Genotype x Environment Interaction and Yield-Stability Analysis of Rice (*Oryza sativa* L.) Grown in salt affected soil

ABSTRACT

This study was conducted during *Kharif*, 2019 At the Students Instructional Farm, MES and Agronomy Farm of A.N.D.U.A.T., Kumarganj, Ayodhya, the trials were set up in RBD with three replications. The experimental material comprised of 25 genotypes of rice were evaluated for 11 quantitative traits under three different environmental locations. High significant mean squares were found for all eleven research characteristics in the environment-specific analysis of variance and the pooled analysis of variance for three environments encompassing one crop season. T-3, Kavery Sampoorna, NDRK-11-27, Moti Gold, and NDRK-11-29 under irrigated circumstances were the genotypes demonstrating high mean performance for grain yield per plant and some of its significant components when considering the mean performance of genotypes under various environmental situations. Out of 25 genotypes tested in three conditions, T-3, Kavery Sampoorna, and NDRK-11-27 had the maximum grain yield per plant.In path coefficient analysis highest positive direct effects on grain yield per plant was exerted by L/B ratio (0.281), followed by panicle length (0.167), number of fertile spikelet per plant (0.092) and days to 50% flowering (0.037). On the other hand, negative direct effects on grain yield per plant was exerted by plant height (-0.255), leaf area index (-0.195), spikelet fertility (-0.187), biological yield per plant and harvest index (-0.126) and productive tillers / plant (-0.049). Positive indirect effects on spikelet fertility was recorded via biological yield per plant (0.040) followed by panicle length via biological yield per plant (0.264), productive tiller per plant biological yield per plant (0.021) and plant height via biological yield per plant (0.011).

Considering the mean performance and stability parameters, three high yielding genotypes T-3, Kavery Sampoorna and NDRK-11-27 merit due consideration for recommending their exploitation as cultivars or varieties for commercial cultivation and/or as donor for hybridization programme for wide range of environments pertaining especially to different environments. In addition to these genotypes, several other genotypes exhibiting high or average mean performance, desirable non- linear response and stable nature for different characters may also be useful for exploitation as parents in hybridization programme as donors for characters for which they showed superiority even if they had average or low grain yield per plant.

Keywords: *Oryza sativa* L, *Genotype x Environment, Stability,*

1. INTRODUCTION:

Rice (Oryza sativa L.) is an annual self-pollinated short-day plant of family Poaceae (Graminae) with chromosome number 2n=2x=24. Rice is the staple food of more than 2.7 billion people. Over 2 billion people in Asia alone derive 80% of their energy needs from rice (Juliano, 1985) . 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. Rice is cultivated worldwide over an area of about 153.51 million-hectare with annual production of 650.19 million tons. . India ranked first in area of 143 million ha, nearly 45.07 million ha is utilized for rice cultivation with a production of 122.27 million tonnes and average productivity of 2713 kg/ha (Agriculture Statistics at a Glance, 2021). Uttar Pradesh has the largest area of rice, i.e. 5.68 million ha, and covers 12.60 % of the total rice area in India with a production of 15.66 million tonnes. The productivity of rice in Uttar Pradesh is 2759 kg/ha. (Directorate of Economics and Statistics, 2021).

Analysis of yield stability and the genotype by environment (GxE) interaction have remained crucial in assessing the stability of a varietal and its appropriateness for cultivation through seasons and ecological zones. Despite the crop's importance, the study of the interactions between genotype and environment in rice agriculture, particularly inland swamp-based farming, has not gotten enough attention. Although McLaren and Chaudhary (1994) published a thorough investigation on GxE in rice, the study's global emphasis disguised several intricate genotypic and environmental subtleties unique to the ecologies where the crop is grown. As yield is a polygenically controlled character, the presence or absence of Genotype × Environment (GE) interaction largely determines the average response of the varieties. G × E interaction, linked with high yield suggests the suitability of variety in varying environments. But this ideal condition is rare and the varieties with high stability generally show low yield capacity and vice versa. Evaluating genotypes under various contrasting environments with uncertain variation is a recognized approach for choosing stable genotypes. A stable variety can be defined as the one having unit regression coefficient (b=1) and the least possible departure from the regression line (S2d=0) (Eberhart and Russel, 1966).

2. MATERIALS AND METHOD

This study was conducted during *Kharif,* 2019 At the Students Instructional Farm, MES and Agronomy Farm of A.N.D.U.A.T., Kumarganj, Ayodhya.The trials were set up in RBD with three replications The experimental material for the present investigation was comprised of 25 lines of rice germplasm along with 2 checks *viz.*, CSR-10, NDR-2064. Twenty-five diverse lines were evaluated at three different sodicity levels. 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, penicle length, leaf area index(cm^2), no of fertile spikelet per penicle,

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 Phenotypic stability analysis (Eberhart and Russell, 1966),

3. RESULT AND DISCUSSION:

The interactions of Genotypes x Environment are of major importance to plant breeders in developing novel crop varieties, to a target environment. In general, the environment is created due to differences in edaphic and climatic factors. The data collected on 11 plant characters of 25 genotypes over three different environments were subjected to stability analysis. Mean sum of squares due to genotype x environment interactions for all most all the characters viz., days to 50% flowering, no of effective tiller, plant height, panicle length, number of filled grains per panicle, spikelet fertility percent, grain yield per plant, L/B ratio, leaf area index, biological yield per plant and harvest index were significant. Hence, stability analysis for those characters was carried out according to Eberhart and Russel (1966) model after testing the homogeneity of error variances.These results are similar to those of Mosavi *et al*. (2013), Palanog *et al.* (2014).

The three stability parameters *viz.*, mean, regression coefficient (bi) and mean square deviation from regression line (S^2di) were estimated for all the eleven traits and the results obtained are presented trait wise in the Tables 2.

3.1 Days to 50% flowering

The genotypes Puas Basmati-1 had recorded highest mean value for days of 50% flowering. It possessed bi>1 and $S^2di=0$. It indicated thatgenotypes is stable for favorable environmental condition. While, Royal Bhog possessed bi>1 and $S^2di=0$. It means this genotype is stable for favorable environments. (Palanog *et al.* (2014), Vivekanandan and Subramanian (1994)

3.2 Plant height (cm)

The genotype CSR-1620 had recorded highest mean value for plant height. It possessed bi>1 and $S^2di=0$. This genotype is stable for favorable environments conditions. While, genotype KALANAMAK had bi<1. This genotype is stable for unfavorable environments. Ramalingam *et al.* (1990)

3.3 Number of productive tillers per plant

The genotypes Kavery Chintoo recorded highest mean value for productive tillers per plant. It possessed bi>1 and $S^2di=0$. It showed that this genotype is stable for favorable environmental conditions. However, CSR-10 possessed bi>1 and $S^2di=0$. It showed that this genotype is stable for favorable environments condition.(Krishnappa *et al.* (2009**)**

3.4 Panicle length (cm)

The genotypes Ideva had recorded highest mean value for panicle length. It possessed bi<1. It showed that this genotype is stable for unfavorable environmental conditions.

Genotype CSR-20 possessed bi>1. It showed that this genotype is stable for favorable environments conditions. (Vivekanandan and Subramanian (1994)

3.5 Leaf area index (cm^2)

The genotypes NDRK-11-30 reported highest mean value for leaf area index. It possessed bi<1. It showed that this genotype is stable for unfavorable environments. However, genotype Kavery Sampoorna possessed bi<1 and $S^2di=0$. It showed that this genotype is stable for unfavorable environmental conditions. **(**Vivekanandan and Subramanian (1994)

3.6 Number of fertile spikelet per panicle

The genotypes Moti Gold reported highest mean value for number of fertile spikelet per panicle. It possessed bi<1 and $S^2di=0$, it showed that this genotype is stable for unfavorable environmental conditions. Genotype CSR-13 possessed bi<1 and S^2di-0. This genotype showed stable for unfavorable environments conditions. The genotypes Pusa Basmati-1 reported highest mean value for spikelet fertility . It possessed bi<1 and $S^2di=0$, it showed that this genotype is stable for unfavorable environmental conditions. Genotype NDR-2064 possessed bi<1and $S^2di=0$. This genotype showed stable for unfavorable environments conditions**.** Mosavi *et al*. **(2013)**

3.7Biological yield per plant (g)

The genotypes NDR-2064 reported highest mean value for biological yield per plant. It possessed bi<1 and $S^2di=0$. it showed that this genotype is stable for unfavorable environmental conditions. Susk Samrat possessed bi<1 .This genotype showed stable for unfavorable environments conditions**.** (Ramalingam *et al.* (1990) Chaudhuri *et al*(1999)

3.8Harvest index (%)

The genotypes Kala Namak reported highest mean value for harvest index. It possessed bi<1. It showed that this genotype is stable for unfavorable environmental conditions. While, T-3 possessed bi<1 and $S^2di=0$ .This genotype showed stable for unfavorable environments conditions. *(*Ramalingam *et al.* (1990)

3.9L/B ratio (%)

The highest L/B ratio was registered in genotypes NDR 2064 (3.95) whereas the lowest L/B ratio was found in CSR-13 (1.76). Seventeen genotypes exceeded and seven genotypes were at par to the general mean (3.00). The genotypes NDR- 2064 reported highest mean value for L/B ratio. It possessed bi>1 and $S^2di=0$. It showed that this genotype is stable for favorable environmental conditions. While, CSR-13 possessed bi>1 and $S^2di=0$ .This genotype showed stable for favorable environments conditions.

3.10Grain yield per plant (g)

The T-3 recorded the highest grain yield (29.09g) whereas NDRK-11-30 registered the lowest grain yield per plant (10.01 g). Twelve genotypes showed above the general mean (16.27g). The genotypes T-3 reported highest mean value for grain yield per plant. It possessed

bi>1 and $S^2di=0$. it showed that this genotype is stable for favorable environmental conditions. While, NDRK-11-30 possessed bi>1 and $S^2di=0$. This genotype showed stable for favorable environmental conditions.(Chaudhuri *el al* (1999),Krishnappa *et al.* (2009)

4. Conclusion:

Considering the mean performance and stability parameters, the genotypes, Pusa Basmati-1, emerged as the most desirable genotype among the 25 genotypes.,T-3 produced highest grain yield per plant (29.09g) across three environments. , NDRK-11-30 showed average responsiveness (bi<1) for grain yield per plant with stable for unfavorable environments ($S^2di=0$) for grain yield per plant., Moti Gold was present in the top non-significant group for higher grain yield per plant alone thereby significantly out yielding the remaining 24 genotypes. The genotypes T-3 (29.09g), and Kaveri Sampoorna (24.84g) produced higher grain yield per plant. These genotypes had bi>1 and $S^2di=0$ showed non-linear and stable ($S^2di=0$) for favorable environment.

Table- 1 : The pooled analysis of variance for 11 characters of 25 rice genotypes across three environments

Source of variation	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**
Replication × Environment	4	35.23**	382.228**	1.5425**	11.011**	116.50*	700.1**	94.297**	363.68**	18.322**	1.15263**	110.754**
Genotype × Environment	46	19.78*	75.10**	4.377**	11.21**	1339**	22.33**	7.68**	15.94**	5.23**	0.12**	12.21**
Error	138	14.81	95.23	5.61	16.35	1678	44.34	8.29	18.88	6.22	0.17	6.20

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

Table 2: Stability analyses of 11 characters of rice genotype

Genotype	Days to 50% flowering			Plant height(cm)			Panicle length(cm)			Leaf Area Index (cm^2)			Productive tiller per plant		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
CSR-10	96.1489	0.8864	54.3925	105.8311	-1.5581	-141.384	24.7144	0.6522	-4.1837	28.5711	1.7131	-6.5032	10.9656	2.1397	-1.7365
CSR-13	93.0967	2.3946	-9.1081	107.0311	3.375	141.9836	24.72	1.361	11.5534	27.0322	4.1704	-7.3118	11.2811	-1.7086	-0.8406
CSR-1620	91.8289	1.074	6.3328	109.7078	1.8552	-188.309	25.6289	2.9928	17.947	26.3756	2.4133	-11.8447	11.0633	-1.1613	4.2406
CSR-20	94.8667	0.3236	27.1779	112.9422	5.8651	494.118	26.4144	2.1668	16.283	24.9844	2.8484	-4.3935	10.1556	1.219	-0.1871
CSR-27	93.6189	1.5441	-3.5397	104.1378	3.4747	-132.213	25.56	0.6217	-1.9337	26.1756	1.6956	-11.9916	11.1222	1.9606	-1.882
Damini Delta	93.0578	1.5285	4.8715	112.9022	0.1958	-188.842	24.1911	0.6192	-3.485	24.2257	0.4229	2.8295	9.4533	1.3842	-1.5644
Ideva	96.4522	0.2854	2.8655	103.3589	-2.7539	-189.194	23.9578	0.9774	28.972	25.8411	2.2484	9.8831	11.1989	2.3482	0.2965
Kala Namak	93.0433	2.2575	-12.7022	103.0911	-1.6664	249.7204	25.3289	0.9742	2.8316	24.6111	0.6543	-12.3927	10.47	-0.445	-1.9433
Kasturi	94.5411	0.9683	-13.3472	102.8622	-2.3579	-7.3069	25.4522	0.7292	-3.0981	25.2867	1.7637	-12.3763	11.6656	2.7669	2.6282
Kavery Chintoo	94.7811	0.267	-13.9681	93.3644	3.5501	-180.739	25.0278	1.3123	10.8636	24.82	1.0696	0.7442	10.0111	2.0601	-1.2395
Kavery Sampoorna	96.1589	0.5612	-9.3223	111.7144	-1.0287	158.0984	24.0189	2.2002	-4.9542	22.9222	-1.001	-11.8032	9.1656	1.5308	-1.9447
KR15100	97.7889	0.3105	-6.4314	104.9089	0.8476	-51.2659	23.5367	0.2497	11.6841	26.6956	4.5514	-11.5426	9.6422	2.1891	-1.9369
Moti Gold	95.1544	1.4773	4.0176	115.3989	0.9821	9.648	22.4256	-0.5322	0.8574	23.6244	0.8514	-12.1515	8.8922	3.006	-1.6255
NDR-2026(Richa)	90.2822	0.852	-12.0171	110.4122	1.9045	-65.9479	24.44	-0.7027	-2.667	26.5211	1.1575	-12.3966	10.6933	0.9076	0.9788
NDR-2064	92.5278	0.699	-12.503	108.6522	4.5045	14.0167	25.8633	0.91	-2.9716	29.3989	1.8962	-10.0402	10.5889	-1.2633	-1.1725
NDRK-11-29	97.5744	0.7608	3.17	103.0989	1.2866	-187.869	26.05	2.3348	3.6654	23.6889	-0.2844	3.6793	11.1644	-0.9025	3.7834
NDRK-11-30	94.2222	1.2015	-10.0108	104.8022	3.931	-68.2183	25.0644	1.5542	1.0169	25.4089	-0.9083	8.0825	10.7178	0.4487	-1.8602
NDRK-1127	97.8444	1.0962	-12.6873	111.26	3.5787	151.5448	24.4889	0.4033	-2.9094	23.8656	-0.1372	-11.6076	9.9133	-1.8284	-0.8584
NDRK-133	94.3822	1.1343	17.9474	106.5078	-0.6398	-169.525	24.5556	-0.7174	-4.0279	24.7656	-0.7025	18.0518	10.0456	1.5505	-1.207
PantDhan-10	92.3289	0.5187	-13.7535	104.1822	-1.9229	-160.279	26.7644	2.5557	-4.9698	23.5433	1.3736	-10.8171	9.6	-0.3259	-1.9164
Pusa Basmati-1	92.3456	1.6177	-6.5594	108.0422	4.5919	974.3598	25.54	1.293	-2.6763	24.7	0.8546	-9.8619	11.1	-1.9431	-1.7174
Pusasugandha-5	93.6978	1.5996	45.9442	104.5689	0.2331	111.5858	25.6144	1.136	-3.1843	25.8067	3.3103	-9.2153	9.3089	0.7367	-0.9964
Raghuvansi-4	95.9544	0.3228	61.6726	104.8233	-1.9202	826.216	25.2022	1.4894	-1.124	20.8256	-1.7287	-7.6689	10.2822	3.1297	2.7076
Royal Bhog	96.39	1.1246	-6.5442	114.0722	1.8648	-91.0509	24.0322	-0.2442	8.1447	26.1022	-2.2094	10.5584	10.8567	2.4104	-1.7244
Susksamrat	96.5289	1.0107	-0.3762	102.7656	4.0536	1438.165	24.5911	2.098	0.4168	21.9867	-0.4603	2.1987	10.6178	1.7509	-1.8762
T-3	96.2433	0.3619	10.8158	99.4278	-2.3808	452.5384	25.5211	0.0444	-4.7661	20.9811	-0.7633	27.0873	9.4211	2.0363	-1.7966
Vandana	95.26	0.8218	-3.3655	103.2922	-2.8656	-184.197	26.1667	0.5209	-4.8482	28.3833	2.2005	-10.1474	9.9589	3.0028	-0.2438

Genotype	No of fertile spikelet per panicle			Spikelet fertility (%)			L/B ratio (%)			Harvest index (%)		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
CSR-10	130.9722	0.025	-107824	80.6833	1.8849	-18.1437	2.6267	-0.114	-0.0629	41.5944	-0.2531	-18.836
CSR-13	119.1433	-0.2587	-106798	80.8278	-1.8717	6.6209	2.4578	1.8164	-0.0785	28.5444	0.4768	-35.0124
CSR-1620	104.21	0.0528	-107912	78.0378	1.806	0.9196	2.9056	2.1518	-0.0504	33.2956	0.1451	62.2698
CSR-20	1089.083	26.7844	-81213.8	79.3744	1.0199	7.6027	2.4878	0.2736	-0.1019	36.2789	1.4367	175.0629
CSR-27	121.4622	-0.1433	-107882	74.5867	1.2383	-30.4167	2.6367	1.6982	-0.0177	35.8833	0.618	-35.3243
Damini Delta	120.5522	0.1935	-107128	82.0889	0.2002	-33.5696	2.6244	-0.8707	-0.0316	38.8989	0.3984	-11.0421
Ideva	113.4033	0.2285	-107825	73.9944	5.3908	-1.4751	2.7344	-0.4019	-0.0837	40.7878	3.1651	-35.704
Kala Namak	116.3656	0.0181	-107606	84.4733	1.3162	-33.127	2.8122	-0.5471	-0.0876	32.5689	-0.7726	15.4794
Kasturi	131.5556	0.1782	-107670	82.7274	0.5388	-10.8604	2.6878	2.1361	-0.1033	33.9089	-1.8746	-38.4133
Kavery Chintoo	119.6856	-0.0849	-107464	81.3478	-0.2969	-31.1247	2.8856	1.6265	-0.0615	33.8289	4.1474	1.9371
Kavery Sampoorna	109.5133	0.4577	-107741	76.3322	2.664	-33.0348	2.8311	2.0417	-0.0621	30.0133	1.5625	-23.0983
KR15100	119.78	-0.0699	-107713	71.9767	-0.1575	-8.6524	2.9122	0.8669	0.0125	34.48	0.9093	347.1764
Moti Gold	122.0233	0.0153	-107916	80.3878	2.102	-25.5893	2.8167	1.6928	-0.0862	35.4022	1.1409	-32.1861
NDR-2026(Richa)	126.2033	-0.0822	-107917	81.2233	1.1889	-29.3365	2.69	0.9237	-0.0897	37.1989	1.6907	36.4813
NDR-2064	124.4656	0.0903	-107649	82.3889	-1.4506	-20.5651	2.6144	1.0366	-0.0655	33.9711	1.6164	1.9931
NDRK-11-29	118.2256	-0.2829	-107606	82.2344	1.8736	-33.9476	2.8389	0.6869	-0.1035	36.9656	-0.1838	-36.4208
NDRK-11-30	106.3789	-0.1593	-107892	82.4322	-0.3922	-27.6319	2.6089	0.3511	-0.1019	32.4533	1.7878	30.9379
NDRK-1127	115.0089	-0.2491	-107494	82.1556	1.3943	37.2757	2.7311	2.5132	-0.0917	38.83	1.2125	-30.5953
NDRK-133	115.59	-0.1572	-107911	79.6656	1.5542	-32.888	2.7889	0.5981	-0.1047	39.9056	3.0564	-30.538
PantDhan-10	110.7533	0.0775	-107665	81.4189	-0.6812	-12.2214	2.6956	-0.3154	-0.1053	33.1644	1.3102	-33.0319
Pusa Basmati -1	116.9678	-0.1262	-107811	83.8978	-0.4669	-29.1786	2.7044	-1.398	0.0572	28.54	0.0857	18.9286
Pusasugandha-5	120.9956	0.198	-107687	70.1533	6.5576	-32.5902	2.8289	0.1905	-0.0985	33.1256	0.7948	97.4765
Raghuvansi-4	106.4489	0.2366	-107906	81.24	0.415	8.6247	2.7656	3.7792	-0.1053	33.6233	0.52	-39.1558
Royal Bhoga	117.6533	-0.1112	-106471	83.9844	-1.0026	-15.1438	2.8867	1.9078	0.2741	37.1056	1.6062	-38.3822
Susksamrat	107.1244	0.3542	-107888	84.2722	1.353	-32.4697	2.3367	1.2116	-0.0621	37.2511	1.9611	-5.4373
T-3	121.17	-0.0922	-106694	82.6911	0.1912	-30.9198	2.6744	4.2859	0.0877	33.6444	0.5452	-39.1415
Vandana	133.2211	-0.0929	-107884	77.8166	0.631	-27.7769	3.0433	-1.1416	-0.1038	36.2244	-0.1033	84.7498

Genotype	Biological yield per plant (g)			Grain yield per plant (g)		
	Mean	Bi	S2di	Mean	bi	S^2di
CSR-10	45.69	-0.4685	-48.8701	18.3667	-0.6131	-6.0296
CSR-13	49.0567	0.3779	33.7243	13.6878	0.3793	1.4538
CSR-1620	45.55	1.04	-48.8339	15.1101	0.3607	20.6599
CSR-20	47.5211	0.7258	-47.8649	16.5544	1.6927	26.4663
CSR-27	45.5256	-0.016	17.8061	15.4311	-0.0049	3.2257
Damini Delta	47.6467	-1.3006	-44.9021	18.0067	-0.5515	1.5971
Ideva	44.8311	0.5713	37.6671	17.0789	1.9247	-2.9241
Kala Namak	40.3322	3.2688	-30.5768	12.3411	0.8119	-3.8926
Kasturi	47.3689	2.9546	-30.465	15.8611	0.1479	-2.8447
Kavery Chintoo	48.1489	0.6725	-45.0207	15.0333	2.5629	-5.8382
Kavery Sampoorna	48.0822	2.5352	-32.5796	14.1633	1.756	-4.5126
KR15100	45.0389	-0.0852	18.5527	14.9078	0.5728	24.5024
Moti Gold	47.57	1.1778	1.3683	16.6378	1.3378	15.2699
NDR-2026(Richa)	50.2278	-0.0552	-45.1778	17.4889	0.7956	-1.1018
NDR-2064	49.62	-1.5818	-48.5165	16.5344	0.6052	3.1239
NDRK-11-29	43.6211	2.4596	-5.146	15.5244	0.9196	-3.8419
NDRK-11-30	49.1356	-0.3919	-48.8027	15.63	1.1323	13.6494
NDRK-1127	44.6356	1.8638	-28.8295	17.2211	1.5977	-6.0511
NDRK-133	39.79	-1.4397	-48.8613	15.2922	1.0197	-5.8529
PantDhan-10	47.0344	3.2605	-48.0043	15.2933	2.2316	-2.4911
Pusa Basmati-1	46.6422	2.7128	-48.7355	12.4	1.138	8.9568
Pusasugandha-5	45.6833	2.3045	104.5142	14.6111	1.2868	-4.9975
Raghuvansi-4	41.9589	1.4542	-43.9991	13.7533	1.0163	-5.5789
Royal Bhog	46.4667	2.027	39.4448	17.4222	2.0069	8.4813
Susksamrat	47.1178	-0.2309	100.4813	17.0667	1.1372	-1.9478
T-3	49.16	2.7341	-9.0611	16.62	1.6103	-0.3199
Vandana	48.8933	0.4293	-41.0803	17.7489	0.1252	11.8609

References:

Agriculture Statistics at a Glance, 2021

Chaudhuri, R. K., Panda, P. K., Das, B. P., Mahapatra, U. S., & Mukherjee, D. (1999). Relativistic coupled-cluster-based linear response theory for ionization potentials of alkali-metal and alkaline-earth-metal atoms. *Physical Review A*, *60*(1), 246

Directorate of Economics and Statistics, 2021

Eberhart, S.A. and Russel, W.A. (1966).Stability Parameters for Comparing Varieties. Crop Science. 6(1): 36-40.

Juliano, B.O. (1985). Criteria and Tests for Rice Grain Qualities. In: Rice Chemistry and Technology, 2nd Edition, American Association of Cereal Chemists, 443-524.

Krishnappa, M. R., Chandrappa, H. M., & Shadakshari, H. G. (2009). Stability analysis of medium duration hill zone rice genotypes of Karnataka. *Crop Research (Hisar)*, *38*(1/3), 141-143.

McLaren CG, Chaudhary C (1994). Use of additive main effects and multiplicative interaction models to analyse multilocation rice variety trials. Paper presented at the FCSSP Conference, Puerton Princesa, Palawan, Philippines

Mosavi, S. A., & Kenarehfard, M. (2013). The impact of value creation practices on brand trust and loyalty in a Samsung galaxy online brand community in Iran. *International Journal of Mobile Marketing*, *8*(2), 75-84.

Palanog, A. D., Swamy, B. M., Shamsudin, N. A. A., Dixit, S., Hernandez, J. E., Boromeo, T. H., ... & Kumar, A. (2014). Grain yield QTLs with consistent-effect under reproductive-stage drought stress in rice. *Field Crops Research*, *161*, 46-54.

Ramalingam, A., Muralidhar, V., & Sheriff, N. M. (1990). Combining ability studies in sesame. *Journal of Oilseeds Research*, *7*(2), 75-77.

Ramalingam, J., Vivekanandan, P., Vanniarajan, C., & Subramanian, M. (1994). Heterosis in early rice. *Ann. Agric. Res*, *15*(2), 194-198.