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Correlation analysis of rice (*Oryza sativa* (L.) recombinant inbred population under nitrogen-starved condition

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Abstract
The present investigation was conducted at Agricultural College and Research Institute, Madurai, under nitrogen-starved conditions. The experimental material comprised 245 recombinant inbred populations (RILs) of ASD 16 X Basmati 370 cross, which were laid out in randomized complete block design with two replications. Observations were recorded for eighteen quantitative characters including grain yield per plant. Correlation studies revealed that grain yield per plant was positively and significantly correlated with grain nitrogen uptake, total nitrogen uptake, dry matter production, productive tillers per plant, productive tillers per plant, tillers per plant, straw nitrogen uptake, straw nitrogen content, nitrogen translocation efficiency, 100 grain weight, grains per panicle and plant height. Whereas, negatively and significantly correlated with days to 50% flowering. These results indicated the inherent relationship of these characteristics with grain yield per plant. Hence these characters are best considered for yield improvement of recombinant inbred population of rice.

Keywords: Rice, association, correlation, recombinant inbred population, nitrogen

Introduction
The improvement of rice production in much of the world increasingly focuses on optimizing the grain yield, reducing production costs and minimizing pollution risks to the environment. One of the inputs limiting rice production is nitrogen**.** Hence there is a need to develop rice varieties having high nitrogen use efficiency.

The genetic potential of rice serves as an indispensable resource for understanding their tolerance to biotic and abiotic stresses through selection. The efficiency of selection for yield mainly depends on the direction and magnitude of association between yield and its component characters and among themselves. The character association provides information on the nature and extent of association between pairs of metric traits and helps in the selection for the improvement of the character. Hence, the present study was carried out with the objective to study the correlation among the yield traits of rice recombinant inbred population.

Materials and methods
The experiment was conducted at Agricultural College and Research Institute, Madurai, under nitrogen-starved conditions with 245 recombinant inbred lines of ASD 16 X Basmati 370 cross. The experiment was laid out in a randomized block design with two replications. The observations were recorded from five randomly selected plants in each genotype for eighteen characters *viz.*, days to 50 % flowering, plant height, pollen fertility, tillers per plant, productive tillers per plant, panicle length, grains per panicle, spikelet fertility, 100 grain weight, dry matter production, grain yield per plant, straw nitrogen content, grain nitrogen content, grain nitrogen uptake, straw nitrogen uptake, total nitrogen uptake, nitrogen use efficiency, and nitrogen translocation efficiency. The correlation coefficient was analyzed as per Johnson *et al.* (1955) [10] using the TNAUSTAT statistical package.

Result and discussion
In the present investigation, the correlation coefficient of eighteen characters is depicted in Table. 1. The highest positive and significant correlation with grain yield was recorded by grain nitrogen uptake (0.984), total nitrogen uptake (0.964), dry matter production (0.953), productive tillers per plant (0.918), tillers per plant (0.888),straw nitrogen uptake (0.862), straw nitrogen content (0.726), nitrogen translocation efficiency (0.732), straw nitrogen uptake (0.862), nitrogen translocation efficiency nitrogen use efficiency (0.624), 100 grain weight (0.623), grains per panicle (0.480) and plant height (0.425). This outcome was consistent with the findings of Farooq *et al.*, 2019 [6] and Kiran *et al.*, 2023 [12]. The characters having significant positive correlations with grain yield reported by Bhardru *et al.*,2011 [4]*;* Babu *et al.*,2012 [3]*;* Nuruzzaman *et al.*,2017 [18]*;* Kampe *et al.*, 2018 [11], Arulmozhi and Muthusamy (2019) [2] reported for plant height, Rajeswari and Natarajan (2004) [20]; Yadav *et al.*, 2010 [25], Eswaran and Anandan 2011 [5]; Nikil *et al.*,2014; Lakshmi *et al.*, 2014 [15]; Kishore *et al.*,2015 [13]*;* Sarwar *et al.*,2015 [21]; Islam *et al.*, 2016 [8]; Tiwari, 2017 [24]; Prakash *et al.*, 2018 [19]; Hemalatha (2018) [7]*;* Arulmozhi and Muthusamy (2019) [2]; Jasmine *et al.*, 2022 [9]; Singh *et al.*, 2022 [22] for 100-grain weight, Akinwale *et al.*,2011 [1], Nanda *et al.*, 2019 [16] for productive tillers per plant and Akinwale *et al.*,2011 [1]; Swapna *et al.*, 2018 [23] for grains per panicle character.

The results indicated that tillering capacity increases with plant height, panicle length, and 100-grain weight would also increase. This can probably be explained as the available resources were used for the production of profuse vegetative growth that may be used as a source for production that should be stored in the seeds. The characters show a strong positive association with one another, indicating a relationship between morphological features and yield could be innate associations between the genotypes.

The trait days to 50 % flowering recorded a significantly negative correlation with grain yield, which indicates that

the photosynthetic rate could be faster in early flowering genotypes, which helps in the accumulation of dry matter in the grain, than in later flowering genotypes. These results were in accordance with the earlier findings of Kole *et al.*, 2008 [14], Yadav *et al.*, 2010 [25] and Nuruzzaman *et al.*, 2017 [18].

Table 1: Correlation coefficient of yield and yield components in rice recombinant inbred population

	DF	PH	PF	TP	PTP	PL	GP	SF	WT	DMP	YD	SN	GN	GNUP	SNUP	TNUP	NUE	NTE
DF	1																	
PH	-0.332	1																
PF	-0.198	0.089	1															
TP	-0.571**	0.387	0.104	1														
PTP	-0.575**	0.363	0.078	0.806**	1													
PL	-0.297	0.208	0.016	0.381	0.386	1												
GP	-0.337	0.233	0.129	0.434**	0.462**	0.510**	1											
SF	-0.148	0.043	0.597**	0.108	0.048	0.041	0.105	1										
WT	-0.376	0.277	0.063	0.528**	0.581**	0.284	0.286	0.045	1									
DMP	-0.630**	0.422	0.106	0.851**	0.863**	0.398	0.464**	0.070	0.587**	1								
YD	-0.656**	0.425**	0.137	0.888**	0.918**	0.419	0.480**	0.106	0.623**	0.953**	1							
SN	-0.493**	0.243	0.051	0.653**	0.681**	0.361	0.357	0.093	0.457**	0.688**	0.726**	1						
GN	-0.135	0.209	-0.044	0.291	0.299	0.133	0.131	0.032	0.247	0.300	0.293	0.344	1					
GNUP	-0.632**	0.433**	0.115	0.883**	0.913	0.412	0.469**	0.097	0.622**	0.942**	0.984**	0.740**	0.442	1				
SNUP	-0.577**	0.339	0.059	0.779**	0.790	0.386	0.431**	0.064	0.525**	0.925**	0.862**	0.868**	0.344	0.870**	1			
TNUP	-0.629**	0.407	0.095	0.868**	0.890	0.414	0.468**	0.086	0.601**	0.966**	0.964**	0.819**	0.415	0.977**	0.954**	1		
NUE	-0.436****	0.268	0.180	0.520**	0.5589	0.199	0.266	0.097	0.386	0.474**	0.624**	0.126	-0.128	0.543**	0.205	0.416	1	
NTE	-0.472	0.357	0.143	0.634**	0.6758	0.250	0.306	0.104	0.487**	0.593**	0.732**	0.291	0.388	0.734	0.363	0.599**	0.862**	1

DF-Days to 50 % flowering, PH-Plant height, PF-Pollen fertility, TP-Tillers per plant, PTP- Productive tillers per plant, PL- Panicle length, GP-Grains per panicle, SF-Spikelet fertility, WT-100 grain weight, DMP-Dry matter production, YD-Grain yield per plant, SN-Straw nitrogen content, GN-Grain nitrogen content, GNUP-Grain nitrogen uptake, SNUP-Straw nitrogen uptake, TNUP-Total nitrogen uptake, NUE-Nitrogen use efficiency and NTE-Nitrogen translocation efficiency

Conclusion

In the present study, it could be concluded that grain nitrogen uptake, total nitrogen uptake, dry matter production, productive tillers per plant, productive tillers per plant, tillers per plant, straw nitrogen uptake, straw nitrogen content, nitrogen translocation efficiency, 100 grain weight, grains per panicle and plant height influenced more than other characters studied in the present investigation. Hence, it would be worth laying more emphasis on these characters in the selection program for improving the rice yield.

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