PATH COEFFICIENT AND CORRELATION STUDIES OF YIELD AND YIELD ASSOCIATED TRAITS IN CANDIDATE BREAD WHEAT (*TRITICUM AESTIVUM* L.) LINES

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Abstract

Yield and yield contributing traits were studied in candidate bread wheat lines in order to find out the genetic contribution of different characters towards grain yield at NIFA, Peshawar, Pakistan during 2001-02. All the characteristics studied differed significantly from one another. Days to heading showed negative and significant correlation with harvest index and grain yield was not found with the biological yield. Days to maturity were negatively correlated at both genotypic and phenotypic levels with biological yield, harvest index and grain yield and the level of negative genotypic correlation was significant with harvest index and grain yield. Plant height showed negative genotypic and phenotypic correlation with harvest index and grain yield. Biological yield had positive significant genotypic and phenotypic correlation with harvest index and grain yield. Harvest index had positive and highly significant genotypic and phenotypic correlation with grain yield. Positive direct effect of days to heading, days to maturity and biological yield with grain yield were observed. Harvest index showed positive and highest direct effect on grain yield. Genotypic and phenotypic correlation coefficients revealed that important characters influencing grain yield (kg/ha) are harvest index and biological yield. Path analysis showed the importance in order of harvest index, biological yield, plant height, days to maturity and days to heading in grain yield.

Keywords: correlation, morphological traits, path coefficient, yield components, wheat genotypes

Introduction

The production of wheat has always been the main occupation of the farmers in the diversified agro-climatic conditions of NWFP, province of Pakistan. This is because wheat is an important source of human nutrition and deserves special attention. Evolution of varieties with high yield potential accompanied with desirable combination of traits has always been the major objective of wheat breeding programme. Wadington *et al.* (1986) reported that 1,000 grain weight was reduced slightly in modern high grain number cultivars. In the pre-green revolution

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era the major factor of low yield of varieties was their tallness which is negatively correlated with yield (Hatam and Akbar, 1995). Earlier Ihsanullah and Mohammad (2001) reported that correlations of days to heading with harvest index; 1,000 grain weight with harvest index and yield with harvest index were positively and significantly correlated. Thus the lines with medium height and higher harvest index would have potential for higher grain yield. Shahid *et al.* (2002) reported that plant height showed a strong negative genotypic correlation with grain yield. Path analysis identified that 1,000 grain weight and days to maturity had the positive direct effect on grain yield whereas days to heading and plant height had negative direct influence on the grain yield.

Bingham (1969) reported that a long vegetative period partly contributed to higher grain yield in common wheat. Spiertz *et al.* (1971) found a positive correlation between length of grain filling period and grain yield in spring wheat. Donald and Hamblin (1976) reported harvest index as breeding criteria in cereals. Hakam *et al.* (1977) concluded that to increase grain yield selection in the F_2 population should be for plants having high harvest index and high biological yield because all these characters are correlated with grain yield. Belay *et al.* (1993) carried out correlation studies between seed yield and nine components in durum wheat genotypes. The seed yield exhibited a strong positive association with all characters except days to heading and harvest index. Besides, the seed yield itself plant height and 1000 grain weight may also be considered good indirect selection criteria. Razzaq *et al.* (1986) reported that, the length of vegetative period has a positive influence on grain yield and a negative influence on grain filling period. Cultivars with the highest harvest index were found superior and efficient in apportion their dry matter into grain yield and vegetative part in a proper proportion.

The objectives of this study were:

1) To determine the correlation and direct and indirect influence of yield and yield associated traits.

2) To use these breeding lines in wheat breeding programs.

Materials and Methods

A number of bread wheat genotypes are routinely evaluated for yield and other agronomic characters each year at NIFA, Peshawar, Pakistan in order to select promising genotypes among them under field condition. The experimental material comprised 8 candidate wheat lines and two standard varieties as checks. These were planted in a micro plot trial in the randomized complete block design, with three replications at NIFA, Peshawar during 2001-02. The genotypes were CT-00019, CT-00037, CT-00051, CT-00108, CT-00131, CT-00271, CT-99023, CT-99186 along with two check varieties Bakhtawer-92 and Fakhre-Sarhad. The plot size harvested was 5 m x 1.20 m (4 rows, 5 m long) and row to row spacing was 30 cm. The data were recorded on days to heading, days to maturity, plant height (cm), Bio.Yield (kg/plot), grain yield (kg/plot), and harvest index (%). The harvest index was computed by the formula: Economic yield/Total biological yield * 100 (Singa, 1977). Days to heading were counted from the date of sowing till 50% of the heads emerged while days to maturity were recorded from the date of sowing till 75% of the plants were matured. A plant was assumed to be physiologically mature when 75 percent of the glumes of the primary spike turned yellow. The 1,000-grain weight was computed by counting the grains by an electric grain counter and then weighed by an electronic balance.

The correlation coefficients between all possible pairs of the characters were computed from the genotype means (Steel and Torrie, 1960) and the path coefficient analysis was conducted by the procedure following Dewey and Lu (1959).

Results and Discussion

The data regarding means of grain yield and other characters of ten different genotypes for the year (2001-02) are presented in Table 1. The mean differences are statistically significant for some of the genotypes. The data revealed that all the

characteristics studied differed significantly from one another (Table 2). Genotypic and phenotypic correlations are presented in Table 3. Generally the genotypic correlation coefficients were higher than the respective phenotypic correlation coefficients indicating the involvement of genetic factors more than the environmental ones. However, the direction of correlation was the same at both genotypic and phenotypic levels.

The coefficient of genotypic correlation showed highly significant and positive association of days to heading with days to maturity (0.9162) whereas positive but non-significant association was observed between days to heading and plant height (0.0686). Similar results were earlier reported by Shahid *et al.* (2002). Days to heading showed negative and significant correlation with harvest index (-0.6704) and grain yield (-0.7969) but was not found with the biological yield (-0.3917). At the phenotypic level, the correlation of days to heading was positive with days to maturity and plant height and negative with biological yield, harvest index and grain yield. The path analysis showed that days to heading had low but positive direct effect on grain yield at the genotypic level (0.0107). Its positive indirect effect was through days to maturity (0.0464) and plant height (0.0066) whereas its indirect effect was negative through biological yield (-0.2068) and harvest index (-0.5620). Earlier

Table 1. Means for grain yield and other characters

Line/var.	Grain yield	Days to heading	Days to maturity	Plant height	Biological yield	Harvest index	1,000 grain weight
CT-00019	4.0 cd	128 ab	164 a	108.6 a	14.9 bc	26.9 cd	29.4 bc
CT-00037	4.5 bc	126 bc	162 abc	95.7 e	13.6 c	32.8 ab	46.8 ab
CT-00051	5.0 ab	125 cde	162 abcd	96.1 e	16.0 ab	31.2 abc	41.6 ab
CT-00108	5.1 ab	122 f	160 e	99.9 d	15.9 ab	31.9 ab	28.8 bc
CT-00231	5.2 ab	121 f	162 bcd	110.1 a	16.3 ab	32.0 ab	50.8 a
CT-00271	3.7 d	126 bcd	162 abcd	108.2 a	14.0 c	26.5 d	31.2 bc
CT-99023	4.9 ab	129 a	164 ab	101.6 cd	15.6 ab	31.1 abc	41.6 bc
CT-99186	5.0 ab	123 def	161 de	107.1 ab	15.9 ab	31.7 ab	32.8 bc
Bukhtawar-92	5.5 a	123 ef	162 cde	89.7 f	15.6 ab	35.0 a	28.7 c
Fakhar-e-Sarhad	4.8 ab	126 bc	163 abc	104.2 bc	16.8 a	28.7 bcd	38.8 ab

Means sharing same alphabets are not significantly different according to DMRT and Different alphabets represent significance at 5% level of probability

Table 2. Mean squares for analysis of variance of different characters in micro plot trial Variables

Variables	d.f	Days to heading	Days to maturity	Plant height	Biological yield	Harvest index	Grain yield
Varieties	9	20.580**	4.597**	135.788**	0.187**	21.183**	648128.0**
Replication	2	2.031ns	0.125 ns	6.188ns	0.264*	20.099*	12480.0ns
Error	18	1.366	0.986	4.913	4.544	5.281	140904.9
Total	29						

* and ** significant at p = 0.05 and 0.01, respectively.

Shahid *et al.* (2002) reported negative direct effect of days to heading on grain yield.

Days to maturity was positively correlated with plant height at both genotypic and phenotypic levels whereas it was negatively correlated at both levels with biological yield, harvest index and grain yield and the level of negative genotypic correlation was significant with harvest index and grain yield. Opposite results were earlier observed by Singh *et al.* (1982). Positive direct effect of days to maturity and grain yield (0.0560) was observed (Table 3). Its indirect effect was positive through days to heading (0.0098) and plant height (0.0160) whereas it was negative through biological yield (-0.1995) and harvest index (-0.6218).

Plant height showed positive but non-significant genotypic (0.1011) and phenotypic (0.0591) correlation with biological yield but negative genotypic and phenotypic correlations with harvest index and grain yield. The level of negative genotypic correlation (-0.8221) of plant height with harvest index was highly significant. Earlier the negative correlation of plant height with yield was observed by Ahmad *et al.* (1980). Plant height directly affected the grain yield in

Table 3. Genotypic and phenotypic correlation coefficients matrix of micro plot trial

Variables		Days to heading	Days to maturity	Plant height (cm)	Biological yield	Harvest index (%)	Grain yield (kg/ha)
Days to heading	r_g	1					
	r_p	1					
Days to maturity	r_g	0.9162**	1				
	r_p	0.7632*	1				
Plant height (cm)	r_g	0.0686	0.1659	1			
	r_p	0.0657	0.1413	1			
Biological yield	r_g	-0.3917	-0.3747	0.1011	1		
	r_p	-0.1568	-0.0501	0.0591	1		
Harvest index (%)	r_g	-0.6704**	-0.7417*	-0.8221**	0.2840*	1	
	r_p	-0.3924	-0.2058	-0.5301	0.1318	1	
Grain yield (kg/ha)	r_g	-0.7069*	-0.7449*	-0.5299	0.7269*	0.8464**	1
	r_p	-0.3901	-0.193	-0.3581	0.6588*	0.8039**	1

* and ** significant at p = 0.05 and 0.01, respectively.

Table 4. Direct (in parentheses) and indirect effect of different traits on grain yield

Variables	Days to heading	Days to maturity	Plant height	Biological yield	Harvest index
Days to heading	-0.0107	0.0464	0.0066	-0.2068	-0.562
Days to maturity	0.0098	-0.0506	0.016	-0.1995	-0.6218
Plant height	0.0007	0.0084	-0.0963	0.0538	-0.6892
Biological yield	-0.0042	-0.019	0.0097	-0.5325	0.2079
Harvest index	-0.0072	-0.0375	-0.0792	0.132	-0.8383

the positive direction (0.0963). Contradictory results were earlier reported by Chowdhry *et al.* (1986) and explained that an adequate amount of dry matter is partitioned towards the height of the plant in taller plants, affecting the grain yield adversely. The positive indirect effect of plant height was through days to heading (0.0007), days to maturity (0.0084) and biological yield (0.0538) whereas the negative indirect effect was through harvest index (-0.6892).

The biological yield had a positive significant genotypic and phenotypic correlation with harvest index and grain yield. It also had a positive direct effect on grain yield (0.5325). It had a positive indirect effect through plant height (0.0097) and harvest index (0.2079) whereas a negative indirect effect through days to heading (-0.0042) and days to maturity (-0.0190).

Harvest index had a positive and highly significant genotypic and phenotypic correlation with grain yield. It was observed to have a positive and high direct effect on grain yield (0.8383) whereas a positive indirect effects through biological yield (0.1320). Harvest index had negative indirect effect through days to heading (-0.0072), days to maturity (-0.0375) and plant height (-0.0792).

The genotypic and phenotypic correlation coefficients revealed that important characters influencing grain yield (kg/ha) are harvest index and biological yield while the other characters showed a negative association with grain yield. The path analysis showed the importance in order of harvest index, biological yield, plant height, days to maturity and days to heading in grain yield of the experimental material used and in such specific environmental conditions.

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