedlings were transplanted to main field at spacing of 15 x 20 cm.

Standard agronomic practices were followed to raise a good crop. Observations were recorded on five randomly selected plants per replication for days to 50% flowering, days to maturity, plant height (cm), panicle length (cm), effective tillers per plant, filled grains per panicle, unfilled grains per panicle, total grains per panicle, spikelet fertility percentage, test weight (g) and grain yield per plant (g).

The analysis of variance was carried out for all the eleven traits and then data was analysed for genetic divergence based on Mahalanobis' (1936) generalized distance and the genotypes were grouped into different clusters by Tocher's method as described by Rao (1952).

Results and Discussion

The analysis of variance revealed significant differences among the genotypes for all the characters during both season indicating existence of variability among the genotypes for the characters studied. In the present investigation, D^2 analysis revealed the presence of considerable diversity in the set of forty-eight germplasm under study. The germplasm were observed to be distributed in ten different clusters based on multiple traits during both the season (Table 1 & Table 2).

During *Kharif 2017-18*, the intra-cluster distance for clusters V, VI, VII, VIII, IX and X was observed to be smallest *i.e.* zero since these contains only one genotype in each cluster. Cluster II exhibited maximum intra-cluster distance with 12 germplasm followed by cluster III with 2 genotypes and cluster I containing maximum number of genotypes i.e. 20, having sufficient diversity. The maximum inter-cluster distance was observed between clusters IX and X indicated that the hybridization between the most diverse accessions would yield desirable segregants with accumulation of maximum favourable genes in the segregating generations (Babu *et al.*, 2003) (depicted in Table 3).The traits viz., plant height, total grain number per panicle, test weight and days to flowering contributed 91.61% towards total divergence, indicating their importance during hybridization programmes.

In *Kharif 2018-19*, clusters V, VII, VIII, IX and X containing one genotype in each cluster observed smallest intra-cluster distance while the maximum intra-cluster distance with 10 germplasm was exhibited by cluster VI, indicating presence of diversity. The maximum inter-cluster distance was observed between clusters VIII and X (Table 4). Therefore, the hybridization between them would yield desirable progenies with maximum favourable genes. Total grains per panicle, days to flowering, test weight and filled grains per panicle contributed 86.52% towards total divergence as observed by Guru *et al.*, (2017).

Genotypes that occur in a particular cluster manifested their close relationship among themselves as compared to that present in other clusters. Therefore, accessions within a cluster were less genetically different with each other. The germplasm maintained their distinct identity by falling in different clusters. The clustering pattern indicated wide diversity between different groups of genotypes. Greater the distance between two clusters, wider is expected genetic advance between them. Therefore, indication of the genetically diverse genotypes would help in selecting parents for hybridizing programme.

The study of cluster depicted that there existed considerable differences in the mean values of different traits (Table 5 & Table 6). Distribution of highest and lowest mean values for different traits in distinct cluster indicated the traits contributing to the total divergence.In this regard, plant height (42.55%) contributed maximum towards divergence followed by total grains per panicle (25.71%) and test weight (13.83%)during *Kharif 2017-18*(Table 7).Singh *et al.*, (2006) reported similar results. However, during *Kharif 2018-19*, total grains per panicle (32.36%) contributed maximum towards divergence followed by days to flowering (31.74%) and test weight (16.22%)(Table 8). These results were in accordance with Padmaja *et al.*, (2010).

In the present set of rice germplasm, based on cluster mean and inter-cluster distances, it was observed that the germplasm desirable for different traits belonged to different clusters. Therefore, accessions from diverse germplasm with desirable traits may be utilized in multiple cropping programmes and is expected to be effective in accumulation of maximum favourable genes for bringing together different desirable traits into the common background. Hence, an improved germplasm can be developed by utilizing such diverse germplasm in rice.

Table.1 Grouping of 48 rice germplasm during *Kharif 2017-18* into ten clusters (by Tocher method)

Clusters	Germplasm	Number
I	LC-52, LC-56, LC-57, LC-54, LC-98, LC-97, LC-64, LC-86, LC-78, LC-92, LC-83, LC-88, LC-50, LC-79, LC-67, LC-70, LC-84, LC-75, LC-77, LC-93	**20**
II	LC-58, LC-76, LC-60, LC-69, LC-61, LC-71, LC-73, LC-74, LC-68, LC-66, LC-59, LC-82	**12**
III	LC-65, LC-55	**2**
IV	LC-57, LC-95, LC-80, LC-96, LC-91, LC-94	**6**
V	LC-63	**1**
VI	LC-62	**1**
VII	LC-81	**1**
VIII	LC-53	**1**
IX	LC-87	**1**
X	LC- 90	**1**

Table.2 Grouping of 48 rice germplasm during *Kharif 2018-19* into ten clusters (by Tocher method)

Clusters	Germplasm	Number
I	LC-54, LC-56, LC-52, LC-57, LC-70, LC-79, LC-98, LC-50, LC-58, LC-66	**10**
II	LC-60, LC-61, LC-73, LC-84, LC-76, LC-69, LC-83, LC-78, LC-55, LC-77	**10**
III	LC-64, LC-75, LC-67, LC-71, LC-82, LC-92	**6**
IV	LC-59, LC-68, LC-74, LC-53, LC-65, LC-57, LC-97	**7**
V	LC-94	**1**
VI	LC-86, LC-95, LC-93, LC-90, LC-85, LC-96, LC-87, LC-88, LC-91, LC-89	**10**
VII	LC-81	**1**
VIII	LC-80	**1**
IX	LC-62	**1**
X	LC-63	**1**

Table.3 Average Intra and Inter-cluster D^2 values among 10 Clusters (by Tocher method) during *Kharif 2017-18*

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X
I	**107.31**	260.3	200.53	171.4	229.19	201.79	387.44	284.6	199.92	478.85
II		**118.80**	335.83	221	324.33	427.18	192.24	225.86	498.28	378.95
III			**109.20**	262.28	292.75	257.27	558.25	323.02	242.26	397.68
IV				**0.00**	53.57	426.91	419.15	190.64	219.01	440.21
V					**0.00**	398.5	664.63	120.85	136	707.87
VI						**0.00**	590.95	306.84	168.23	764.41
VII							**0.00**	526.22	806.38	312.3
VIII								**0.00**	235.41	780.56
IX									**0.00**	854.2
X										**0.00**

(Figure in diagonal indicate intra- cluster D^2 value)

Table.4 Average Intra and Inter-cluster D^2 values among 10 Clusters (by Tocher method) during *Kharif 2018-19*

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X
I	**35.87**	96.34	115.1	145.82	155.22	302.97	162.61	526.43	94.54	148.12
II		**35.11**	99.62	86.81	65.48	153.71	63.92	302.69	166.57	237.87
III			**49.37**	206.45	137.74	244.15	88.94	287.83	130.55	270.29
IV				**67.81**	99.03	170.66	192.94	413.36	169.33	159.73
V					**0.00**	68.79	127.69	194.99	149.22	214.84
VI						**80.38**	222.12	156.49	258.85	329.76
VII							**0.00**	264.3	287.57	425.36
VIII								**0.00**	441.89	633.32
IX									**0.00**	48.06
X										**0.00**

Table.5 Mean values of different characters of forty eight rice germplasm grouped into 10 clusters during *Kharif 2017-18*

Traits	DF	DM	PH	PL	ET	FGP	UFGP	TGP	TW	GYP	SF%
Cluster											
I	83	111.57	113.78	24.92	12.83	81.03	24.92	105.95	20.79	24.34	78.28
II	88.8	118.33	151.64	26.93	10.87	129.64	18.09	147.73	21.3	29.15	87.37
III	97.72	126.89	111.28	27.33	10.39	87.33	50.17	137.5	19.6	22.94	63.77
IV	85.67	116	130	29.67	12.67	128	42	170	12.61	29.32	76.28
V	85.67	116	128	27.33	10.33	121.33	34	155.33	11.86	20.15	78.07
VI	82.67	111	103.33	28.33	11	113.33	12	125.33	27.83	27.94	90.45
VII	85.33	111	154.33	27.67	8	147.67	31	178.67	26.12	54.99	82.2
VIII	90	116	148.67	30.67	7.67	106.33	27.33	133.67	18.65	24.57	79.55
IX	83.67	112	101.67	25.67	10.33	119.33	74	193.33	17.81	23.79	61.66
X	101.67	132	128	27	12.67	219.67	41.67	261.33	18.5	50.16	84.04

(DF) = Days to 50% flowering, (DM) = Days to maturity, (PH) = Plant height (cm), (PL) = Panicle length (cm), (ET) = Number of effective tillers per plant, (FGP) = Number of filled grains per panicle, (UFGP) = Number of unfilled grains per panicle, (TGP) = Total number of grains per panicle, (SF%) = Spikelet fertility percentage, (TW) = Test weight (g), (GYP) = Grain yield per plant (g)

Table.6 Mean values of different characters of forty eight rice germplasm grouped into 10 clusters during *Kharif 2018-19*

Traits	DF	DM	PH	PL	ET	FGP	UFGP	TGP	TW	GYP	SF%
Cluster											
I	80.23	108.63	109.1	23.8	13.67	83.4	9.27	92.67	21.69	25.41	89.61
II	89.27	117.97	126.17	24.97	9.8	108.2	16.97	125.17	24.5	23.35	85.63
III	86.28	115.5	126	24	7.67	147.17	14.61	161.78	21.15	21.86	91.15
IV	90.33	119.14	126.52	25.9	7.76	148.57	23.43	172	22.75	24.76	84.35
V	94.67	120.67	97.33	27.33	8	78	39.67	117.67	20.44	16.63	66.33
VI	100.07	129.37	103.27	25.23	9.2	110.27	52.03	162.3	19.57	24.21	66.92
VII	90	119	122.67	26.33	8.67	109.33	15.67	125	28.51	32.51	87.52
VIII	107.67	136	113	29	7	144.33	72	216.33	19.24	26.06	66.76
1X	85	112	111.67	24	7.67	144	9	153	14.01	19.17	94.07
X	84.33	111	106.33	28	8.33	168.67	20.33	189	14.26	23.86	89.26

(DF) = Days to 50% flowering, (DM) = Days to maturity, (PH) = Plant height (cm), (PL) = Panicle length (cm), (ET) = Number of effective tillers per plant, (FGP) = Number of filled grains per panicle, (UFGP) = Number of unfilled grains per panicle, (TGP) = Total number of grains per panicle, (SF%) = Spikelet fertility percentage, (TW) = Test weight (g), (GYP) = Grain yield per plant (g)

Table.7 Percentage contribution of each character towards total genetic divergence in forty eight germplasm during *Kharif 2017-18*

S.No.	Characters	Times Ranked 1st	Contribution %
1.	Days to 50%flowering	108	9.57
2.	Days to maturity	18	1.60
3.	Plant height (cm)	480	42.55
4.	Panicle length (cm)	5	0.44
5.	Effective tiller/plant	17	1.51
6.	Filled grains per panicle	74	0.35
7.	Unfilled grains per panicle	4	0.35
8.	Total grains per panicle	290	25.71
9.	Test weight (g)	156	13.83
10.	Grain yield/plant (g)	45	3.99
11.	Spikelet fertility (%)	1	0.09

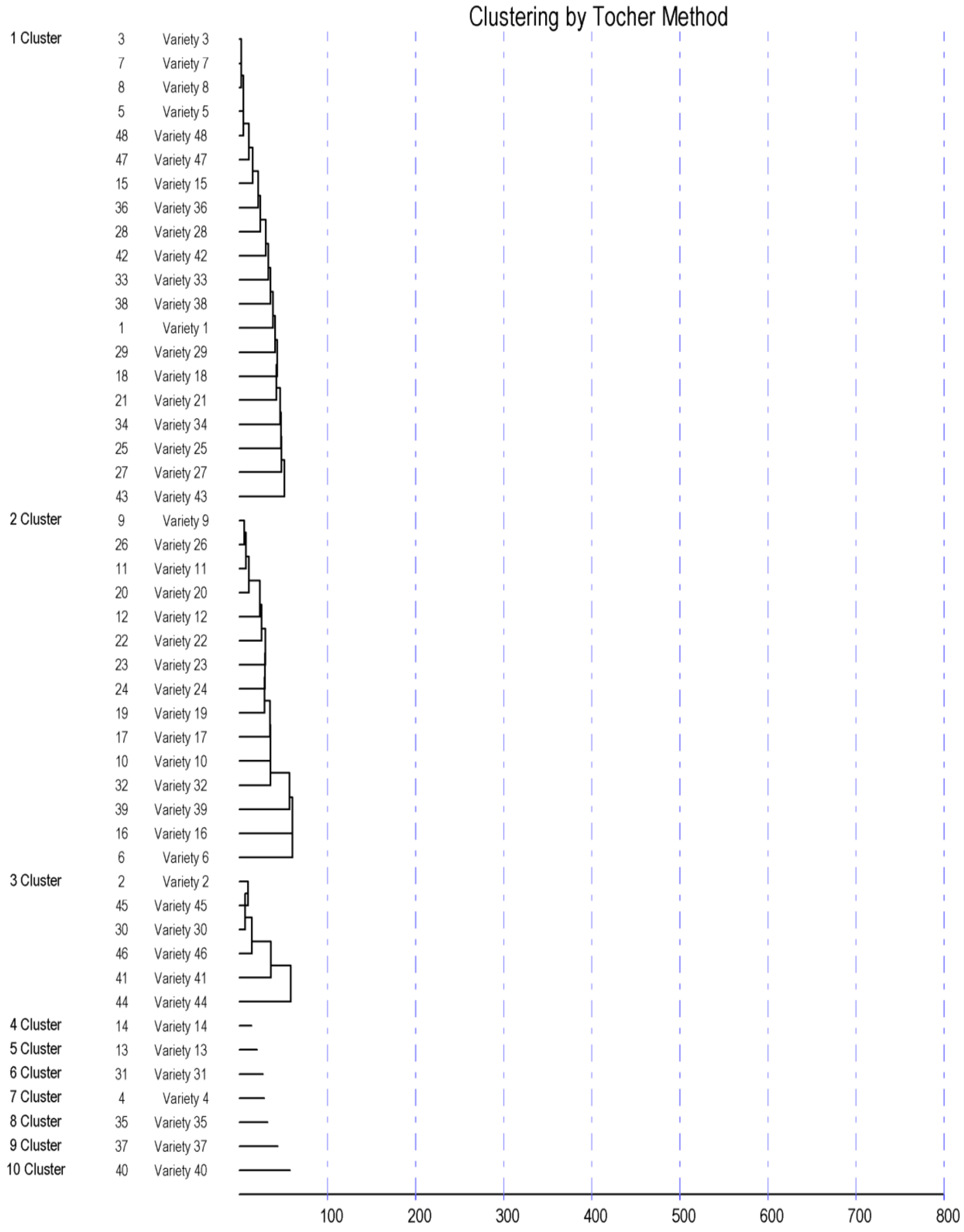


Figure.1 Grouping of 48 rice germplasm during *Kharif 2017-18* into ten clusters (by Tocher method)

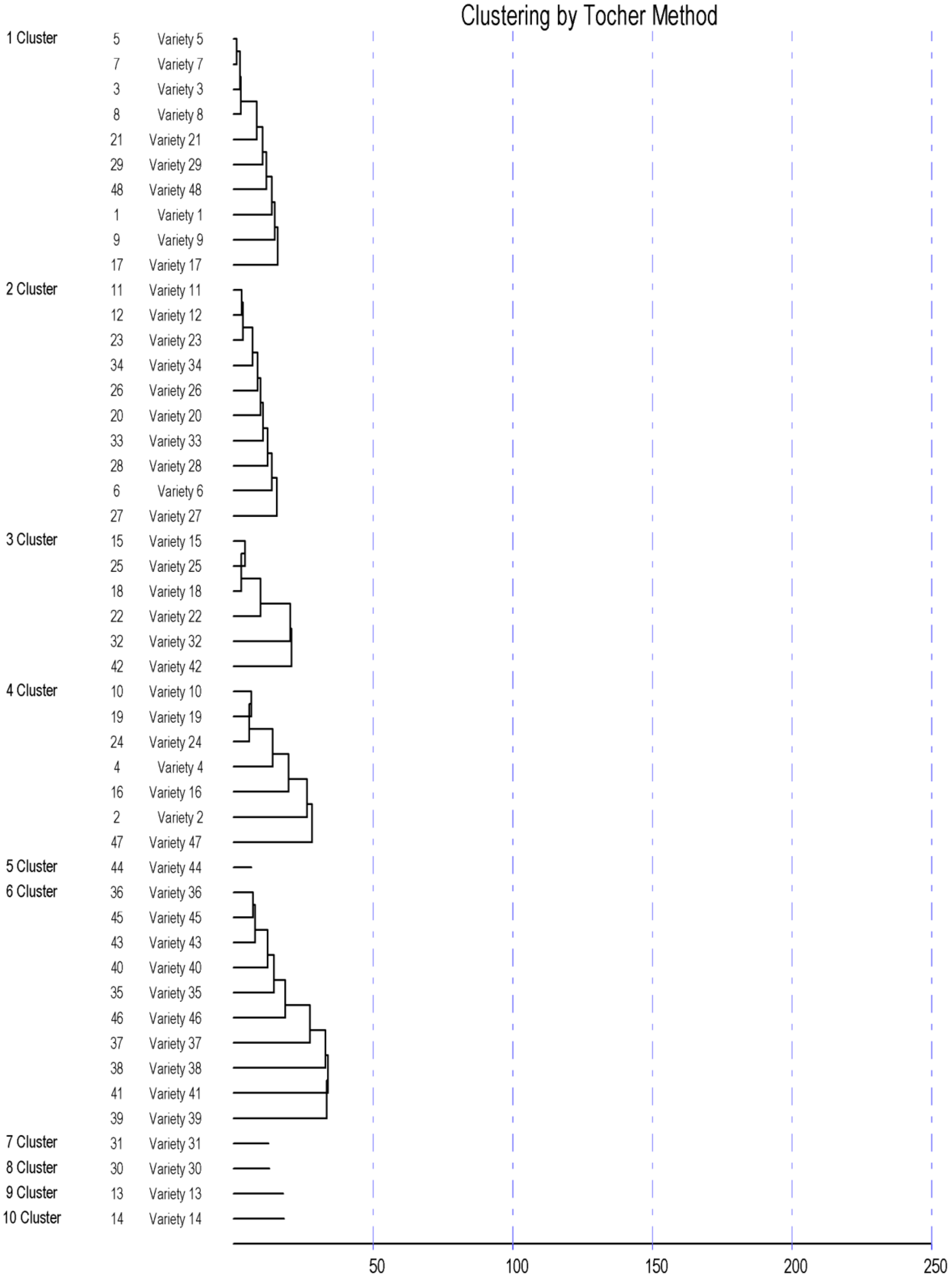


Figure.2 Grouping of 48 rice germplasm during *Kharif 2018-19* into ten clusters (by Tocher method)

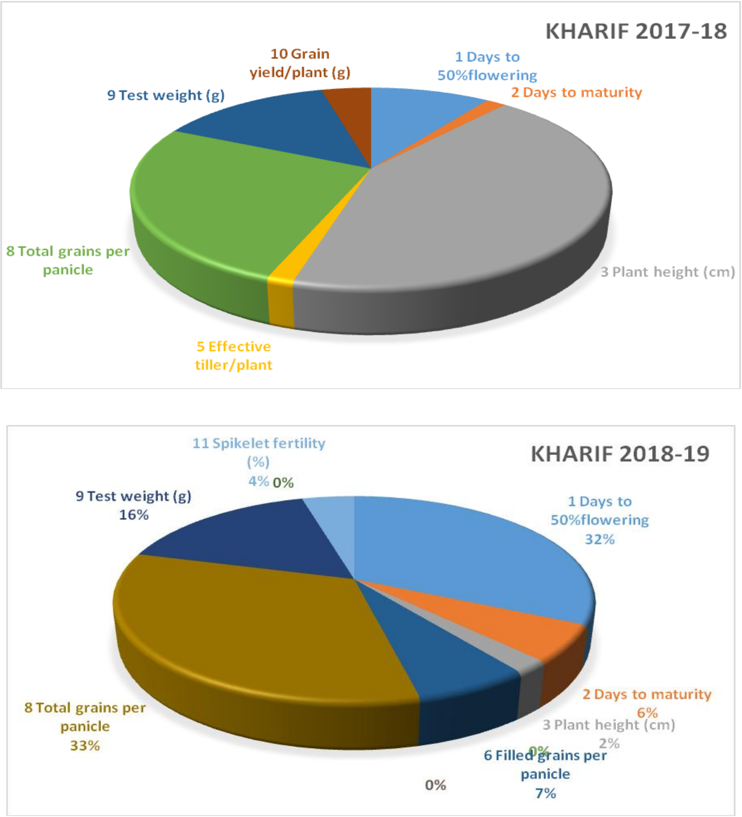


Figure.3 Percentage contribution of each character towards total genetic divergence

Table.8 Percentage contribution of each character towards total genetic divergence in forty eight germplasm during *Kharif 2018-19*

S.No.	Characters	Times Ranked 1st	Contribution %
1.	Days to 50%flowering	355	31.47
2.	Days to maturity	64	5.67
3.	Plant height (cm)	22	1.95
4.	Panicle length (cm)	1	0.09
5.	Effective tiller/plant	5	0.44
6.	Filled grains per panicle	73	6.47
7.	Unfilled grains per panicle	1	0.09
8.	Total grains per panicle	365	32.36
9.	Test weight (g)	183	16.22
10.	Grain yield/plant (g)	12	1.06
11.	Spikelet fertility (%)	47	4.17

The conclusion drawn by the cluster analysis is that in the studied population, high variability was observed between the germplasm lines in different clusters for different traits.The most distant clusters were cluster IX and X (*Kharif 2017-18*) and cluster VIII and X (*Kharif 2018-19*). The traits plant height, total grains per panicle and test weight contributed maximum towards divergence.Therefore, selection of genotypes based on these traits hold great promise as parents for obtaining promising elite lines through hybridization and to create further variability for these characters.

References

Babu, S., Anbumalaramati, J., Yogameenakshi, P., Sheebha, A. and Rangaswami. 2003. Genetic diversity studies in rice (*Oryza sativa* L.). *Crop Research*, 25(2): 280-286.

Chandra, R., Pradhan, S. K., Singh, S., Bose, L. K., & Singh, O. N. (2007).Multivariate analysis in upland rice genotypes. *World Journal of Agricultural Sciences*, 3(3), 295-300.

Guru, T., Padma, V., Reddy, D. V. V., Rao, P. R., Rao, D. S., Ramesh, T., &Radhakrishna, K. V. (2017). Genetic diversity analysis for yield attributing traits in rice genotypes. *Research on Crops*, 18(2), 311-315.

Mahalanobis, P.C. (1936). On the generalized distance in statistics.*Proceedings of the National Institute of Science (India)*, 12: 49-55.

Padmaja, D., Radhika, K., Rao, L. V. S., & Padma, V. (2010). Studies on genetic divergence in rice (*Oryza sativa* L.) germplasm. *Crop Research (Hisar)*, 40(1/3), 117-121.

Rao, C.R.(1952). *Advanced statistical methods in biometrical research*. John Wiley and Sons

Inc., New York pp. 236-272.

Singh, P. K., Mishra, M. N., Hore, D. K., &Verma, M. R. (2006). Genetic divergence in lowland rice of north-eastern region of India. *Communications in Biometry and Crop Science*, 1(1), 35-40.

Tripathi, A., Bisen, R., Ahirwal, R. P., Paroha, S., Sahu, R. and Ranganatha. A. R. G. 2013. Study on genetic divergence in sesame (*Sesamumindicum* L.) Germplasm based on morphological and quality traits. The Bioscan. 8(4): 1387-1391.

How to cite this article:

Sneha Gupta, Prashant Bisen, Sameer Upadhyay, S. R. Rathi, Ganesh Kumar Koli, P. K. Singh and Sinha. B. 2020. Assessment of Genetic Divergence in Rice (O*ryza Sativa* L.) Germplasm. *Int.J.Curr.Microbiol.App.Sci.* 9(02): 1499-1507. doi: https://doi.org/10.20546/ijcmas.2020.902.173