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Studies on Gene Action for Yield and its Components Traits in Rice (*Oryza sativa* L.) for Sodicity Tolerance

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ABSTRACT: The present investigation was based on evaluation of a line × tester set of 60 hybrids (F1s) and their 20 parents along with two checks (Narendra Usar 2009 and IR 28) for thirteen characters. In general, PCV were higher than the GCV for all characters under sodic soil. Nine traits emerged as most important associates of grain yield per plant under sodic soil. The mean square due to lines representing additive effects and G.C.A. are significant for all characters. For grain yield per plant, lines NDRK 50057, Narendra Usar 2009, CSR 36, NDRK 50037, IRRI 123, NDRK 50036, NDRK 50045, NDRK 50055 and NDRK 50063 and testers, Jaya and Sarjoo 52 were identified as good general combiners in sodic soil for Grainyield per plant and several other important traits to emerge as valuable parents for hybridization programme for obtaining High yielding pure line/hybrid varieties. The most desirable crosses show showing high mean performance and high and significant heterosis of positive Nature one or both types for grain yield per plant as well as sum of its components traits where CSR 36 X Jaya, Narendra usar 209 X sarjoo 52, CSR 36 X 252, NDRK 50057 X Saju 52, NDRK 50057 X Jaya, NDRK 50057 Narendra 5026, IRRI 123 X jaya, NDRK 50037 X jaya, NDRK 50055 x sarjoo52 and NDRK 50037 x Narendra 5026 under sodic soil.

Keywords: Heritability, path analysis, line × tester, sodic soil

INTRODUCTION

Rice (*Oryza sativa* L.) belongs to family Gramineae (Poaceae). The cultivated rice belongs to genus *Oryza* and there are about 24 species of rice distributed in tropical, sub -tropical and warm temperate regions of the world. The *Oryza sativa* is divided into three sub-species, namely, *Indica*, *japonica and Javanica* rice is one of the most important staple food of developing world as well as majority of Asian countries. In the year 2016, the top three producers were China, India and Indonesia producing 31, 20 and 9 percent of the world' Rice production, respectively more than 90% of the world's rice is grown and consumed in Asia, known as rice bowl of the world 60% of the earth's people live. Uttar Pradesh is an important rice growing state. In land salinity areas are mainly concentrated in Raibareilly, Azamgarh, Sultanpur, Faizabad, Lucknow, Unnao and Pratapgarh districts. Development of high yielding varieties required the sufficient knowledge of existing variability with good transmitting ability that gives the better scope of selection. In contrast, the character with low GCV, PCV, heritability and genetic advance may be used in heterosis breeding (Table 1). The choice of parents especially for crop breeding largely depends on their combining ability and mean performance. Study of GCA effects (Shukla and Pandey, 2008) helps in selection of superior parents and SCA effects (Bano and Singh, 2019) for superior hybrids. Hybrid rice Technology has also showed increased yield farmer profitability and better adaptability to stress environment such as water scarcity. Keeping these facts in views the present investigation has been planned to fulfill the following objectives:

1. To study the combining ability variances and their effects.
2. To find out gene action (Pradhan *et al.*, 2006) involved in the inheritance of various characters.
3. To estimate heterosis (Tripathi *et al.*, 2018) over better parent and standard variety.
4. To identify promising parents for exploitation in breeding program and superior hybrids (Radha Devi *et al.*, 2002).

5. To study the genetic variability (Shrivastava *et al.,* 2015) for different traits in rice genotypes under sodic soil.
6. To work out correlation and path coefficients (Kumar and Verma, 2015) between yield and its component traits.

MATERIAL AND METHODS

The present investigation entitled "Studies on gene action for yield and its component traits in rice (*Oryza sativa* L.) For sodicity tolerance" Kumar *et al.,* (2007) was conducted at Genetics and plant breeding Research Farm of N.D. university of Agriculture and Technology, Narendra Nagar (kumarganj), Faizabad. A line × tester Arunachalam (1974) set of 60 hybrids (F1 s) was derived by crossing twenty lines (females) with three high yielding testers (males) viz., Narendra 5026, Jaya and Sarjoo52 during *kharif,* 2014. The twenty lines were Narendra 3112-1, NDRK -50036, NDRK-50057, A69-1, CSR-28, NDRK-50037, Narendra Usar 2009, NDRK-50033, NDRK-50033, NDRK -50046, CSR-36, NDRK-50055, NDRK 50029, NDRK-50063, NDRK-50045, IR13T 146l, Narendra 2064, NDRK-50051, Pusa Basmati, IRRI 123 and IR13T143. The 60 F1 S along with their parents and check varieties Narendra dhan 3 and I are 28 when evaluated in randomised complete block design with three replications during kharif 2015 single row plot of 3cm length where used for transplanting single Seedling for him for each genotype (Lussewa *et al.,* 2016) treatment in each replication following intra and inter row spacing of 15cm and 20cm respectively recommended cultural practices where followed to raise a good crop.

RESULTS AND DISCUSSION

ANOVA carried out for 13 character (Table 1) for 20 lines,3 tester, and 60 f1s. Among parents minimum and maximum grains per panicle where recorded in NDRK 50045 (67.00) and CSR 36 (142.73), respectively. Among parents, minimum and maximum harvest index was recorded in IR13T146 (37.21%) and Narendra 3112-1 (42.53%), respectively. The magnitude of phenotyping coefficient of variation was higher than the corresponding genotype coefficient of variation for all the traits. Heritability and genetic advance observed (Shukla and Pandey, 2008). The characters like grain yield per plant biological yield grains per panicle bearing tillers per plant spikelets per Panicle L:B ratio and flag leaf area. The phenotypic correlation coefficients and genotype correlation coefficients for 13^{th} rates were analysed in the F1 of 60 cross combinations and their 23 parents the estimates of genotype correlation Coefficient for higher than the corresponding phenotypic correlations (Dhurai *et al.,* 2016). Positive direct effect is best shown by biological yield per plant (0.867) grains per panicle (0.649) and harvest index (0.191). In the phenotypic path analysis, spikelets fertility exerted high order positive indirect effects (Table 2) on grains yield per plant via biological yield per plant (0.634), harvest index (0.119) and grains per panicle (0.105). In sodic soil, estimates of sca variances were higher than the corresponding estimates of gca variance for all the traits. The values of average degree of dominance were more than unity (>1) revealing over dominance for all characters. Among lines, Narendra Usar2009 (1.55), CSR 36 (1.36), IRRI 123 (1.06), CSR 28 (0.98), NDRK 50055(0.97) and NDRK 50057 (0.95) had significant positive gca effects for harvest index. As early flowering being desirable, the negative and significant estimates gca effects where considered as desirable for crosses. The heterobeltiosis for harvest-index varied from -9.51 (NDRK 50033 x jaya) to 11.58% (IRRI 123 x jaya) with the mean heterosis of 2.48%. For grain per plant the heterosis (Mani, 2013) over better –parent. Varied from-37.78(CSR 28 x Narendra 5026) to 58.14 per cent (CSR 36 x jaya) with mean heterosis of 6.32%. Twelve parents, 28 crosses and one check (IR 28) were found moderately resistant against blast while 18 parents,29 crosses and one check (IR 28) were found moderately resistant against BLB. Fifteen parents,25 crosses and 1 check (IR 28) showed moderately resistant response against brown spot (Rajpurohit *et al.,* 2011), while fifteen parents,37 crosses and one check (IR 28) recorded moderate resistance against leaf folder (Waheed *et al.*, 2015) (Table 2).

Estimate of heritability help in estimating expected progress through selection. Broad sense heritability and narrow sense heritability both have immense significance. The highest limits of genotype and phenotype the coefficient of variation (Mall *et al.,* 2005) and high heritability in broad sense along with very high genetic advance in percent of main were recorded for grain yield per plant (Chauhan *et al.,* 2016). In general the process showing significant and desirable is combining ability effects (Latha *et al.,* 2013) where associated with better but safe performance for respective trades the parents and crosses exhibiting immune resistant or moderately resistant response to the disease and pest studied (Rana *et al.*, 2016) in the present study may be considered for further exploitation for breeding purpose.

Table 1: Estimation of Genotypic correlation coefficient between 13 characters in rice under sodic soil.

Characters	Plant Height (Cm)	Flag leaf (cm^{-2})	Panicle Bearing tillers per plant	Panicle Length (Cm)Ch aracters	Spikelets per panicles	Grains per panicles	Spikelets fertility (%)	1000-grains weight (g)	Biological Yield Per plant (g)	Harvest index
Days to 50% flowering	0.225	-0.342	-0.270	- 0.019	- 0.092	-0.156	-0.301	-0.215	-0.225	-0.186
Plant height (cm)		0.093	0.024	0.198	0.027	0.30	0.055	0.059	0.116	0.031
Flag leaf area (cm^{-2})			0.291	0.34 8	0.326	0.396	0.421	0.147	0.332	0.397
Panicle bearing tillers per plant				0.667	0.444	0.586	0.733	0.543	0.729	0.588
Panicle length (cm)					0.485	0.552	0.480	0.327	0.550	0.420
Spikelet per panicles						0.965	0.431	0.316	0.354	0.418
Grains per panicle							0.647	0.446	0.541	0.559
Spikelet fertility (%)								0.618	0.833	0.708
1000-grains weight (g)									0.600	0.620
Biological yield per plant (g)										0.5389
Harvest index (%)										

Table2: Estimation of direct and indirect effects of 12 characters on grain yield per plant at phenotypic level in rise under sodic soil.

Characters	Days to 50% flowering	Plant height (cm)	Flag leaf area (cm)	Panicle length (cm)	Spikelets per panicles	1000-grains weight (g)	Biological yield per plant (g)	Harvest index (%)	L:B ratio	Correlation with grain yield per plant (g)
Days to 50% flowering	**0.007**	-0.000	0.001	0.000.	0.12	0.002	-0.191	-0.36	0.000	-0.222*
Plant height (cm)	0.001	**-0.002**	0.000	-0.001	-0.001	-0.000	0.075	0.006	0.000	0.079
Flag leaf area (cm^{-2})	-0.002	-0.000	0.**003**	-0.001	-0.041	-0.001	0.269	0.062	-0.00	0.334**
Panicle bearing tillers per plant	0.001	-0.000	0.001	-0.004	-0.059	0.002	0.576	0.092	0.000	.668**
Panicle length (cm)	-0.000	-0.000	0.001	**-0.008**	-0.054	-0.002	0.398	0.068	0.000	0.461**
Spikelets per panicles	0.000	-0.000	0.001	-0.003	**-0.149**	-0.005	0.289	0.072	0.000	0.755**
1000 – grains weight (g)	0.001	-0.00	0.000	-0.003	-0.143	**0.010**	0.458	0.107	0.000	0.558**
Biological yield per plant (g)	0.001	-0.00	0.001	-0.003	-0.048	-0.005	**0.897**	0.074	0.000	0.971**
Harvest-index (%)	**0.000**	-0.00	0.001	-0.002	0.044	-0.004	0.277	**0.239**	0.000	0.516**
L:B ratio	0.00	-0.000	-0.0	-0.000	-0.002	-0.044	0.07	-0.003	**0.003**	0.114**

SUMMARY AND CONCLUSION

60crosses generated by crossing 20 lines with three testers during kharif 2014 and the hybrid along with parental lines and check varieties were evaluated during kharif 2015 and the Research Farm of department of genetics and plant breeding of N.D. University of Agricultural and Technology Narendra Nagar Kumarganj, Faizabad. Path analysis identified biological yield (Kumar & Verma 2015) as per plant harvest index and grains per panicle as most important and contributing traits are components and speculate fertility in general PCV where higher than GCV for all characters and sodic soil. SCA variances may higher than GCA variances (Dharwal *et al.*, 2017) for all the characters in sodic soil indicating predominance of non additive gene action. There is variability (Basavaraja *et al.*, 2013) in the estimate of heterobeltiosis and standard heterosis. In the positive and negative direction observed for grain yield per plant.

In case of disease and insect 9 parents and 4 crosses where found immune against blast while one parent for Cross is where found immune against BLB. The most desirable cross showing high main performance and high and significant heterosis (Bhandarkar *et al.*, 2005) is positive Nature one or both types for grain yield per plant as well as some of its component trait for CSR 36 X Jaya Narender USAR 2009 X sarjoo52 CSR 36 X sarjoo 52 NDRK 50057 X Jaya, NDRK 50057 X Narendra 5026, IRRI 123 x Jaya, NDRK 50037 x Jaya, NDRK 50055 x sarjoo52 and NDRK 50037 x Narendra 5026 under sodic soil. There is a possibility of breeding more tolerant rice varieties then existing tolerant varieties through multiple or cumulative crosses of tolerant genotypes with Agronomically adapted high yielding rice varieties (Rambabu *et al.*, 2016).

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