Genetic Analysis for Grain Yield and its Attributing Characters in Rice (*Oryza sativa* L.) Under Irrigated Conditions of Prayagraj, Uttar Pradesh"

ABSTRACT

The present investigation was carried out to assess the genetic variability parameters, correlation and path analysis in 23 rice genotypes for 13 quantitative traits *viz* Days to 50% flowering, Days to Maturity, Plant height (cm), Flag Leaf Length (cm), Flag Leaf Width (cm), Number of total tillers, Number of Productive Tillers, Panicle Length (cm), Biomass (g), Harvest Index (%), Number of Grains per Panicle, Test Weight (1000 grain weight), Grain Yield per Plant per Plant (g). in Kharif 2021 season at field experimentation centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Uttar Pradesh in Randomized Block Design in three replications. Analysis of variance indicated high significant differences among the genotypes for all the traits. Genotypes SHIATS DHAN-6, KSRV-12, SHIATS DHAN-2, KSRV-140 depicted highest Grain Yield per Plant. All the characters had expressed high estimates of heritability. There is no evidence for characters expressing moderate and low heritability from the present investigation. The studies on GCV and PCV indicated that the presence of high amount of variation and role of the environment on the expression of these traits. The correlation among the yield and yield attributing characters revealed that Grain Yield per Plant per plant was positively and significantly associated at both genotypic and phenotypic levels. In Phenotypic and Genotypic path analysis a detailed analysis of diagonal values showed positive direct effect Grain Yield.

Keywords: Genetic Variability, Path analysis, character association, Rice

INTRODUCTION

Rice is the world's most widely consumed crop, directly feeding more people than any other. It is the world's most important food crop, both economically and culturally, and its production is considered the single most important economic activity on the globe. Rice is considered Asia's earliest cultivated crop. Around 3000 B.C., preserved rice grains were discovered in China. Paddy grains were uncovered during an excavation of Hastinapur, India, around 1000-750 B.C. and are the world's oldest cereal.

There are three subspecies of O. sativa: indica, japonica, and javanica. Rice grown in the tropics and subtropics, including the Philippines, India, Pakistan, and southern China, as well as several African countries, is known as indica rice. Japonica grows extensively in several parts of the world, particularly northern and eastern China, and is found in milder subtropical and temperate zones. Javanica, also known as tropical japonica, is grown in the Cordillera Mountains of northern Luzon, Philippines, on high-elevation rice terraces.

Rice is a self-pollinated crop with a short-day length. Throughout its life cycle, the crop demands a hot and humid climate with average temperatures ranging from 2 to 370 C. Rice is primarily a Kharif crop in India, and it is widely farmed in rain fed areas with high annual rainfall. It is also grown with irrigation in locations where rainfall is scarce. Rice is a staple cuisine in India's eastern and southern regions.

MATERIALS AND METHODS

The present investigation was carried out at the Field Experimentation Center of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P. during *Kharif*, 2021. The university is situated on the left side of Allahabad Rewa National Highway, about 5km from Prayagraj city. All types of facilities necessary for cultivation of successful crop including field preparation inputs, irrigation facilities were provided from the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P.

The 23 rice genotypes were grown in kharif-2021 in Randomized Block Design with three replications each under lowland conditions. In kharif-2021 nursery sowing for all the genotypes of rice was done on 21 June 2021 and transplanted in field after 30 days i.e., on 21 July 2021.

Each genotype was planted in a row of 2 meter in length with 3 replications. A spacing of 20 cm between rows and 15 cm between plants were given and the crop was raised as per the recommended package of practice. Among the 23 genotypes grown during kharif 2021, to analyze the effect of various traits for heritability, correlation, path analysis and genetic divergence on Grain yield over the years.

Experimental material:

The experimental material for present study is obtained from the Department of Genetics and Plant Breeding, SHUATS, Prayagraj (Allahabad). The details of experimental material are as follows:

Chart 1 : Experimental material

S.No	Name Of Genotypes	S.No	Name Of Genotypes
1	HMT	12	RNR15048
2	KNM 118	13	KSRV 12
3	MTU 1224	14	KSRV 140
4	MTU 1156	15	NDL 7
5	MTU 1010	16	SHUATS DHAN 1
6	JGL 24423	17	SHUATS DHAN 2
7	DURGA PADDY	18	SHUATS DHAN 3
8	BPT 5204	19	SHUATS DHAN 4
9	IR 64	20	SHUATS DHAN 5
10	NLR	21	SHUATS DHAN 6
11	RNR 1446	22	SHUATS DHAN 7
		23	NDR-359(CHECK)

RESULTS AND DISCUSSION

Analysis of variance indicated significant difference among the genotypes for all the traits. This indicates that there was an ample scope for selection of promising lines from the present gene pool for yield and its components traits. The presence of large amount variability might be due to diverse source of material taken as well as environmental influence affecting the phenotypes. On the basic of mean performance, the highest Grain Yield per Plant per hill was observed for rice genotypes Shiats Dhan-6 (62.13gm), KSRV-12 (54.73gm), Shiats Dhan-2 (51.47gm), KSRV- 140 (48.0gm), NLR (47.05gm) were found to be superior in Grain Yield per Plant. The present investigation, the PCV was higher than the corresponding GCV for all the traits indicating that there was an influence of the environment. GCV (%) values ranged between least of 28.7 (Plant height, Days to Maturity) to a highest value of 36.8 (Biomass). PCV (%) followed a similar pattern had a range of least of 29.2

(Days to Maturity) to a highest value of 37.6 (Biomass). The present investigation, all traits showed the high heritability ranging from 92.90% to 99.90%. Test weight (97.40%) showed the highest heritability among all the characters followed by Grain Yield per Plant per Plant (96.9%), Number Grains per Plant (96.7%) and Days to 50% flowering (96.6%).

Moderate range and low range heritability has not observed among these characters. The high heritability values of the considered traits in the present study indicated that those were less influenced by the environment and thus help in effective selection of the traits based on the phenotypic expression by adopting simple selection method and suggested the scope of genetic improvement. In the present investigation all the characters showed highest genetic advance as a percentage of mean except plant height, Days to Maturity, Number of Grains per Plant and Days to 50% flowering. BIOMASS (74.4) showed highest genetic advance as percentage of mean, followed by, Grain Yield per Plant per Plant (72.9), Harvest Index (71.7) and Test Weight (69.7). While moderate genetic advance as a percent of mean was observed in Number of Productive Tillers (67.6), Flag Leaf Width (63) and Flag Leaf Length (62.7).All the characters under study showed high heritability coupled with high genetic advance as percent mean (except plant height, Days to Maturity and Number of Grains per Plant) which indicates that the characters mostly governed by additive gene action. So direct selection of these characters based on phenotypic expression by simple selection method would be effective due to accumulation of more additive genes leading to further improvement.

Phenotypic Correlation Coefficient

In the present investigation Grain Yield per Plant per plant showed positive significant association with Biomass (0.912**), Number of Productive Tillers (0.448**), Number of Total Tillers (0.437**) Plant Height (0.422**) and Flag Leaf Length (0.331*). While positive and non-significant association showed with Harvest Index (0.237), Number of Grains per Panicle (0.227), Panicle Length (0.215) and Test Weight (0.029). Negative and non significant association showed with Days to 50% flowering (-0.057), Flag Leaf Width (-0.049), Days to Maturity (-0.043).

Genotypic Correlation Coefficient

The correlation among the yield and yield attributing characters revealed that Grain Yield per Plant per plant was positively and significantly associated with Biomass (0.919**), Number of Productive Tillers (0.499**), Number of Total Tillers (0.455**), Plant Height (0.422**), Flag Leaf Length (0.393**), Panicle Length (0.258*). But positively and non-significant correlation was found with Harvest Index (0.212), Number of Grains per Panicle (0.228), Test Weight (0.018). Negative and non-significant associated with Days to 50% flowering (- 0.058), Days to Maturity (-0.040), Flag Leaf Width (-0.039).

Phenotypic Path coefficient analysis

Phenotypic path coefficients are calculated using the phenotypic correlation coefficient. It divides the phenotypic correlation coefficients into direct and indirect impact measurements (Dewey and Lu, 1959). A detailed analysis of diagonal values showed positive direct effect of Days to 50% flowering (0.0551), Plant Height (0.0242), Flag Leaf Length (0.0477), Flag Leaf Width (0.031), Number of Total Tillers (0.0197), Biomass (0.946), and Harvest Index (0.4607), and Test weight (0.0212). Negative direct effects were exhibited by Days to Maturity (-0.0413), Number of Productive Tillers (-0.0105), Panicle Length (-0.0126), and Number of Grains per Panicle (-0.0131).

Genotypic path coefficient analysis

A perusal of the results on path coefficient for yield and yield components genotypic to be of similar direction and magnitude in general. Further the genotypic path co-efficient were observed to be of higher magnitude, compared to phenotypic path coefficient indicating the masking effect of environment.A detailed analysis of diagonal values showed positive direct effect of Days to 50% flowering (0.097), Plant Height (0.009), Flag Leaf Length (0.104), Flag Leaf Width (0.067), Number of Total Tillers (0.128), Biomass (0.967), Harvest Index (0.523), and Test Weight (0.063). Negative direct effect was showed by Days to Maturity (-0.077), Number of Productive Tillers (-0.0152), Panicle Length (-0.071), Number of Grains per Panicle (-0.02).

Table 1 : Correlation Coefficient Analysis

Traits		DF50	DM	PH	FLL	FLW	NTT	NPT	PL	BM	H.I.	NGPP	TW	GY
DF50	P	1	0.026	0.014	-0.012	-0.007	0.351*	0.280*	-0.362*	0.114	-0.465**	0.215	-0.477**	-0.057
	G	1	0.013	0.012	-0.014	-0.017	0.380*	0.306*	-0.447**	0.122	-0.509**	0.23	-0.538**	-0.058
DM	P		1	0.149	0.320*	-0.176	-0.172	-0.173	-0.131	-0.076	0.116	-0.135	-0.04	-0.043
	G		1	0.168	0.354*	-0.217	-0.244*	-0.249*	-0.132	-0.074	0.121	-0.206	0.011	-0.04
PH	P			1	0.519**	0.510**	-0.094	-0.146	0.428**	0.501**	-0.225	0.423**	0.162	0.422**
	G			1	0.562**	0.531**	-0.121	-0.184	0.500**	0.525**	-0.262*	0.450**	0.192	0.442**
FLL	P				1	0.184	0.16	0.159	0.141	0.459**	-0.337*	0.006	0.04	0.331*
	G				1	0.207	0.187	0.217	0.172	0.494**	-0.312*	-0.022	0.078	0.393**
FLW	P					1	0.043	-0.071	0.355*	0.087	-0.397**	0.388**	0.068	-0.049
	G					1	0.04	-0.093	0.424**	0.119	-0.473**	0.440**	0.07	-0.039
NTT	P						1	0.942**	-0.109	0.494**	-0.156	-0.059	-0.167	0.437**
	G						1	0.959**	-0.17	0.522**	-0.214	-0.083	-0.189	0.455**
NPT	P							1	-0.108	0.472**	-0.068	-0.149	-0.102	0.448**
	G							1	-0.193	0.521**	-0.093	-0.202	-0.133	0.499**
PL	P								1	0.189	0.051	-0.013	0.600**	0.215
	G								1	0.216	0.099	-0.001	0.705**	0.258*
BM	P									1	-0.17	0.333*	0.002	0.912**
	G									1	-0.183	0.337*	-0.004	0.919**
H.I.	P										1	-0.235	0.062	0.237
	G										1	-0.284*	0.089	0.212
NGPP	P											1	-0.313*	0.227
	G											1	-0.309*	0.228
TW	P												1	0.029
	G												1	0.018
GYP	P													1
	G													1

DF50: Days to 50% Flowering, **DM**: Days to Maturity, **PH**: Plant Height, **FLL**: Flag Leaf Length, **FLW**: Flag Leaf Width, **NTT**: Number of Total Tillers, **NPT**: Number of Productive Tillers, **PL**: Panicle Length, **BM**: Biomass, **H.I**: Harvest Index, **NGPP**: Number of Grains per Panicle, **TW**: Test Weight, **GYP**: Grain Yield per Plant, **P**: Phenotypic, **G**: Genotypic

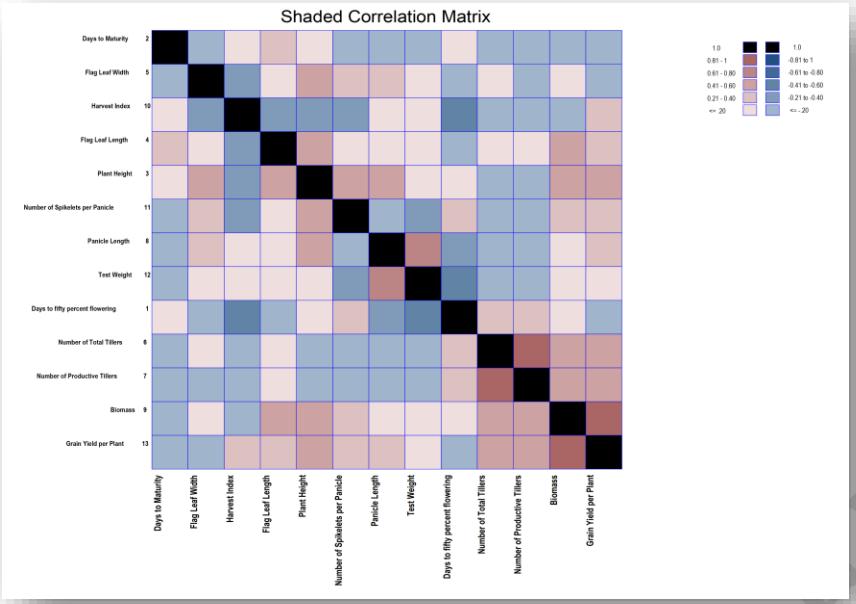

Figure 1 : Phenotypical Correlation Diagram

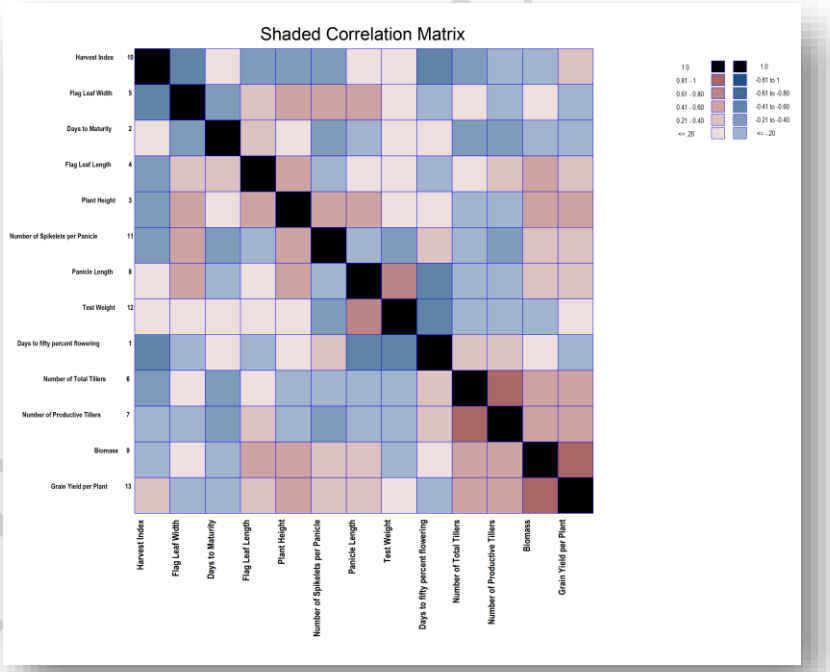

figure 2 : Genotypical Correlation Diagram

Table 2 : Path Coefficient Analysis

Traits		DF50	DM	PH	FLL	FLW	NTT	NPT	PL	BM	H.I.	NGPP	TW
DF50	P	**0.0551**	0.0014	0.0008	-0.0007	-0.0004	0.0193	0.0154	-0.02	0.0063	-0.0256	0.0119	-0.0263
	G	**0.097**	0.001	0.001	-0.001	-0.002	0.037	0.03	-0.044	0.012	-0.05	0.022	-0.052
DM	P	-0.0011	**-0.0413**	-0.0061	-0.0132	0.0073	0.0071	0.0071	0.0054	0.0031	-0.0048	0.0056	0.0017
	G	-0.001	**-0.077**	-0.013	-0.027	0.017	0.019	0.019	0.01	0.006	-0.009	0.016	-0.001
PH	P	0.0003	0.0036	**0.0242**	0.0126	0.0124	-0.0023	-0.0035	0.0104	0.0121	-0.0055	0.0102	0.0039
	G	0	0.002	**0.009**	0.005	0.005	-0.001	-0.002	0.005	0.005	-0.002	0.004	0.002
FLL	P	-0.0006	0.0153	0.0248	**0.0477**	0.0088	0.0076	0.0076	0.0067	0.0219	-0.0161	0.0003	0.0019
	G	-0.002	0.037	0.058	**0.104**	0.022	0.019	0.023	0.018	0.051	-0.032	-0.002	0.008
FLW	P	-0.0002	-0.0055	0.0158	0.0057	**0.031**	0.0013	-0.0022	0.011	0.0027	-0.0123	0.012	0.0021
	G	-0.001	-0.014	0.035	0.014	**0.067**	0.003	-0.006	0.028	0.008	-0.031	0.029	0.005
NTT	P	0.0069	-0.0034	-0.0019	0.0031	0.0008	**0.0197**	0.0185	-0.0021	0.0097	-0.0031	-0.0012	-0.0033
	G	0.049	-0.031	-0.016	0.024	0.005	**0.128**	0.123	-0.022	0.067	-0.027	-0.011	-0.024
NPT	P	-0.0029	0.0018	0.0015	-0.0017	0.0007	-0.0099	**-0.0105**	0.0011	-0.0049	0.0007	0.0016	0.0011
	G	-0.046	0.038	0.028	-0.033	0.014	-0.145	**-0.152**	0.029	-0.079	0.014	0.031	0.02
PL	P	0.0046	0.0017	-0.0054	-0.0018	-0.0045	0.0014	0.0014	**-0.0126**	-0.0024	-0.0006	0.0002	-0.0076
	G	0.032	0.009	-0.035	-0.012	-0.03	0.012	0.014	**-0.071**	-0.015	-0.007	0	-0.05
BM	P	0.1079	-0.0716	0.4742	0.4339	0.082	0.4675	0.4462	0.1792	**0.946**	-0.161	0.3148	0.002
	G	0.118	-0.072	0.507	0.478	0.115	0.505	0.504	0.209	**0.967**	-0.177	0.326	-0.004
H.I.	P	-0.2142	0.0536	-0.1038	-0.1552	-0.183	-0.0718	-0.0315	0.0234	-0.0784	**0.4607**	-0.1082	0.0285
	G	-0.266	0.063	-0.137	-0.163	-0.247	-0.112	-0.049	0.052	-0.096	**0.523**	-0.148	0.046
NSPP	P	-0.0028	0.0018	-0.0055	-0.0001	-0.0051	0.0008	0.0019	0.0002	-0.0044	0.0031	**-0.0131**	0.0041
	G	-0.005	0.004	-0.009	0	-0.009	0.002	0.004	0	-0.007	0.006	**-0.02**	0.006
TW	P	-0.0101	-0.0008	0.0034	0.0008	0.0014	-0.0035	-0.0022	0.0127	0	0.0013	-0.0066	**0.0212**
	G	-0.034	0.001	0.012	0.005	0.004	-0.012	-0.008	0.044	0	0.006	-0.019	**0.063**
GYP	P	-0.0571	-0.0434	0.422**	0.331*	-0.0486	0.437**	0.448**	0.2153	0.912**	0.2368	0.2274	0.0293
	G	-0.058	-0.04	0.442**	0.393**	-0.039	0.455**	0.499**	0.258*	0.919**	0.212	0.228	0.018

DF50: Days to 50% Flowering, **DM**: Days to Maturity, **PH**: Plant Height, **FLL**: Flag Leaf Length, **FLW**: Flag Leaf Width, **NTT**: Number of Total Tillers, **NPT**: Number of Productive Tillers, **PL**: Panicle Length, **BM**: Biomass, **H.I**: Harvest Index, **NGPP**: Number of Grains per Panicle, **TW**: Test Weight, **GYP**: Grain Yield per Plant, **P**: Phenotypic, **G**: Genotypic

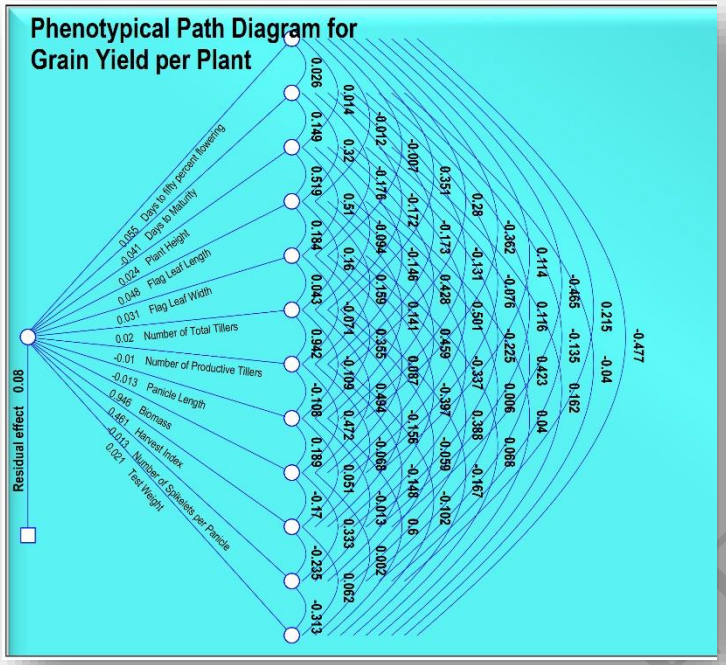

Figure 3 : Phenotypical Path Diagram

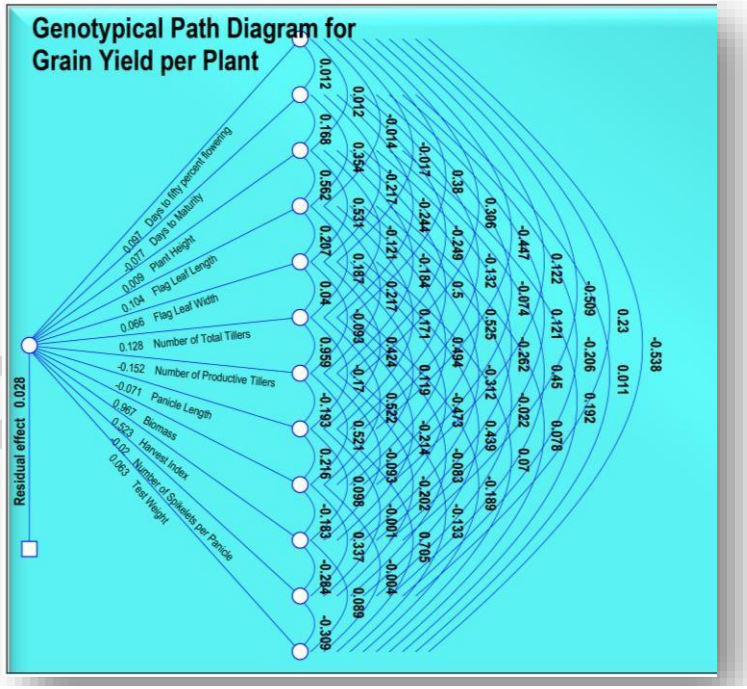

Figure 4 : Genotypical Path Diagram

CONCLUSION

Considerable variability existed in the genotypes for all the characters studied. These were the genotypes with high mean values in desirable direction i.e., From the present investigation it is concluded that among 23 genotypes of rice, JGL-24423 showed early flowering (85 days), MTU-1156 had characters like early maturity (121 days), KSRV-12 showed high plant height (151.22 cm), NLR showed high Panicle Length (31.6 cm), SHIATS DHAN-6 is showing both high Biomass (123.6 g), and Grain Yield per Plant (62.13 g). Highest GCV were depicted for Biomass, Grain Yield per Plant, Number of Grains per Panicle and Test Weight. The highest Heritability was observed for Test Weight followed by Number of Grains per Panicle, Harvest Index, Days to 50% flowering, Days to Maturity and Biomass. In the present investigation Grain Yield per Plant per plant showed positive and significant association with Number of Productive Tillers, Number of Total Tillers, Test Weight, Flag Leaf Length, Biomass, Flag Leaf Width, Panicle Length. Positive direct effect on Grain Yield per Plant per Plant at both genotypic and phenotypic levels with Biomass, Harvest Index, and Days to % Flowering, Flag Leaf Length and Width and Test Weight. This character should be given due consideration during selection for crop improvement.

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