Assessment of Genetic Variability, Heritability and Genetic Advance of Rice Genotypes (*Oryza sativa* L.) under salt affected soil.

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ABSTRACT

The present investigation,was carriedout with –25 rice genotypes. The evaualtion werewas taken evaluated for 11 quantitative traits under three different environmental locations based on 11 quantative traits.. The trials were laid out in RBD with three replications at Students Instructional Farm, MES(Main Experimental Station) and Agronomy Farm of A.N.D.U.A.T., Kumarganj, Ayodhya. The environment-wise analysis of variance and pooled analysis of variance for three environments covering one crop seasons, revealed high significant mean squares for all the eleven characters under the evaluation. Considering the mean performance of genotypes for different environmental conditions, the genotypes viz., T-3, Kavery Sampoorna, NDRK-11-27, Moti Gold and NDRK-11-29 were exhibiting high mean performance for grain yield per plant and some of its important components were T-3, Kavery Sampoorna, NDRK-11-27, Moti Gold and NDRK-11-29 under irrigated condition. Three genotypes, T-3, Kavery Sampoorna, NDRK-11-27 possessed highest grain yield per plant among 25 genotypes across three environments. A wide range of phenotypic and genotypic coefficient of variability was observed. The high magnitude (>20%) of PCV along with GCV observed for productive biological yield per plant (34.88), grain yield per plant (33.41%), L/B ratio (24.76) observed PCV while high GCV recorded in biological yield per plant (31.00%), grain yield per plant (25.14%), no. of fertile spikelet per panicle (21.15%). Moderate estimates of PCV along with GCV were recorded for harvest index (17.75%), panicle length (15.21%), plant height (13.6%) and days to 50% flowering (12.41%) (confused statement) and GCV were recorded productive tiller per plant (17.92%), harvest index (15.28%), leaf area index(13.81%), L/B ratio (13.55%), plant height (12.37%), days to 50% flowering (11.98%) and panicle length (10.75%). The magnitude of heritability in broad sense varied between 93.28% in case of days to 50% flowering to 27.37% in case of L/B ratio. The high estimation of heritability recorded into days to 50% flowering(93.28%) followed by plant height (82.72%), biological yield per plant (78.99%), spikelet fertility (75.70%). moderate estimates of heritability were reported for harvest index (74.08%), productive tiller per plant (69.72%), number of fertile spikelet per panicle (66.78%). while low estimates of heritability were reported in case of L/B ratio (27.37), leaf area index (31.14%).(conclusion, genetic advance)

Keywords: *Oryza sativa L, Genetic advance, heritability, Quantitative Characters*

INTRODUCTION:

Rice (*Oryza sativa* L.) is the one of the staple food for one third of the world population after maize and wheat. It is widely grown in tropical and subtropical regions (Ezuka & Kaku, 2000). Rice is the monocarpic annual plant belonging to genus *Oryza* of Poaceae family. *Oryza sativa* is a diploid species having 24 chromosomes, the genus *Oryza* has 24 species of which, 22 are wild and two species *viz*., *Oryza sativa* and *Oryza glaberrima* are cultivated. It is the rich source of energy and contains reasonable amount of protein 6-10%, carbohydrate 70-80%, mineral 1.2-2% and vitamins (Riboflavin, thiamine, niacin and vitamin E). Global rice production was only 483.9 million tonnes in (2017-18).(latest data) Rice is cultivated worldwide over an area of about 153.51 million hectare with annual production of 650.19 million tonnes. India ranked first in area having 43.57 million hectares and second in production 104.32 million tones. (CSSRI annual report, 2017-2018). The production of rice in U.P. is 19.32 million hectare area and production 44.01million tones (Press Information Bureau, Government of India, 2018).

Phenotypic variability is the differences between individuals in a population due to genetic composition and growing environment (Sumanth *et al*., 2017). Planning and execution of any breeding program for improvement on quantitative traits depends on magnitude of genetic variability. Therefore, success on plant breeding activities entirely depends on the existence of genetic variability with respect to desired traits and selection skill of plant breeder (Adhikari *et al.,* 2018)

Variability, genetic diversity, expected genetic advances and heritability of the traits are therefore key basis for genetic improvement of the trait. Heritability is the ratio of variation due to differences between genotypes to the total phenotypic variation for a trait in a population and shows the component of a character transmitted to future generations. Genetic advance shows the difference between the mean genotypic values of selected population and the original population from which these were selected. Heritability estimates along with genetic advance is more precise in predicting the genetic gain under (selection than heritability alone). In addition, relationship between yield and yield attributing traits are prime important for direct and indirect selection of traits to which contributes to yield (Aditya & Bhartiya, 2013)

Every year more and more land is becoming non-productive because of salt accumulation in soil in coastal as well as certain inland saline tracks. Salinity is a serious problem affecting 1/3 of all irrigated land in the world. Nearly, 6.73 million hectares of soils in India are salt affected and categorized into two broad groups, alkali and saline soils. Recent estimates indicate that more than 1.5 million hectares of salt affected area has been reclaimed and is contributing about 10 million tonnes additional food grains to the central pool. At present, in Indo-gangetic plains in India, a total of 2.348 million hectares area is salt affected in which Uttar Pradesh has a share of 1.37 million hectares. Salinity affects rice growth in varying degrees at all stages starting from germination to maturation (Manneh, 2004). So far, conventional breeding methods for salt tolerance

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have been found ineffective due to the strong environmental effects on genotypic expression and the low narrow sense heritability of salt tolerance (Gregorio, 1997; Gregorio and Senadhira, 1993).

MATERIALS AND METHOD :

The experimental material for the present investigation was comprised of 25 lines of rice germplasm along with 2 checks *viz.*, CSR-10, NDR-2064.The material, comprising scented and non-scented germplasm lines, exhibited wide spectrum of variation for various agronomic and morphological characters. system was carried out in three locations (*viz.,)* students instructional farm, MES and Agronomy Farm of Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya in RBD during *Kharif*, 2019. Twenty-five diverse lines were evaluated at three different sodicity levels. Geographically, this place is situated at 26.47^0N latitude and 82.12^0E longitude at an altitude of 113 m above the mean sea level. This area falls in sub-tropical zone (Indo-gangatic plain) and the soil texture is characterized by silty loam in nature having 8.2 p^H in E_1 (partially reclaimed), 8.1 p^H in E2 (Partialy reclaimed) & 9.5 p^H in E_3(high sodicity condition) at Main Experimental Station farm of Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, (Kumarganj), Ayodhya (U.P.), India. Recommended cultural practices were followed to raise a good crop. Five plants from each treatment were selected randomly for recording following observations except days to 50% flowering which were recorded on plot basis. To ensure a successful harvest, all recommended agronomic techniques were implemented in every plot replication. On five randomly selected plants from each genotype in each replication. we recorded data on eleven different quantitative characteristics, including plant height (cm), productive tillers per plant, paenicle length,leaf area index(cm^2), no of ~~fertile~~ spikelet per paenicle, spikelet fertility(%), biological yield per plant(g), harvest index(%), L/B ratio and grain yield per plant(g). The average performance value was derived using statistical analysis of the data from each replication. Data were subjected for analysis of variance (Panse and Sukhatme, 1978) and genetic parameters *viz,* genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (Burton and de Vane, 1953) and genetic advance (Robinson *et al.*, 1949**)** .

RESULT AND DISCUSSION:

Days to 50% flowering ranged from 69.66 days to 113.33 days with a mean flowering of 95 days. Among all the genotype, Royal Bhog flowered early(days) whereas Pusa Basmati-1 flowered very late(days)~~ly~~. Parimala and Devi (2019) (incomplete)Plant height ranged from 82.62 cm to 143.55 cm with a general mean height of 114.73 cm. Among all the genotype CSR-1620 was the shortest, whereas Kala Namak was the tallest. ~~Hasib *et al.* (2004) Gyawali *et al.* (2018)~~

Number of productive tillers per plant was recorded by the genotype Kavery Chintoo (12.49) whereas the lowest number was registered by the genotype CSR-10(5.42). Nine genotypes have recorded a greater number of productive tillers per plant than the general mean

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of the genotypes (7.95). Panicle length ranged from 18.697 cm to 29.6 cm with a mean panicle length of 22.81 cm. The longest panicles were produced by the genotype Ideva, whereas the shortest panicles were recorded by the genotype CSR-20. Leaf area index ranged from 15.33 cm to 33.33 cm with a mean leaf area index 22.42 cm. The longest leaf area index were produced by the genotype NDRK-11-30, whereas the shortest leaf area index were recorded by the genotype Kavery Sampoorna. Manna *et al.* (2006) Singh and Verma (2018) Vijayalakshmi *et al.* (2008)

The number of ~~fertile~~ spikelet per panicles was ranged ~~of~~ from 75.9 ~~–~~to 189.38 grains per panicle was observed with a general mean of 108.54 grains per panicle over all genotype. The maximum number of grains per panicle was recorded in the genotype~~s~~ Moti Gold whereas minimum in the genotype CSR-13. The spikelet fertility ranges from 57.29% to 92.37%. The highest spikelet fertility observed by the genotype, Pusa Basmati-1 whereas the lowest spikelet fertility observed by the genotype NDR-2064. Fourteen genotypes have recorded more spikelet fertility percentage when compared to general mean81.90%. (Nayak *et al.* (2002) Suman *et al.* (2005)

Biological yield per plant range from 17.04g to 52.96g with mean average biological yield 32.88g. The highest biological yield observed by the genotype NDR-2064 and lowest biological yield observed by the genotype Susk Samrat. The highest harvest index was observed in Kala Namak (43.53%) while T-3 had the lowest harvest index (21.53%) with a mean harvest index of 30.77 per cent. Thirteen genotypes surpassed their mean value for harvest index. The mean performance of L/B ratio varied from CSR-13, 1.76 mm to 3.95mm NDR-2064 recorded. With general mean 3.0mm. Seventeen genotypes have higher L/B ratio in compared to average mean. Ashish *et al*. (2016**)** Singh *et al*. (2008) Sharma and Sharma (2007)

The genotype T-3 recorded the highest grain yield (29.09 g) whereas NDRK-11-30 registered the lowest grain yield per plant (10.01g). Sixteen genotypes have exceeded their general mean value (16.27g).These result are similar to those of Bandi *et al.*(2018), Singh and Verma (2018), Parimala and Devi (2019).

The estimates of phenotypic and genotypic coefficient of variation for eleven characters are presented in Table 3. In general, the magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits.

A wide range of phenotypic and genotypic coefficient of variability was observed. The high magnitude (>20%) of PCV along with GCV was observed for biological yield per plant (34.88), grain yield per plant (33.41) and L/B ratio(25.90), number of fertile spikelet per panicle (25.88), leaf area index (24.76) and productive tillers per plant (21.46%).

Moderate estimates of PCV along with GCV (20-10%) were recorded for harvest index (17.75), panicle length (15.21), plant height (13.6) and days to 50% flowering (12.41). Spikelet fertility showed low estimates (< 10%) of PCV and GCV. These findings are similar to those of Singh and Verma (2018) Parimala and Devi (2019) Gyawali *et al.* (2018) Srujana *et al.* (2017) Ashish *et al*. (2016**)**

The heritability gives an idea of transmissibility of a character from parents to offspring. The magnitude of heritability in broads sense varied between 93.286% in case of days to 50% flowering to 27.37% in case of L/B ratio (mm).while plant height showed (82.73 cm.). The moderate estimates of heritability were reported for biological yield /plant (78.998g), spikelet fertility (75.70%), harvest index (74.08%), productive tillers plant (69.72) and number. of fertile spikelet per plant (66.78%). The character mentioned above has also been reported earlier I chickpea Singh and Verma (2018) Rehman *et al*. (2012) While low estimates of heritability were reported in case of grain yield per plant (56.61 g), panicle length (50.02%), L/B ratio (27.37%). Seyoum *et al*. (2012) The high genetic advance was reported in case of number of fertile spikelet /panicle (38.64), plant height (26.59 cm) and days to 50% flowering (22.71). Moderate estimates of genetic advance were reported in case of spikelet fertility (11.40%) and biological yield per plant (18.66). While low estimates of genetic advance were reported in case of rest of the characters. These findings are similar to those of Karim *et al*. (2016), Sumanath *et al* (2017*)*.Singh and Verma (2018), Bandi *et al*. (2018) and Kurmanchali *et al*. (2018).

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Table 1. Analysis of variance for eleven yield and yield contributing character in rice (*Oryza sativa* L.) genotypes

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	d.f.	Days to 50% flowering	Plant height (cm)	Productive tillers/ plant	Panicle length (cm)	Leaf Area Index (cm)	Number of fertile spikelet/panicles	Spikelet fertility (%)	Biological yield /plant (g)	Harvest Index (%)	L/B ratio (%)	Grain yield/plant(g)
Replication	2	1429.48	48.520	34.4332	248.970	111.59	15379.5	514.488	4882.35	544.458	2.91988	77.907
Genotype	26	184.49**	723.908**	10.3499**	54.882**	54.85**	808.1**	109.669**	237.27**	96.169**	1.56616**	57.476**
Environment	2	16.42	0.009	0.0221	0.719	16.27	75.2	0.622	5.94	0.223	0.00926	0.525
Interaction	52	36.99	135.153	1.7169	6.321	10.33	491.4	18.205	92.64	20.054	0.26261	13.712
Error	156	151.88	218.507	2.3951	9.392	29.33	714.2	63.713	88.84	27.440	0.55372	27.090

***, **: Significant at 5% and 1% probability levels, respectively**

Table 2. Mean performance of genotypes for 11 characters in rice genotypes

Genotype	DFF	PH	PTP	PL	LAI	FSP	SF	BYP	HI	LBR	GYP
CSR-27	87.333	122.587	6.733	20.917	22.07	125.84	78.867	36.52	24.933	1.963	10.483
CSR-13	85.667	114.52	7.343	20.373	23.47	75.9	78.633	39.5	33.07	1.76	15.103
CSR-1620	82	82.627	9.273	21.667	21.333	135.933	79.933	48.367	32.757	2.6	10.633
CSR-20	86.333	118.81	7.553	18.697	29.507	88.967	78.29	46.213	34.763	1.903	14
NDRK-11-27	105.767	118.69	7.137	22.51	23.513	116.59	76.097	41.2	32.553	3.267	22.237
NDRK-11-30	83.847	130.593	7.587	23.11	33.333	130.663	76.413	35.76	24.317	2.587	10.01
NDRK-11-29	79.847	128.463	6.683	25.427	28	142.96	77.78	34.003	28.44	3.06	18.76
NDRK-133	89.18	99.883	7.48	19.423	24.667	117.77	88.687	22.093	37.113	3.113	12.6
Kala Namak	110	143.55	8.433	26.753	18.667	98.507	89.227	30.07	43.537	3.563	11.813
KR15100	100.667	102.953	7.19	22.91	28	89.827	81.957	21.847	34.107	2.953	17.747
Pusa Basmati-1	113.333	124.96	9.413	27.05	23.667	95.503	92.37	26.473	39.67	3.19	10.597
PusaSugandha-5	95.827	115.193	7.73	21.84	19.333	87.733	85.497	21.713	35.58	2.66	18.277
PantDhan-10	82.623	103.46	9.203	21.953	23.333	85.913	79.91	19.85	31.16	3.07	11.417
Ideva	93.667	114.993	10.743	29.6	27	84.267	89.837	20.457	31.137	3.397	18.57
Kavery Chintoo	105.333	125.043	12.49	27.637	21.333	97.917	89.93	24.023	34.407	3.73	15.587
Kavery Sampoorna	110	106.86	10.02	25.637	15.333	89.967	83.577	22.147	29.32	3.1	24.843
SuskSamrat	93.333	123.65	7.433	21.477	18.667	84.747	79.263	17.043	28.183	3.207	16.403
Royal Bhog	69.667	112.11	8.473	25.257	19.333	95.37	87.1	32.053	29.673	3.297	17.427
T-3	78.667	108.54	7.223	22.83	20.333	94.647	78.657	19.56	21.533	3.177	29.093
Moti Gold	100.333	84.57	9.4	21.227	19.333	189.38	86.743	51.857	33.437	3.48	20.727
Raghuvansi-4	101.667	89.9	6.737	23.983	21.143	137.947	82.827	43.33	26.983	2.28	14.21
Damini Delta	99.667	112.657	7.583	19.65	24	133.203	84.61	44.627	29.033	2.523	13.18
Kasturi	95.667	123.597	7.417	19.76	19	108.82	79.737	35.847	27.877	3.72	17.93
Vandana	97.667	121.003	6.76	21.513	20.667	107.433	84.167	35.773	28.53	3.28	15.87
NDR-2026 (Richa)	106.667	114.627	6.293	20.687	23.667	102.197	82.43	32.953	28.437	2.97	15.783
CSR-10	106	113.18	5.423	19.577	19.667	101.297	81.553	31.577	25.313	3.217	15.65
NDR-2064	110	140.623	6.873	24.29	17	111.29	57.29	52.963	24.957	3.953	20.243
Min.	69.66	82.62	5.42	18.69	15.33	75.9	57.29	17.04	21.53	1.76	10.01
Max.	113.33	143.55	12.49	29.6	33.33	189.38	92.37	52.96	43.53	3.95	29.09
Mean	**95.21**	**114.73**	**7.95**	**22.81**	**22.42**	**108.54**	**81.90**	**32.88**	**30.77**	**3.00**	**16.27**
C.D. @ 5%	**0.57**	**0.25**	**2.69**	**0.81**	**0.59**	**1.09**	**1.02**	**0.84**	**2.49**	**0.97**	**0.45**
SE(m)	**0.20**	**0.09**	**0.92**	**0.28**	**0.20**	**0.37**	**0.35**	**0.29**	**0.86**	**0.33**	**0.15**
SE(d)	**0.28**	**0.12**	**1.31**	**0.39**	**0.29**	**0.53**	**0.50**	**0.41**	**1.21**	**0.47**	**0.22**
C.V. @ 5%	5.57	1.60	3.50	0.89	0.34	12.22	4.74	0.50	7.51	1.90	4.36

Table 3. Genotypic (GCV) and phenotypic (PCV) coefficient of variation, heritability (h^2bs) and genetic advance in per cent of mean in rice genotypes.

Traits	Genotypic Coefficient of Variations	Phenotypic Coefficient of Variations	Heritability (%) (h^2b_s)	Genetic Advance	Genetic Advance as % means
Days to 50% flowering	11.988	12.412	93.286	22.711	23.853
Plant height (cm)	12.37	13.6	82.723	26.59	23.176
Productive tiller/plant	17.922	21.464	69.72	2.451	30.827
Panicle length (cm)	10.758	15.21	50.029	3.575	15.675
LAI (Leaf Area Index) cm	13.819	24.762	31.146	3.562	15.887
No. of fertile spikelet /panicle	21.152	25.884	66.78	38.649	35.608
Spikelet fertility (%)	7.772	8.932	75.702	11.409	13.929
Biological yield /plant (g)	31.002	34.88	78.998	18.665	56.763
H.I. (%)	15.281	17.754	74.086	8.337	27.095
L/B ratio (mm)	13.55	25.901	27.37	0.438	14.604
Grain yield/plant (g)	25.144	33.419	56.61	6.339	38.972

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Conclusion:

A wide range of phenotypic and genotypic coefficient of variability observed. The high magnitude (>20%) of PCV along with GCV observed for productive biological yield per plant (34.88), grain yield per plant (33.41%), L/B ratio (24.76) observed PCV while high GCV recorded in biological yield per plant (31.00%), grain yield per plant (25.14%), no. of fertile spikelet per panicle (21.15%). Moderate estimates of PCV along with GCV were recorded for harvest index (17.75%), panicle length (15.21%), plant height (13.6%) and days to 50% flowering (12.41%) and GCV were recorded productive tiller per plant (17.92%), harvest index (15.28%), leaf area index(13.81%), L/B ratio (13.55%), plant height (12.37%), days to 50% flowering (11.98%) and panicle length (10.75%). The magnitude of heritability in broad sense varied between 93.28% in case of days to 50% flowering to 27.37% in case of L/B ratio. The high estimation of heritability recorded into days to 50% flowering (93.28%) followed by plant height (82.72%), biological yield per plant (78.99%), spikelet fertility (75.70%). moderate estimates of heritability were reported for harvest index (74.08%), productive tiller per plant (69.72%), number of fertile spikelet per panicle (66.78%). while low estimates of heritability were reported in case of L/B ratio (27.37), leaf area index (31.14%). High heritability along with high genetics advance in percent of mean was recorded for days to 50% flowering indicating the preponderance of additive gene action.

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