Correlation Analysis on Agronomic Characters in F_1 population derived from a cross of Pongsu Seribu 2 and MR 264

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Abstract

Agronomic characters play a vital role in grain yield performance. However, the information related to the relationships between agronomic characters and grain yield in Malaysia are particularly very limited. Therefore, this study was conducted to determine the correlation between grain yield performance with nine (n=9) agronomic characters namely plant height, panicle length, total grain number, filled grains per panicle, grain length, number of tillers, flag leaf area, flag leaf width and 1000-grains weight. Twenty (n=20) F_1 population derived from a cross of Pongsu Seribu 2 and MR 264 were used and were grown at Malaysian Nuclear Agency Greenhouse, Bangi. Result of correlation analysis revealed a positive and significant at ($p \leq 0.01$) relation between 1000-grains weight with total grains number (r = 0.647), filled grains per panicle (r = 0.603), grain length (r = 0.834), flag leaf area (r = 0.701) and flag leaf width (r = 0.894). However, the negative (inverse) correlation was observed between panicle length with total grain number, number of tiller and filled grain per panicle. Regression analysis revealed that flag leaf width (4.162) has highest direct effect on the yield followed by grain length (2.801), flag leaf area (0.048) and total grain no (0.07) respectively. Whereas, plant height (–0.05), plant length (–0.223), filled grains per panicle (–0.005) and number of tillers (–0.071) has indirect effect on the yield. This study indicated that selection based flag leaf width and grain length will be highly effective for yield improvement can be consider in selection of breeding lines and highly effective for yield improvement in rice breeding program.

Keywords: Agronomic characters, correlation, MR 264, Pongsu Seribu 2, Yield performance

Abstrak

Ciri-ciri agronomi memainkan peranan yang penting dalam prestasi hasil bijirin. Walau bagaimanapun, maklumat yang berkaitan dengan hubungan antara ciri-ciri agronomi dan hasil bijirin di Malaysia terutamanya sangat terhad. Oleh itu, kajian ini telah dijalankan untuk menentukan korelasi antara prestasi hasil bijirin dengan sembilan (n=9) ciri-ciri agronomi iaitu tinggi pokok, panjang panikel, bilangan biji, bilangan biji per tangkai, panjang biji, bilangan anak, luas daun pengasuh, lebar daun pengasuh dan berat 1000 biji. Dua puluh (n=20) populasi F_1 berasal dari kacukan Pongsu Seribu 2 dan MR 264 telah digunakan dan ditanam di rumah hijau, Agensi Nuklear Malaysia, Bangi. Keputusan analisis korelasi menunjukkan hubungan yang positif dan signifikan pada ($p \leq 0.01$) hubungan antara berat 1000-biji dengan jumlah bilangan biji (r= 0.647), biji penuh per tangkai (r= 0.603), panjang biji (r =0.834), luas daun pengasuh (r= 0.701) dan lebar daun pengasuh (r =0894). Walau bagaimanapun korelasi negatif (songsang) diperhatikan antara panjang panikel dengan jumlah biji, bilangan anak padi dan biji penuh per panikel. Analisis regresi menunjukkan bahawa lebar daun pengasuh (4.162) mempuyai kesan langsung tertinggi ke atas hasil diikuti dengan panjang biji (2,801), luas daun pengasuh (0.048) dan jumlah bilangan biji (0.07). Manakala, ketinggian pokok (-0.05), panjang tumbuhan (-0,223), biji penuh per tangkai (-0,005) dan bilangan anak padi (-0,071) mempunyai kesan tidak langsung kepada hasil. Kajian ini menunjukkan bahawa pemilihan berdasarkan lebar daun pengasuh dan panjang bijirin amat berkesan untuk peningkatan hasil boleh dipertimbangkan dalam pemilihan warisan baka dan amat berkesan untuk peningkatan hasil dalam program pembiakbakaan padi

Introduction

Rice is an important crop for more than one third of the world's population (Helliwell and Yang, 2013). In Malaysia, the production of rice increase approximately to 2 millions tons and is expected to increase gradually with the increasing number of population. Currently, Malaysia still largely depends on imported rice to meet the domestic consumer's demand. And there is a growing concern that the current level of production will not meet future demands. In view of the increasing of rice production, improvement of seed yield is the main target of of breeders to provide information about the cause and effect relationship between the agronomic characters (Eidi kohnaki *et al*., 2013).

Crop improvement depends on the magnitude of genetic variability and the extent to which desirable characters are inherited. Genetic variation among traits is important for breeding and in selecting desirable types. Selection is more effective when all the information including the agronomic character associated with yield are considered (Aris *et al*., 2013). Agronomic characters consists of many different traits including the plant height, strong culms, tillering, short and erect leaves, large and compact panicles, and early maturation (Paterson *et al*.2005). Most of agronomical traits are controlled by multiple genes each of which is positively or negatively effective in the emergence of final traits in phenotypes. According to Smith and Dilday, 2003, tillering is the key component in agronomic characters because it determine the panicle number as well as the grains yield. However studies by Seyed, 2011 repoted that the prime characters

for grain quality depends on the grain length, width, shape, and its weight. It is believed that this characters have a dirrect effect on the marketability and commercial success of modern rice cultivars. Under this context, more innovative research and technological advancement is essential to analyze the direct and indirect effect of the agronomic characters. In such situation, correlation and path coefficient analysis could be used as an important tools to bring information about relationship of agronomic characters in rice. Generally, correlation coefficient analysis demonstrated the relationship among interdependent characteristics and the degree of linear relation between these characteristics. However, path coefficient analysis is more clarify in separatiing the two traits into the components which measure the direct and indirect effect (Seyed, 2011). Breeders had extensively used path coefficient analysis to explain direct and indirect effect in different crops species. A number of study have sucessfully used the information of path coefficient analysis to improve seed yield as observed in Bhadru *et al*., 2011 using 93 rice genotypes including both parents and progeny reported the significant porsitive asscociation of yield with phenotypic and genotyic levels. Seyom *et al*, 2012 reported that significant correlation between grain per panicle with grain yield in 14 rice genotyped.Therefore, the present study was carried out to investigate the relationships between agronomic characters between traits and to determine the direct and indirect effect of effective traits on grain yield. It is hope that the result of this study will serve as a basic information in which may be used as selection criteria in a rice breeding program.

Materials and Methods

Plant Materials

A total of 20 F_1 seeds froma a cross between Pongsu Seribu 2 and Mr 264 were collected from Agrotechnology and Bioprocess Divison, Malaysian Nuclear Agency, Bangi, Malaysia. Pongsu Seribu 2 was a resistant variety while MR 264 was a susceptible rice cultivar.

Experimental layout and measurement of variables

Seeds were pre-germinated by soaking in water at 25^{o}C for 48h before were grown at the Greenhouse. Seedling of each lines were transplanted separately into pots in Greenhouse. Measurement of variables were taken at the three main life history stages. The morphological characteristic were measured included plant height,total grain number, filled per panicle, area of flag leaf, number of tiller, panicle per plant, panicle length, 1000-weight grains and grain lenght (**Table 1**). Average value from different characters were determined from each type. Measurement of rice characters referred to standard evaluation system for rice (IRRI, 1996).

Data Analysis

Relationship between agronomic characters was analyzed using simple correlation analysis. Analysis was taken based on average data in each environment. Simple correlation analysis was computed using computer software package of SPSS version 16 statistical package.

Table 1. Agronomic characters measured during life-history stages of plant

Agronomic characters measured	Method of measurement
Plant height	Height from the base of the plant (soil line) to the tip of panicles of the main tillers at first flowering
Panicles lenght	Number of panicles lenght per individual at maturity
Total Grain Number	Total seeds produced from panicles
Filled grains per panicles	Number of seeds fill per panicles
Grain lenght	Lenght of each seeds produced from plant
No. of tillers	Number of tillers determined at first flowering for each individual
Flag leaf lenght	Length of leaf blof the main tillers at first flowering
Flag leaf width	Width of leaf blof the main tillers at first flowering
1000-grains weight	Weight of 1000 seeds per plant

Results and Discussions

Interrelationship between yields and its component plays a vital role in providing an information to breeder on the process of selection of yield contributing traits in a plants. In present study, the relationship between yield performance and nine agronomic characters were analyzed in twenty of F_1 lines. F_1 lines derived from a cross between a resistant cultivar, Pongsu Seribu 2 and a susceptible cultivar, MR 264. Results of the descriptive statistic were shown in Table 2. According to the result, maximum standard deviation belonged to total grain number (84.97) followed by filled grain per panicle (69.26) and plant height (18.43). Generally, all the agronomic characters demonstrated more phenotypic variation exclude the plant height which had less variation and more consistent.

Table 2. **Descriptive statistics in twenty F1 rice lines for some agronomic characters**

Characters	Range	Mean	Standard Deviation	Coefficient of variation (%)
PH	41 – 98	66.53	18.43	27.70
PL	17.5 – 37	25.43	4.13	16.24
TGN	0 – 382	250.65	84.97	33.90
FGP	0 – 283	180.55	69.26	38.36
GL	0 – 3.5	2.35	0.75	31.91
NOT	5 – 25	13.70	5.55	40.51
FL	0 – 75	52.25	17.24	33.00
FW	0 – 2.4	1.91	0.52	27.23
TGW	0 – 19.8	16.52	4.17	25.24

PH = Plant height (cm), PL = Panicle length (cm), TGN = Total Grain Number, FGP = filled grains per panicle,
GL =Grain length, NOT = No. of Tillers, FL = Flag leaf Area, FW = Flag leaf width, TGW = 1000-grains weight (g)

Selection of the yield contributing characters simultaneously will improve the grains yield in subsequent segregation population (Eidi kohnaki *et al*., 2013). Hence, the correlation analysis is therefore necessary to determine the direction of selection and the number of characteristics need to be considered in improving grain yield. Result in Table 3 showed that there was a positive and highly significants correlation between total grains weight with total grain number (r = 0.647), filled grains per panicle (r = 0.603), grain lenght (r = 0.834), flag leaf lenght (r = 0.701) and flag leaf width (r = 0.894) at ($p \leq 0.01$). Among the characters, flag leaf area give the highest correlation coefficient value. This is because the flag leaf is the most important site of photosynthesis for supplying carbon to grains (Cook and Evans 1983), and the degree of senescence of this leaf is statistically will increased the yield grains production. Findings indicated that all the characters will be considered in simultaneous selection on enhancing the yield for next population. Similar findings also observed in the study made by Gulzar et al (2012) for total grains number and Seyed et al., 2013 for flag leaf lenght and width. However, panicle lenght and number of tillers demonstrated that there is no relationship with total grain weight with (r = 0.177 and r = 0.213), respectively. It seems that both criterion will not give any attribute on total grain weight for the plant.

Table 3. Correlation coeeficients among agronomic characters in twenty F_1 rice lines

Characters	PH	PL	TGN	FGP	GL	NOT	FL	FW	TGW
PH	1								
PL	0.104	1							
TGN	0.430	-0.076	1						
FGP	0.479*	-0.02	0.896**	1					
GL	0.743**	0.310	0.609**	0.575**	1				
NOT	-0.134	-0.527*	0.406	0.202	0.06	1			
FL	0.276	0.558*	0.484*	0.489*	0.618**	-0.139	1		
FW	0.462*	0.221	0.554*	0.553*	0.769**	0.274	0.641**	1	
TGW	0.461*	0.177	0.647**	0.603**	0.834**	0.213	0.701**	0.894**	1

* and ** , significant at the 0.05 and 0.01 level of probability, respectively.
PH = Plant height (cm), PL = Panicle length (cm), TGN = Total Grain Number, FGP = filled grains per panicle,
GL =Grain length, NOT = No. of Tillers, FL = Flag leaf Area, FW = Flag leaf width, TGW = 1000-grains weight (g)

Table 4. Coefficient of Determination among agronomic characters in twenty F_1 rice lines

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.952	0.907	0.840	1.6712

a. Predictors: (Constant),Plant height, Panicle length, Total Grain No, Filled grains per panicle, Grain length, No. of Tillers, Flag leaf Area, Flag leaf width
b. Dependent Variable: Total grain weight

Table 5. Regression model in twenty F_1 rice lines

Model	(Coefficient) B	Sig.
(Constant)	8.570	.070
Plant Height	–0.050	.201
Plant Length	–0.223	.149
Total Grain No	0.007	.635
Filled Grains per Panicle	–0.005	.758
Grain Length	2.801	.059
No of Tillers	–0.071	.596
Flag Leaf Area	0.048	.280
Flag Leaf Width	4.162	.024

a. Dependent Variable: Total grain weight

$\hat{y} =$ 8.570 – 0.050 Plant Height – 0.223 Plant Length + 0.007 Total Grain No – 0.005 Filled Grains per Panicle + 2.801 Grain Length – 0.071 No of Tillers + 0.048 Flag Leaf Area + 4.162 Flag Leaf Width

Based on the Table 4, adjusted R square value (0.840) indicates that relationship with plant height, panicle length, total grain number, filled grains per panicle, grain length, number of tillers, flag leaf area and flag leaf width explained 84 percent of the variance in total grains weight. Regression analysis revealed that flag leaf width (4.162) has highest direct effect on the yield followed by grain length (2.801), flag leaf area (0.048) and total grain no (0.07) respectively. Positive direct effect indicates that these traits were more contribute towards grain yields in this rice lines. Whereas, plant height (–0.05), plant length (–0.223), filled grains per panicle (–0.005) and number of tillers (–0.071) has indirect effect on the yield.

Conclusion

Characters with positive correlation on total grain weight included total grains weight with total grain number filled grains per panicle, grain lenght, flag leaf lenght and flag leaf width. Panicle lenght and number of tiller had no relationship on total grain weight. Both correlation and regression analysis, shows that flag leaf width and grain length will be highly effective for yield improvement can be consider in selection of breeding lines.

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