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Correlation coefficient analysis of grain yield and yield related traits in rice (*Oryza sativa* L.) genotypes under alkalinity condition

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Abstract
In order to study correlation coefficients analyses among 100 rice genotypes, including six standards (checks) varieties-CSR10, CSR36, CSR43, and Usar Dhan 3-for salinity and alkalinity tolerant soil conditions, the current research was carried out at Crop Research Farm, Nawabganj, and Seed Multiplication Farm Bojha, Chandra Sheker Azad University of Agriculture and Technology, Kanpur (U.P.), India. Meanwhile, IR64 and PUSA 44, which are sensitive to salt stress, were grown in expanded randomised block design as parents for developing new rice varieties to overcome the yield barrier under sodic land. The correlation study showed that every characteristic, including days to 50% flowering, days to maturity, height of the plant, number of tillers per plant, length of the plant, number of spikelets per panicle, number of grains per panicle, and fertility of the spikelets, With the exception of the stress score during the vegetative stage in a pooled environment with alkalinity conditions, biological yield/plant, grain yield/plant, harvest index, stress score during the reproductive phase, and 1000-grain weight all positively contribute to grain yield. In terms of yield and features that contribute to yield, the genotypes IL 773, IL444, IL 105, IL 277, IL 891, IL 125, IL 344, IL 1121, and IL655 64 were determined to be the most promising.

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

Introduction

Front row In Indian agriculture, rice (*Oryza sativa* L.) plays a key role since it is the staple diet for two thirds of the population, supplies 43% of the energy needed, and generates 25% of the country's agricultural income. Asia, also referred to as the "rice bowl of the world," is home to two thirds of the world's poor and 60% of the world's population. There, more than 90% of the world's rice is produced and consumed. Alkalinity and salinity are becoming global issues. Salinity can be man-made, primary, secondary, or natural. The weathering of naturally saline rocks or the deposition of sea salt brought on by wind and precipitation causes the primary salinity of soil and ground water. Human activities such as erratic water sources and irrigation systems are the cause of secondary salinity. Consecutive salinity in the soil has a depressing effect on plant growth, lowering crop yields globally and, in the worst-affected places, leading to total crop failure. Grain yield, the economic result of rice, is complexly genetically regulated by a variety of yield contributing features and environmental factors. The most significant yield component linked to rice yield is generally an increase in the number of panicles; the percentage of grains per panicle and the number of spikelets per panicle are also of secondary and tertiary value (Jones and Synder, 1987) [3]. According to Prasad *et al*. (2001) [9], these yield-contributing elements are extensively influenced by the environment and are connected to one another in a complicated chain of relationships. In rice, the degree of linked features as well as the kind and amount of variation are the primary determinants of breeding strategy (Zahid *et al*., 2006 and Prasad *et al*., 2001) [14, 9]. Thus, in order to generate superior rice varieties or lines with higher yield potential, plant breeders need to know everything there is to know about the qualities that contribute to yield. Grain yield is a complex feature that is quantitative in nature and a combined function of several constituent traits, according to Moosavi *et al*. (2015) [7].

As a result, yield- based selection might not be fruitful if yield component features are ignored.

Accordingly, positive correlations between yield and yield components are necessary for efficient breeding of yield components to increase rice grain production (Ogunbayo *et al*., 2014) [8]. Therefore, it is critical for plant breeders to comprehend the extent of the relationship between yield and its constituent parts. Correlation coefficients can be used to quantify how closely certain components are related to yield. The current study aims to investigate the character connections in rice to improve yield under conditions of both normal and high salt stress, taking into account the scenario mentioned above.

Materials and Methods

At the Chandra Shekhar Azad University of Agriculture and Technology in Kanpur (U.P.), India. Crop Research Farm in Nawabganj and the Seed Multiplication Farm in Bojha, the experiment was carried out in the years 2018 and 2019. One hundred genotypes of cultivated rice and six standard check varieties (PUSA36, CSR10, CSR36, CSR43, IR64, Usar Dhan 3) that are sensitive to salt stress were used as the experimental material. The check varieties were replicated under four different environments, taking into account the types of soil and the timing of sowing. The experiment was conducted using an au 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.

The experimental field was split up into ten equal-sized blocks, with sixteen plots in each block. Six of the sixteen plots in a block were set aside for checks, namely PUSA36, CSR10, CSR36, CSR43, IR64, and Usar Dhan 3. Ten of the sixteen plots were used to accommodate the test genotypes that were not reproduced. The test genotypes and the six checks were distributed in a block at random. Every genotype was cultivated in seven rows with a length of 01 m, with a plant-to-plant spacing of 15 cm and a row spacing of 15 cm, respectively. To grow a decent harvest, recommended cultural techniques were followed. Data on fourteen carefully chosen plants' characteristics, including 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 were recorded. The formula proposed by Searle (1961) was utilized to evaluate the correlation coefficients between genotype (rg) and phenotype (rp).

Results and Discussion

A correlation coefficient is a statistical tool used to quantify the degree of relationship and association between two variables. When two variables in a distribution vary in response to changes in one another, the two variables are said to be correlated. Because correlation allows us to employ indirect selection to improve another targeted trait, correlation is a particularly significant tool in plant breeding. Both positive and negative correlational effects lead to concurrent changes in related character. Table 1 shows the genotypic association between fourteen parameters of one hundred genotypes of rice. The genetic influence of the qualities is involved in the link at the genotypic level, also known as genotypic correlation. (Hallauer and Sughroue, 1997) [11]. With the exception of stress score at the vegetative stage (0.46), panicle length (0.03), and stress score at the reproductive phase (0.51), which exhibited negative significant association, day to fifty percent flowering exhibits positive significant correlation with all the parameters (Table -1). For the number of panicles, previous studies by Zhou *et al*. (2010) [15] and Khan *et al*. (2014) [5] confirmed the found positive connection between the date and 50% flowering. With the exception of the stress scores at the vegetative stage (0.17) and the reproductive phase (0.23), day to maturity has a positive and substantial correlation with every character. The traits harvest index (0.93) and 1000-grain weight (0.88) were found to be positively significant correlated with grain yield per plant and negatively significant with stress score at reproductive phase (0.73). Stress score at vegetative stage has positive significant correlation with stress score at reproductive phase (0.95), while it was found to have negative significant correlation with the remaining traits. The literature on rice that is currently available (Yadav *et al*., 2011; Yadav *et al*., 2012; Ratna *et al*., 2015; Akhilesh Kumar Yadav *et al*., 2016; Kalyan *et al*., 2017 and Prakash) [12, 13, 10, 1, 4] is consistent with the above findings of high positive relationships between yield and components.

Conclusion

In conclusion all of the characteristics, including day to 50% flowering, days to maturity, plant height, length of the pimple, grains per pimple, and spikelet fertility, were found to be correlated. Abiotic stress at the reproductive phase, biological yield/plant, grain yield/plant, harvest index, and 1000-grain weight all positively contribute to grain yield, with the exception of the stress score during the vegetative stage in a pooled environment with alkalinity conditions. In terms of yield and features that contribute to yield, the genotypes IL 773, IL444, IL 105, IL 277, IL 891, IL 125, IL 344, IL 1121, and IL655 64 were determined to be the most promising. Thus, these genotypes could be used as selection criteria in a hybridization program under alkalinity to increase rice grain production as donor parents.

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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