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Unrevealing the relationship between grain yield and yield related traits in rice (*Oryza sativa* L.) genotypes under alkalinity condition

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Abstract
The present research work was conducted at Crop Research Farm, Nawabganj and Seed Multiplication Farm Bojha, Chandra Sheker Azad University of Agriculture and Technology, Kanpur (U.P.) India at high and normal salt stress soil condition to study Correlation coefficients analyses during *kharif 2018 and* 2019 among the 100 rice genotypes including six standards (checks) varieties *viz*., CSR10, CSR36, CSR43, Usar Dhan 3 for salinity and alkalinity tolerant, while IR64 and PUSA 44 as salt stress sensitive were grown in Augmented Randomized Block Design as parents for developing new rice varieties to break the yield barrier under *sodic* land. The correlation analysis revealed that all the traits such as day to 50% flowering, Days to maturity, Plant height, Panicle bearing tillers/plant, Panicle length, Spikelets /panicle, Grains/panicle, Spikelet fertility, Biological yield/plant, Grain yield/ plant, Harvest index, Stress score at reproductive phase and 1000-grain weight have the positive contribution to grain yield except Stress score at vegetative stage under pooled environment of alkalinity condition. The genotypes IL 773 followed by IL444, IL 105, IL 277, IL 891, IL 125, IL 344, IL 1121 and IL655 64 were found to be the promising genotypes for yield and yield contributing traits.

Keywords: salt stress condition, genotypes, check varieties, pooled, correlation, stress score, biological yield, hybridization

Introduction
Frontline Rice (*Oryza sativa* L.) occupies a pivotal place in Indian agriculture, as it forms the staple food for two-thirds of the population, provides 43 per cent calories requirement and 20-25% agriculture income. More than 90 per cent of the world's rice is grown and consumed in Asia, known as rice bowl of the world, where 60 per cent of the earth's people and two third of world's poor live (Khush and Virk, 2000) [6]. Salinity and alkalinity are growing problems worldwide. It can either be natural or primary or secondary or men made salinity. Primary salinity of soil and ground water is due to the weathering of naturally saline rocks or by deposition of oceanic salt carried by the wind and rain affects 130 m ha out of the global land area (Szaboles 1994). Secondary salinity is due to human-activities like unreliable irrigated schemes and source of water. Successive salinity in the soil has the divesting effect on plant growth reducing crop yields worldwide that leads complete crop failure in worst affected areas.

Economic product of rice is the grain yield, which exhibits complex genetics as it is influenced by various yield contributing characters and the environment. In general, increased number of panicles is the single most important yield component associated with rice yield, number of spikelets/panicle; percent grains/panicle are also of secondary and tertiary importance (Jones and Synder, 1987) [3]. These yield contributing components are interrelated with each other showing a complex chain of relationship and also highly influenced by the environmental conditions (Prasad *et al*., 2001) [9]. Breeding strategy in rice mainly depends upon the degree of associated characters as well as its magnitude and nature of variation (Zahid *et al.*, 2006 and Prasad *et al*., 2001) [14, 9]. Therefore, information about the yield contributing traits is of immense importance to the plant breeders for the development of improved varieties/ lines of rice with increased yield potential. Moosavi *et al*. (2015) [7] reported that grain yield is a complex trait, quantitative in nature and a combined function of a number of constituent traits. Consequently, selection for yield may not be satisfying without taking into consideration yield component traits.

Thus, positives correlated between yield and yield components are requires for effective yield component breeding increasing grain yield in rice (Ogunbayo *et al*., 2014) [8]. So, it is important for plant breeders to understand the degree of correlation between yield and its components. The degree of relationship and association of these components with yield can be measured by correlation coefficients. In the light of the above scenario, the present investigation is carried out with the objective of studying the character associations in rice for yield improvement under high and normal salt stress condition.

Materials and Method

The experiment was conducted during year *2018* and 2019, at Crop Research Farm, Nawabganj and Seed Multiplication Farm Bojha, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) India. experimental material comprised of one hundred genotypes of cultivated rice and six standard check varieties (PUSA36, CSR10, CSR36, CSR43, IR64, Usar Dhan 3) as salt stress sensitive in Augmented Randomized Block Design with replications of check under four environments taking into consideration of soil types and days of sowing. The details of the environments are given below:

Environments

E-1: Environment I, Year 2018, high stress, pH 9.36, Ec 1.59 dsm^{-1}, Seed Multiplication Farm, Bojha

E-2: Environment II, Year 2018, Normal stress Year 2019, pH 8.5, Ec0.93dsm^{-1} CRF, Nawabganj,

E-3: Environment III, Year 2019, high stress, pH 9.48, Ec1.63 dsm^{-1}, Seed Multiplication Farm, Bojha,

E-4: Environment IV, Normal stress Year 2019, pH 8.7, Ec 0.98dsm^{-1} CRF, Nawabganj. experimental field was divided into ten blocks of equal size and each block had sixteen plots. Out of sixteen plots in a block, ten plots were used for accommodating the test genotypes which were not replicated while remaining six were allocated to checks i e PUSA36, CSR10, CSR36, CSR43, IR64, Usar Dhan 3. The six checks were randomly allocated along with the test genotypes in a block Each genotype was grown in seven-row, 01m length following row to row and plant to plant spacing of 15 cm and 15 cm respectively. Recommended cultural practices were practiced to raise a good crop. Data was recorded from fourteen selected plants on traits viz., Days to 50% flowering, Days to maturity, Plant height (cm), Stress score at vegetative stage, Panicle bearing tillers/plant, Panicle length (cm), Spikelets/panicle, Number of grains/panicle, Spikelet fertility (%), Biological yield /plant, Grain yield / plant (g), Harvest index (%), Stress score at reproductive phase, 1000- grains weight. Estimation of phenotypic (rp) and genotypic (rg) correlation coefficients were estimated by the formula suggested by Searle, (1961).

Results and Discussion

Correlation coefficient is a measure of the degree of association and relationship between two variables. In a distribution if the change in one variable effects a change in the other variable, the variable are said to be correlated. Correlation is very important tool in plant breeding because we can use indirect selection to improve another targeted parameter. There is positive and negative effect in correlation which results in simultaneous changes in related character. Genotypic correlation between fourteen parameters of 100 genotypes of rice is illustrated in Table 1. The relationship at genotypic level or genotypic correlation, involves the genetic effect of the traits (Sughroue and Hallauer, 1997) [11].

Day to 50percent flowering has positive significant correlation with all the traits except stress score at vegetative stage (0.46), panicle length (0.03), stress score at reproductive phase (0.51) where it showed negative significant correlation (Table -1). The observed positive correlation of date to 50% flowering was supported by earlier researchers such as Zhou et al. (2010) [15] and Khan et al. (2014) [5] for number of panicle. Day to maturity has positive significant correlation with all the character except stress score at vegetative stage (0.17) and stress score at reproductive phase (0.23), Stress score at vegetative stage has positive significant correlation with stress score at reproductive phase(0.95), where as it was found negative significant correlation with rest of the traits, The traits harvest index(0.93) and 1000-grain weight(0.88) was found to be positive significant correlated with grain yield per plant and negatively significant with stress score at reproductive phase(0.73). The above findings of strong positive associations between yield and components are in agreement with the available literature in rice (Yadav *et al.*, 2011; Yadav *et al.*, 2012; Ratna *et al.*, 2015; Akhilesh Kumar Yadav *et al.*, 2016; Kalyan *et al.*, 2017 and Prakash *et al.*, 2018) [12, 13, 10, 1, 4, 2].

Conclusion

The correlation analysis revealed that all the traits such as day to 50% flowering, Days to maturity, Plant height, Panicle bearing tillers/plant, Panicle length, Spikelets/panicle, Grains/panicle, Spikelet fertility, Biological yield/plant, Grain yield/ plant, Harvest index, Stress score at reproductive phase and 1000-grain weight have the positive contribution to grain yield except Stress score at vegetative stage under pooled environment of alkalinity condition.

The genotypes IL 773 followed by IL444, IL 105, IL 277, IL 891, IL 125, IL 344, IL 1121 and IL655 64 were found to be the promising genotypes for yield and yield contributing traits. So, these genotypes may be considered as the selection criteria for the improvement of grain yield in rice as donor parents in hybridization programme under Alkalinity.

Table 1: Correlation Coefficient of 14 characters under study for pooled over environment

	Days to 50% flowering	Days to maturity	Plant height	Stress score at vegetative stage	Panicle bearing tillers/ plant	Panicle length	Spikelets /panicle	Grains /panicle	Spikelet fertility	Biological yield/ plant	Grain yield/ plant	Harvest index	Stress score at reproductive phase	1000-grain weight
Days to 50% flowering	1.00													
Days to maturity	0.69***	1.00												
Plant height	0.59***	0.24**	1.00											
Stress score at vegetative stage	-0.46***	-0.17*	-0.42***	1.00										
Panicle bearing tillers/plant	0.52***	0.31***	0.48***	-0.89***	1.00									
Panicle length	-0.03	0.04	0.04	-0.14	0.14	1.00								
Spikelets /panicle	0.35***	0.20*	0.33***	-0.66***	0.69***	0.24**	1.00							
Grains /panicle	0.35***	0.13	0.40***	-0.73***	0.76***	0.27***	0.89***	1.00						
Spikelet fertility	0.10	-0.11	0.24**	-0.33***	0.35***	0.15	0.04	0.49***	1.00					
Biological yield/plant	0.57***	0.42***	0.45***	-0.69***	0.79***	0.01	0.60***	0.60***	0.14	1.00				
Grain yield/ plant	0.49***	0.19*	0.54***	-0.93***	0.92***	0.12	0.74***	0.82***	0.38***	0.74***	1.00			
Harvest index	0.34***	0.03	0.46***	-0.88***	0.80***	0.17*	0.67***	0.77***	0.43***	0.45***	0.93***	1.00		
Stress score at reproductive phase	-0.51***	-0.23**	-0.47***	0.95***	-0.89***	-0.10	-0.67***	-0.74***	-0.34***	-0.73***	-0.93***	-0.85***	1.00	
1000-grain weight	0.54***	0.30***	0.48***	-0.86***	0.85***	0.03	0.61***	0.65***	0.24***	0.77***	0.88***	0.75***	-0.88***	1.00

* 95% level of significance,
** 99% level of significant and
*** 99.99% level of significant

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