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Research Article

Association and Path Coefficient Analysis of Grain Yield and Its Attributing Traits in Different Genotypes of Wheat (*Triticum aestivum* L.)

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Abstract

Forty-one wheat genotypes were tested in randomized complete block design with three replications at experimental farm of Institute of Agriculture and Animal Science Paklihawa, Rupendehi, Nepal in 2014 spring season. The objective of this study was undertaken to estimate the correlation and path coefficient of yield and its contributing traits The data showed that the grain yield had significant associated with biomass and significant correlation with number of effective tillers (0.36*), thousand grain weight (0.376*) and harvest index (0.37*). Path coefficient analysis revealed maximum positive direct contribution towards yield by biomass (0.94) and harvest index (0.3).The study suggested that these traits may serve as effective selection attributes during breeding program for yield improvement in wheat.

Keywords: Wheat; Grain yield; Correlation; Path coefficient analysis

Introduction

Wheat (*Triticum aestivum L.*) is a food crop of high economic importance; being one of the largest crop of the world which covers 17% of the total cultivated land in the world. It is a staple food for 35% of the world's population providing more calories and proteins (niacin, thiamin) in the world's diet than any other cereals. The greater gluten protein content in its kernel in contrast to other cereals makes it uniquely possible to produce a wide array of end-products (CIMMYT, 2002).Wheat comes third in Nepal after rice and maize and is a major winter cereal crop in Nepal. Wheat grows well in temperature 15-18°C during grain filling period. It can be grown from below sea level to 5000 meter altitude and in areas where rainfall ranges between 300-1130milli meter. Factors like climate change, hindrance in selection of good genotypes, improper knowledge are resulting in decrease in its production and productivity annually. Grain yield is a complex trait and highly influenced by many genetic factors and environmental fluctuations. In plant breeding programme,

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direct selection for yield as such could be misleading. A successful selection depends upon the information on the genetic variability and association of morph-agronomic traits with grain yield. If the sources of variation in yield and the components are known, it may be a way to improve yield potential through specification of the modification of crops and improved farming operations (Fraser and Eaton, 1983). Correlation coefficient is an important statistical procedure to evaluate breeding programs for high yield, as well as to examine direct and indirect contribution of the yield variables as well as other variables through path coefficient analysis. Path coefficient analysis provides a better understanding of the association of different characters with grain yield. It is flexible means of relating the correlation coefficient between variables in a multiple system to the functional relations among them the method has been applied in quite a variety of cases. It seemed to be desirable now to make a restatement of the theory and to review the types of application, especially as there has been a certain amount of misunderstanding both of purpose and of procedure (Wright, 1934).

Material and Methods

The plant material was comprised of 41 genotypes of wheat. The genotypes was collected from National Wheat Research Program,Nepal. The investigation was carried out RCBD design with three replications at Agriculture College Farm, Institute of Agriculture and Animal Science (IAAS), Paklihawa, Rupendehi during December 2014. The recommended spacing of wheat in 22.5×8 cm. The data were taken from five randomly selected plants per genotype per replication was used. Data of the following mentioned traits DTB-Days to booting, DTH-Days to heading, PHV-Plant height at vegetative, PHM-Plant height at maturity, NH-Days to 50% anthesis, ANF-Days to 100% anthesis, FLS-Flag leaf senescence, PM-Days to physiological maturity, ET-Effective tillers, PL-Peduncle length(cm), SL-Spikelet's length(cm), GPS-Grain per spike, BM-Biomass(ton/ha), GY-Grain yield(ton/ha), HI-Harvest index, ST-Sterility(%), TGW- Thousand grain weight(gm) were recorded.

Statistical Analysis

Data were analyzed using software M-Stat-C and MS excel for path coefficient and for Correlation coefficients. Different traits were carried out using the formula given by Steel and Torrie (1980) by using SPSS program.

Results and Discussion

Correlation Analysis

Biomass, harvest index, effective tiller and thousand kernel weight were highly positive significant correlation with grain yield and selection for these traits might bring improvement in grain yield as shown in Table 1. Whereas individual trait, biomass exhibited highly significant correlation with other traits viz., effective tiller, thousand grain weight and grain yield. Akhtar and Choudhary (2006) reported similar result for positive significant association between grain yield and biomass yield. Sharma (1993) reported similar finding positive correlation between biomass and grain yield and number of effective tiller. Harvest index had positive and high significant association with grain yield. White and Wilson (2006) reported similar result for positive significant relation between harvest index and grain yield. Effective tiller exhibited highly significant positive association with biomass and grain yield. Kashif and Khaliq (2004) reported similar result for significant positive relation between no of tiller and grain yield. Thousand grains weight exhibited highly significant positive association flag leaf senescence, spikelet's length, biomass and grain yield. The result of negative association of grain yield with days to heading coincides with the finding trait but relation was significant (Yağdı and Sözen, 2009). Ashok *et al.* (2003) report negative association of heading day and maturity day with grain yield but relationship was significant.

Path Coefficient Analysis

Table 2 shows that direct effect of biomass (0.94) and harvest index (0.3) on grain yield had highest positive value as compared to all other traits, such as days to heading (0.031), exerted maximum positive direct effect on yield followed by days to 100% anthesis (0.018), days to 50% anthesis (0.055), Sterility percentage (0.0088),days to physiological maturity (0.0087), plant height at maturity (0.0082) and number of grains spike^{-1}(0.003) based on direct effect in path analysis but they were non-significant correlated with grain yield hence may not be statistically considerable. Similiarly correlation coefficient of effective tiller and thousand kernels weight were positive and significant with grain yield while there direct effects on grain yield were negative. However, negative direct effects of these traits were nullified by their positive indirect contribution via other yield components. Biomass showed the highest positive indirect contribution towards grain yield via harvest index (0.025), peduncle length(0.003), day to booting (0.002), plant height at maturity(0.002), physiological maturity (0.001) and grain per spike (0.001). However, it showed negative indirect effect via flag leaf senescence, days to 100 % anthesis, thousand kernels weight, days to 50 % anthesis, effective tiller and days to heading respectively. Leilah and Al-Khateeb (2005) showed that biological yield and harvest index had high positive direct effects on grain yield per area and the highest indirect effects were observed with weight of grains per spike, number of spikes per m^2 and 100-grain weight. Baylan and Singh (1987) reported similar result that biological yield had greatest direct effect in yield in four experimental population developed from 160 F2 plants.

Table 1: Pearson's correlation coefficient among 17 traits of 41 genotypes of wheat.

	DTB	DTH	PHV	PHM	ANH	ANF	FLS	PM	ET	PL	SL	GPS	BM	GY	HI	ST	TGW
DTB	1.00	.93**	-0.33	0.16	.66**	.41**	.68**	0.27	0.10	-0.22	-0.14	0.10	-0.05	-0.13	-0.26	0.03	-0.08
DTH		1.00	-0.27	0.12	.72**	.39*	.72**	0.22	-0.05	-0.10	-0.13	0.19	-0.04	-0.08	-0.11	0.03	-0.06
PHV			1.00	0.20	-0.25	-0.44	-0.21	-0.02	-0.14	0.12	0.28	-0.07	0.09	0.11	0.13	-0.21	0.30
PHM				1.00	-0.14	-0.40	0.05	0.08	0.02	.45**	0.08	-0.08	0.27	0.24	0.00	0.23	0.22
ANH					1.00	.74**	.71**	0.24	0.06	-0.06	-0.15	0.06	-0.19	-0.21	-0.13	-0.02	-0.02
ANF						1.00	.48**	0.21	0.07	-0.16	-0.17	0.06	-0.28	-0.31	-0.22	-0.12	-0.14
FLS							1.00	.45**	-0.02	-0.01	0.06	0.13	0.19	0.15	-0.05	-0.07	.321*
PM								1.00	0.13	-0.09	0.08	-0.15	0.09	0.07	-0.03	-0.11	0.19
ET									1.00	-0.30	-0.41	-0.09	.40**	.36*	-0.08	-0.06	-0.27
PL										1.00	0.07	-0.16	-0.12	-0.05	0.25	0.14	0.07
SL											1.00	0.19	0.09	0.10	0.10	-0.01	.55**
GPS												1.00	0.19	0.24	0.21	-0.23	0.04
BM													1.00	.95**	0.08	-0.05	.376*
GY														1.00	.37*	-0.11	.38*
HI															1.00	-0.24	0.05
ST																1.00	-0.03
TGW																	1.00

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed); DTB- Days to booting; DTH- Days to heading; PHV- Plant height at vegetative; PHM- Plant height at maturity; ANH- Days to 50% anthesis; ANF- Days to 100% anthesis; FLS- Flag leaf senescence, PM- Days to physiological maturity, ET- Effective tillers, PL- Peduncle length (cm), SL- Spikelet's length (cm), GPS- Grain per spike, BM- Biomass (ton/ha), GY- Grain yield (ton/ha), HI- Harvest index, ST- Sterility (%), TGW- Thousand grain weight (gm)

Table 2: Phenotypic path coefficient among grain yield and yield components in wheat genotype tested.

	DTB	DTH	PHV	PHM	ANH	ANF	FLS	PM	ET	PL	SL	GPS	BM	HI	ST	TGW
via DTB	**-0.048**	-0.045	0.016	-0.008	-0.032	-0.020	-0.033	-0.013	-0.005	0.011	0.007	-0.005	0.002	0.012	-0.002	0.004
via DTH	0.029	**0.031**	-0.008	0.004	0.023	0.012	0.022	0.007	-0.001	-0.003	-0.004	0.006	-0.001	-0.003	0.001	-0.002
via PHV	0.001	0.001	**-0.004**	-0.001	0.001	0.002	0.001	0.000	0.001	0.000	-0.001	0.000	0.000	-0.001	0.001	-0.001
via PHM	0.001	0.001	0.002	**0.008**	-0.001	-0.003	0.000	0.001	0.000	0.004	0.001	-0.001	0.002	0.000	0.002	0.002
viaANH	0.010	0.011	-0.004	-0.002	**0.016**	0.012	0.011	0.004	0.001	-0.001	-0.002	0.001	-0.003	-0.002	0.000	0.000
via ANF	0.008	0.007	-0.008	-0.008	0.014	**0.019**	0.009	0.004	0.001	-0.003	-0.003	0.001	-0.005	-0.004	-0.002	-0.003
via FLS	-0.017	-0.018	0.005	-0.001	-0.018	-0.012	**-0.025**	-0.011	0.001	0.000	-0.001	-0.003	-0.005	0.001	0.002	-0.008
via PM	0.002	0.002	0.000	0.001	0.002	0.002	0.004	**0.009**	0.001	-0.001	0.001	-0.001	0.001	0.000	-0.001	0.002
via ET	-0.001	0.000	0.001	0.000	0.000	0.000	0.000	-0.001	**-0.006**	0.002	0.002	0.001	-0.002	0.000	0.000	0.002
via PL	0.006	0.003	-0.003	-0.012	0.002	0.004	0.000	0.002	0.008	**-0.027**	-0.002	0.004	0.003	-0.007	-0.004	-0.002
via SL	0.001	0.001	-0.001	0.000	0.001	0.001	0.000	0.000	0.002	0.000	**-0.005**	-0.001	0.000	0.000	0.000	-0.003
via GPS	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	**0.003**	0.001	0.001	-0.001	0.000
via BM	-0.045	-0.039	0.082	0.259	-0.177	-0.259	0.182	0.082	0.381	-0.109	0.083	0.176	**0.941**	0.078	-0.048	0.354
via HI	-0.077	-0.032	0.038	0.000	-0.040	-0.065	-0.015	-0.010	-0.024	0.076	0.030	0.063	0.025	**0.300**	-0.071	0.015
via ST	0.000	0.000	-0.002	0.002	0.000	-0.001	-0.001	-0.001	0.000	0.001	0.000	-0.002	0.000	-0.002	**0.009**	0.000
viaTGW	0.001	0.001	-0.003	-0.002	0.000	0.002	-0.004	-0.002	0.003	-0.001	-0.006	0.000	-0.004	-0.001	0.000	**-0.011**
Total	-0.128	-0.076	0.109	0.238	-0.210	-0.308	0.154	0.069	0.362	-0.052	0.099	0.242	0.953	0.373	-0.114	0.348

DTB-Days to booting, DTH-Days to heading, PHV-Plant height at vegetative, PHM-Plant height at maturity, ANH-Days to 50% anthesis, ANF-Days to 100% anthesis, FLS-Flag leaf senescence, PM-Days to physiological maturity, ET-Effective tillers,
PL-Peduncle length (cm), SL-Spikelet's length (cm), GPS-Grain per spike, BM-Biomass (ton/ha), GY-Grain yield (ton/ha),
HI-Harvest index, ST-Sterility (%), TGW- Thousand grain weight (gm).

Harvest index showed the highest positive indirect contribution towards grain yield via biomass (0.078),day to heading (0.012), grain per spike (0.001) and flag leaf senescence (0.001). However, it showed negative indirect effect peduncle length (0.007), days to 100% anthesis, days to heading, sterility percentage, thousand kernel weight, plant height at vegetative stage respectively. Effective tiller exhibited had positive indirect contribution on grain yield via biomass, peduncle length, thousand kernel weight, spikelet's length(cm).plant height at vegetative stage, days to 50 % anthesis, days to 50 % anthesis, flage leaf senessence, physiological maturity whereas it had negative indirect effect via harvest index (0.024), day to booting(0.005) and days to heading(0.001). Thousand grain weight exhibited had positive indirect contribution on grain yield biomass, harvest index, days to booting, plant height at maturity, effective tiller and plant maturity however it was negative indirect effect via flag leaf senescence, days to 100 anthesis, spikelet's length, days to heading, plant height at vegetative. Path coefficient analysis showed that harvest index, biological yield and tiller number were most important contributor to yield. Majumder *et al*. (2008) reported similar result of harvest index had positive direct effects on grain yield of bread wheat.

Conclusion

Correlation analysis revealed that biomass, harvest index, effective tiller, and thousand kernel weights were most yield determinative traits hence simultaneous selection for these trait might brining an improvement in wheat grain yield. Path analysis using grain yield as dependent variable revealed that biomass and harvest index exerted maximum positive direct effect on grain yield and these trait could be relied upon for selection of genotypes to improve grain yield whereas, other traits days to 100% anthesis, days to 50% anthesis, Sterility percentage, days to physiological maturity, plant height at maturity and number of grains spike^{-1} were non-significant correlated with grain yield indicating relatively poor importance in yield improvement. On contrary, some character via effective tiller and thousand grains weight exerted negative direct effect on grain yield. However, negative direct effect of effective tiller and thousand kernel weights were nullified by their positive effects through other components traits flag leaf senescence, spikelet's length, biomass, which ultimately resulted in to highly significant positive correlation with grain yield. Hence, indirect selection through other component characters with which these two traits exhibited positive indirect effects can be recommended so as to bring improvement in grain yield. Thus, selection of genotypes having maximum biomass yield (kg ha^{-1}) and harvest index is pre-requisite for attaining improvement in grain yield.

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