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Correation and Path analysis studies of yield and its component traits in F^5 families of rice (Oryza sativa L.)

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Abstract: *Fourty two F5 families of rice belonging to four crosses along with their five parents were evaluated during kharif, 2015 at Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru with an objective to establish the nature of relation between grain yield and yield components by partitioning the correlation coefficients between grain yield and its components into direct and indirect effects by using simple correlation and path analysis. Data was recorded on seven characters which showed significant differences among themselves. The study of character association and path coefficient analysis indicated that panicle length had positive direct effect coupled with positive significant correlation with grain yield per plant and hence direct selection can be made based on this trait for improving yield.*

Keywords: *Rice, F5 families, Correlation, Path analysis.*

I. Introduction

Rice is the staple food for two thirds of the Indian population. It contributes 43 per cent of caloric requirement and 20-25% of agricultural income. China and India alone account for >50% of the rice grown and consumed. Globally, it is planted on about 158 million hectares with an annual production of 478 million tons. India ranks first in area (43.85 million hectares) and second in the production (104.78 million tonnes) with a productivity of 2185 kg ha^{-1}. The demand for rice production is increasing day by day because of expansion of rice consuming people. Therefore, keeping in view of the future demand of rice, there is a continuous need to evolve new varieties with higher yields through various genetic approaches and selection of genotypes in early generations would become essential. Yield is a complex character, which is highly influenced by the environment, hence direct selection for yield alone limit the selection efficiency and ultimately results in limited success in yield improvement. Thus, effective improvement in yield may be brought about through selection of yield component characters. Yield component characters show association among themselves and also with yield. Correlation is the measure of mutual relationship between two variables and measures the degree of closeness and the linear relationship between them. Path analysis facilitates the partitioning of correlation coefficients into direct and indirect effects of various characters on yield. Information on association of characters, direct and indirect effects contributed by each character towards yield will be an added advantage in aiding the selection process. Plant Breeder has to find significant correlations among yield and yield component traits, and effect of yield component traits on grain yield to predict the superior cross combinations and to select ideal plant type with increased yield (Nagaraju *et al.*, 2013). The present study was undertaken to derive information on correlation among yield and yield component traits and to estimate the direct and indirect effects of yield component traits on grain yield by taking fourty two F_5 rice families.

II. Material and Methods

The experiment was conducted during *Kharif* 2015 at Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station, Maruteru with fourty two F_5 families belonging to four crosses of rice with five parents sown in a randomized block design with two replications. Details of studied crosses were presented in table 1 and details of studied plant material was presented in table 2. Thirty day old seedlings of each genotype were transplanted in a row of 4.0 m length by adopting a spacing of 20 cm between rows and 15 cm between plants within the row. Observations were recorded on five randomly selected plants in each genotype in each replication and the average values were subjected for statistical analysis. Observations were recorded on plant basis for all characters, except days to 50 per cent flowering and days to maturity which were recorded on plot basis. The mean values over two replications were used for statistical analysis and analysis was done as per Panse and Sukhatme (1985), Falconer (1964) and Dewey and Lu (1959).

III. Results and Discussions

The analysis of variance revealed significant differences among the genotypes for all the characters (Table 3) indicating that there is an inherent genetic difference among the genotypes.The study of character association (Table 4 and Fig 1&2) revealed that the character panicle length showed significant positive association (0.426*/0.492*) with grain yield per plant indicating that increase in panicle length will increase grain yield and hence direct selection can be practiced for this character. Other traits *viz.,* days to 50% flowering (-0.302*/-0.318*) and days to maturity (-0.364*/-0.383*) recorded significant negative association with grain yield indicating that increase in days to 50% flowering and days to maturity results in reduction in yield. Characters plant height (-0.004/0.003) and test weight (0.041/0.036) recorded positive non significant correlation with grain yield (plant height at genotypic level only) while number of panicles per plant (-0.106/-0.138) reported negative non significant correlation with grain yield indicating that these traits have little influence on yield.

Days to 50% flowering showed positive significant association with days to maturity (0.936*/0.952*), plant height (0.267*/0.278*) and number of panicles per plant (0.422*/0.457*) while days to maturity recorded significant positive association with plant height (0.268*/0.272*) and number of panicles per plant (0.370*/0.413*) at both the levels.Plant height reported positive significant correlation with number of panicles per plant (0.210*/0.210*) at both genotypic and phenotypic levels. Number of panicles per plant reported positive significant association with panicle length (0.2025/0.213*) at genotypic level only but it recorded negative significant association with test weight (-0.381*/-0.431*) at both the levels. Strong positive association among the traits indicated that simultaneous selection for these characters would result in improvement of high yielding varieties. These results are in agreement with the findings of Jambhulkar and Bose (2014), Khare *et al.* (2014) and Patel *et al*. (2014). The genotypic correlation values were also in general higher than the phenotypic correlation values indicating the masking effects of environment on these traits.

The above inter se association (Fig 1 & 2) amongst the traits indicated that Panicle length had positive significant correlation with grain yield per plant and hence direct selection for such trait will be effective in improving the yield. The strong positive association among the traits indicated that simultaneous selection for these characters would result in improvement of high yielding varieties. Although plant height and test weight did not exhibit positive significant association with grain yield, their role in contributing towards grain yield could not be overlooked as these component traits exhibited positively significant association with important yield attributes. Thus, these traits may be assumed to indirectly contribute via other traits in governing grain yield. In this regard it is important to partition out the observed phenotypic association into direct and indirect effects of the component traits towards grain yield.

A character contributing to grain yield may contribute directly or indirectly. The estimates of direct and indirect effect are presented in Table 5. In the present investigation, panicle length had the highest positive direct effect (0.4151/0.4877) coupled with positive significant correlation (0.4265/0.4925) with grain yield per plant. Therefore, simultaneous improvement of grain yield is possible through selection of this trait. Days to maturity recorded direct negative effects (-0.7014/-0.8933) and significant negative correlation (-0.3644/-0.3835) with grain yield. Hence selection should be dropped based on this character. Days to 50% flowering has positive direct effect (0.3905/0.6182) with grain yield but correlation coefficient is negative and significant. Hence a restricted selection model has to be employed to nullify the indirect effects in this case. This trait shows positive indirect effect via test weight (0.0095/0.0102) and negative indirect effects via days to maturity (-0.6567/-0.8508), number of panicles per plant (-0.0241/-0.0518) and panicle length (-0.0242/-0.0409). Days to maturity reported positive indirect effects via days to maturity (0.3657/0.5888) and test weight (0.0175/0.0166) and negative indirect effects via number of panicles per plant (-0.0211/-0.0468) and panicle length (-0.0272/-0.0465). Plant height reported negative direct effect (-0.0088) at genotypic level while correlation coefficient at genotypic level was positive (0.0032). in such situations indirect effects seems to be the causal factors for positive correlation and selection should be based on indirect effects. This trait reported positive indirect effects via days to 50% flowering (0.1045/0.1722), panicle length (0.0825/0.1057) and test weight (0.0011/0.0014) and negative indirect effects via days to maturity (-0.1881/-0.2433) and number of panicles per plant (-.0120/-0.0239). Test weight reported positive direct effects (0.1052/0.0952) with grain yield along with positive correlation (0.0412/0.03680. Hence selection can be made based on this trait. Number of panicles per plant showed negative indirect effect (-0.0569/-0.1132) along with negative non significant association (-0.1060/-0.1386) with grain yield. Hence selection should be dropped based on this character. Similar findings were reported by Hasan *et al.* (2011), Rangare *et al*. (2012), Ravindrababu *et al.* (2012), Sanghera *et al*. (2013), Aditya and Bhartiya (2013) and Jambhulkar and Bose (2014). Residual effect was high (77.1%) indicating that some other factors which were not been considered in the study, need to be included in the analysis to explain total variation in yield. (Fig 3). The study of character association and path coefficient analysis indicated that panicle length had positive direct effect (Fig 3&4) coupled with positive significant correlation with grain yield per plant and hence direct selection can be made based on this trait for improving yield.

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Fig. 1. Genotypic correlations

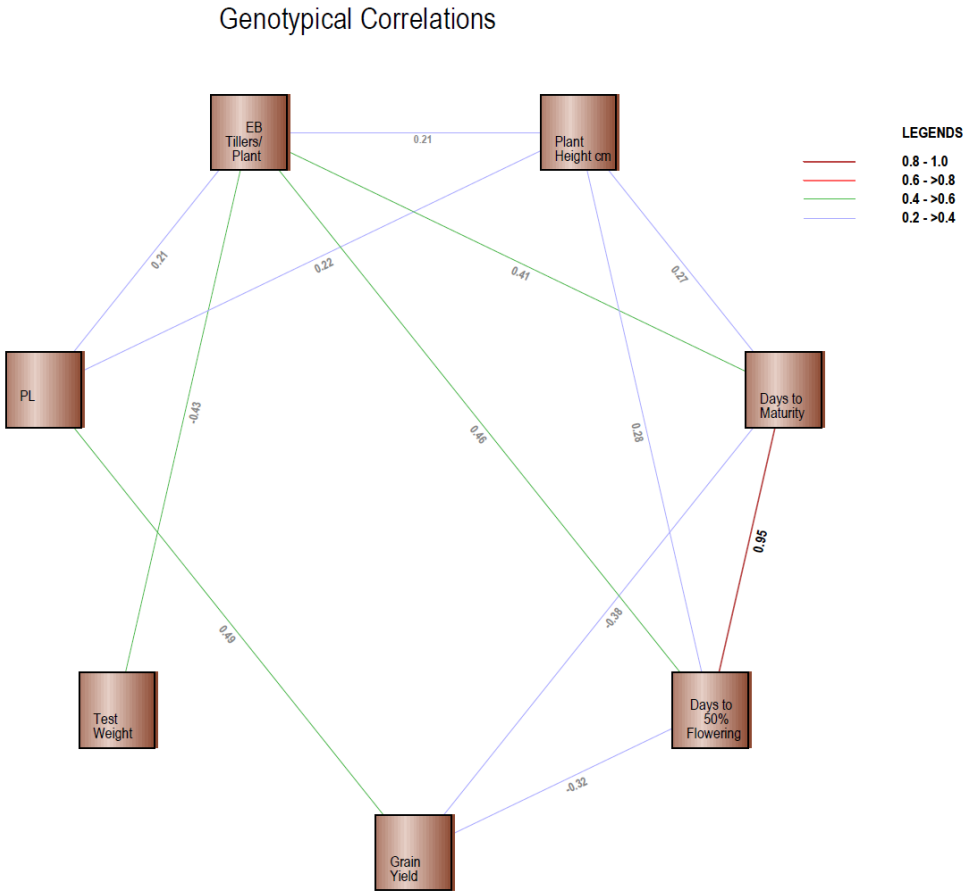

Fig. 2. Phenotypic correlations

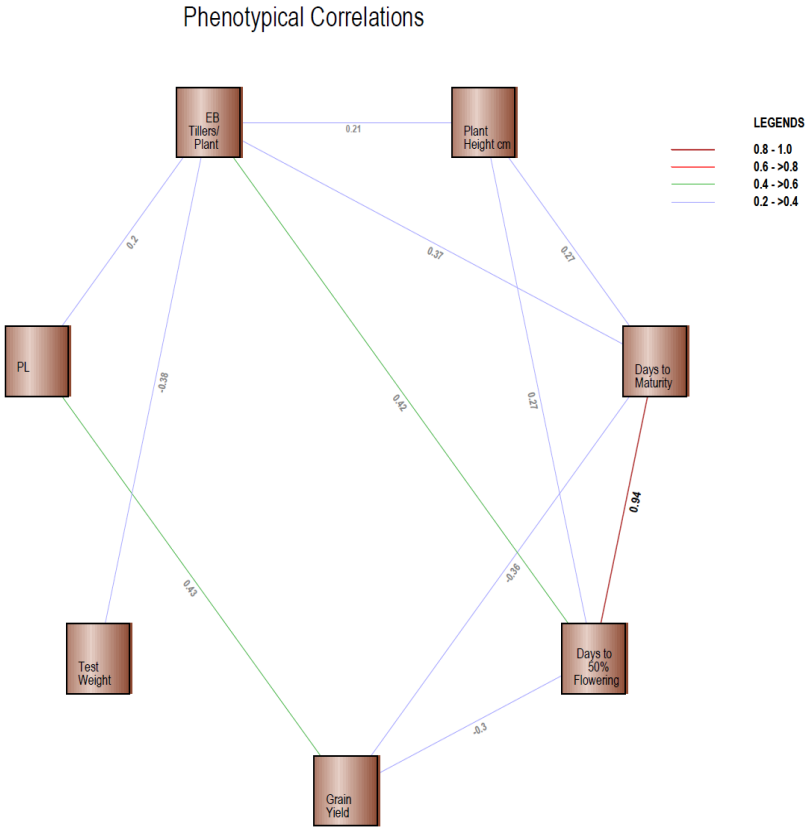

Fig. 3. Genotypical path diagram for grain yield per plant

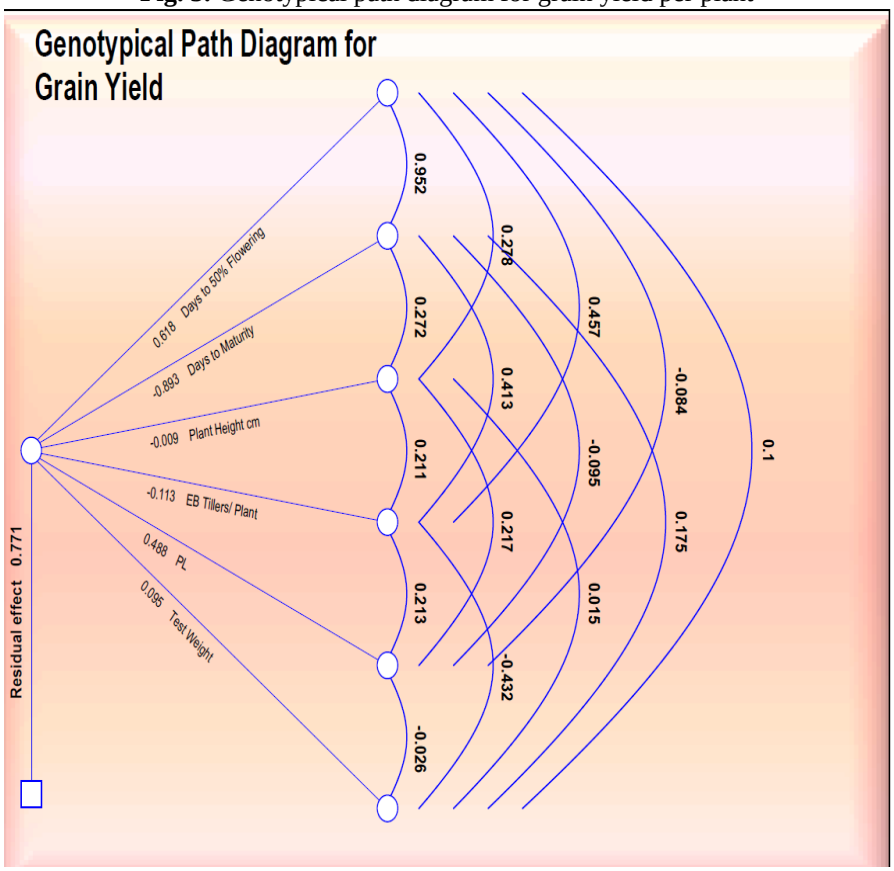

Fig. 4. Phenotypical path diagram for grain yield per plant

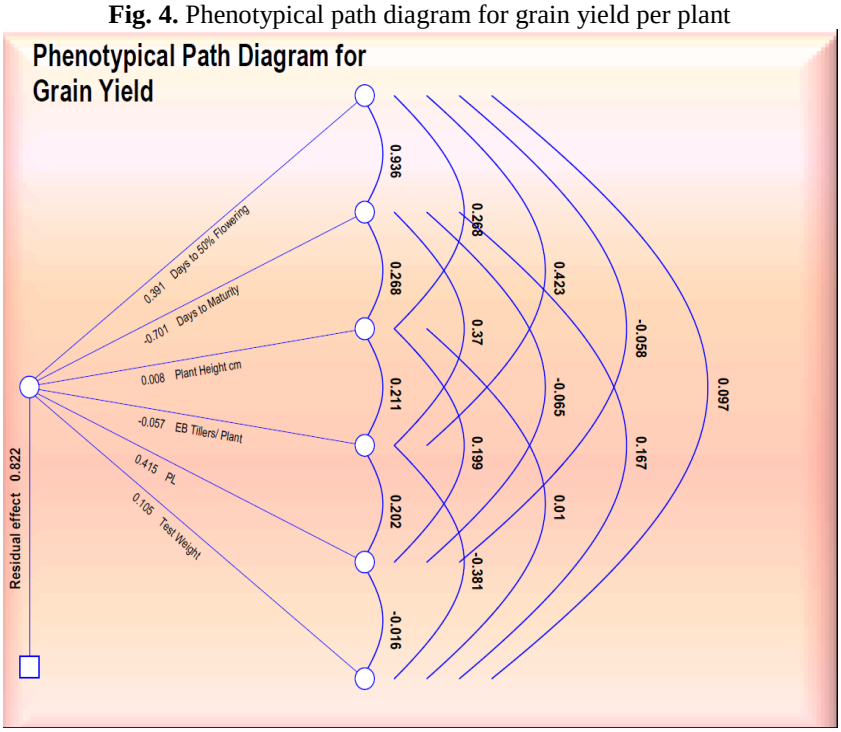

Table 1. List of crosses studied and number of families studied under each cross

Cross	Number of families studied
MTU 7029/ MTU 1081	28
MTU 7029/ JGL 11118	2
MTU 7029/ NLR 34449	10
MTU 7029/ MTU 1121	2
Total - Six crosses	**42**

Table 2. List of F5 families studied

S.No	ENTRY	Cross combination
1	MTU 2462-2-2-1	MTU 7029/ MTU 1081
2	MTU 2462-4-1-2	MTU 7029/ MTU 1081
3	MTU 2462-5-2-1	MTU 7029/ MTU 1081
4	MTU 2462-5-3-1	MTU 7029/ MTU 1081
5	MTU 2462-12-1-2	MTU 7029/ MTU 1081
6	MTU 2462-12-2-2	MTU 7029/ MTU 1081
7	MTU 2462-13-1-1	MTU 7029/ MTU 1081
8	MTU 2462-13-1-2	MTU 7029/ MTU 1081
9	MTU 2462-13-2-1	MTU 7029/ MTU 1081
10	MTU 2462-13-3-1	MTU 7029/ MTU 1081
11	MTU 2462-13-4-1	MTU 7029/ MTU 1081
12	MTU 2462-15-2-2	MTU 7029/ MTU 1081
13	MTU 2462-16-1-1	MTU 7029/ MTU 1081
14	MTU 2462-18-2-1	MTU 7029/ MTU 1081
15	MTU 2462-21-2-1	MTU 7029/ MTU 1081
16	MTU 2462-21-4-1	MTU 7029/ MTU 1081
17	MTU 2462-22-3-2	MTU 7029/ MTU 1081
18	MTU 2462-22-3-3	MTU 7029/ MTU 1081
19	MTU 2462-23-1-1	MTU 7029/ MTU 1081
20	MTU 2462-23-2-1	MTU 7029/ MTU 1081
21	MTU 2462-26-2-1	MTU 7029/ MTU 1081
22	MTU 2462-26-4-1	MTU 7029/ MTU 1081
23	MTU 2462-27-1-1	MTU 7029/ MTU 1081
24	MTU 2462-28-1-1	MTU 7029/ MTU 1081
25	MTU 2462-32-3-1	MTU 7029/ MTU 1081
26	MTU 2462-33-2-1	MTU 7029/ MTU 1081
27	MTU 2462-42-2-2	MTU 7029/ MTU 1081
28	MTU 2462-45-1-1	MTU 7029/ MTU 1081
29	MTU 2463-4-1-1	MTU 7029/ JGL 11118
30	MTU 2463-4-2-2	MTU 7029/ JGL 11118
31	MTU 2465-3-1-1	MTU 7029/ NLR 34449

32	MTU 2465-11-2-1	MTU 7029/ NLR 34449
33	MTU 2465-12-2-1	MTU 7029/ NLR 34449
34	MTU 2465-16-1-1	MTU 7029/ NLR 34449
35	MTU 2465-16-2-2	MTU 7029/ NLR 34449
36	MTU 2465-22-3-1	MTU 7029/ NLR 34449
37	MTU 2465-23-1-1	MTU 7029/ NLR 34449
38	MTU 2465-24-3-1	MTU 7029/ NLR 34449
39	MTU 2465-27-1-1	MTU 7029/ NLR 34449
40	MTU 2465-35-2-1	MTU 7029/ NLR 34449
41	MTU 2466-3-4-1	MTU 7029/ MTU 1121
42	MTU 2466-4-4-1	MTU 7029/ MTU 1121
		PARENTS
43		MTU 7029
44		MTU 1081
45		MTU 1121
46		JGL 11118
47		NLR 34449

Table 3. Analysis of variance (mean sum of squares) for 10 characters for 121 genotypes of rice (Oryza sativa L.) during kharif, 2015.

Source of variations	d. f.	Days to 50% flowering	Days to maturity	Plant height	No. of panicles per plant	Panicle length	Grain yield per plant	Test weight
Mean sum of squares								
Replications	1	0.26	0.01	3.64	0.01	1.55	0.40	0.82
Genotypes	46	91.83*	92.51*	68.50*	4.71*	9.09*	38.95*	31.65*
Error	46	1.78	1.51	2.57	0.40	0.93	1.06	0.63

*****Significance at 5% level

Table 4. Phenotypic and genotypic correlation coefficient of 47 lines (42 F5 families and 5 parents) of rice (Oryza sativa L.) during kharif, 2015.

S.No	Characters		Days to 50% flowering	Days to maturity	Plant height	Number of panicles per plant	Panicle length	Test weight
1.	**Days to 50% flowering**	**P**	**1.0000**					
		G	**1.0000**					
2.	**Days to maturity**	**P**	0.936*	**1.0000**				
		G	0.952*	**1.0000**				
3.	**Plant height**	**P**	0.267*	0.268*	**1.0000**			
		G	0.278*	0.272*	**1.0000**			
4.	**Number of panicles per plant**	**P**	0.422*	0.370*	0.210*	**1.0000**		
		G	0.457*	0.413*	0.210*	**1.0000**		
5.	**Panicle length**	**P**	-0.058	-0.065	0.198	0.2025	**1.0000**	
		G	-0.083	-0.095	0.216	0.213*	**1.0000**	
6.	**Test weight**	**P**	0.096	0.166	0.01	-0.381*	-0.016	**1.0000**
		G	0.100	0.174	0.014	-0.431*	-0.026	**1.0000**
7.	**Grain yield per plant**	**P**	-0.302*	-0.364*	-0.004	-0.106	0.426*	0.041
		G	-0.318*	-0.383*	0.003	-0.138	0.492*	0.036

*****Significance at 5% level

Table 5. Path coefficients of yield and yield components of rice (Oryza sativa L.) during kharif, 2015.

S.No	Characters		Days to 50% flowering	Days to maturity	Plant height	Number of panicles per plant	Panicle length	Test weight
1.	**Days to 50% flowering**	**P**	**0.3905**	0.3657	0.1045	0.1652	-0.0228	0.0379
		G	**0.6182**	0.5888	0.1722	0.2828	-0.0518	0.061
2.	**Days to maturity**	**P**	-0.6567	**-0.7014**	-0.1811	-0.2597	0.0159	-0.1169
		G	-0.8508	**-0.8933**	-0.2433	-0.3692	0.0856	-0.1562
3.	**Plant height**	**P**	0.0020	0.0020	**0.0075**	0.0016	0.0015	0.0001
		G	-0.0025	-0.0024	**-0.0088**	-0.0019	-0.0019	-0.0001
4.	**Number of panicles per plant**	**P**	-0.0241	-0.0211	-0.0120	**-0.0569**	-0.0115	0.0217
		G	-0.0518	-0.0468	-0.0239	**-0.1132**	-0.0241	0.0489
5.	**Panicle length**	**P**	-0.0242	-0.0272	0.0825	0.0840	**0.4151**	-0.0067
		G	-0.0409	-0.0465	0.1057	0.1040	**0.4877**	-0.0128
6.	**Test weight**	**P**	0.0102	0.0175	0.0011	-0.0401	-0.0017	**0.1052**
		G	0.0095	0.0166	0.0014	-0.0411	-0.0025	**0.0952**
7.	**Grain yield per plant**	**P**	-0.3023	-0.3644	-0.0044	-0.1060	0.4265	0.0412
		G	-0.3182	-0.3835	0.0032	-0.1386	0.4925	0.0368

Diagonal: direct effects