Pak. J. Bot., 38(2): 417-424, 2006.

PATH COEFFICIENT ANALYSIS OF YIELD AND YIELD COMPONENTS IN BREAD WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES

MEHMET AYCICEK AND TELAT YILDIRIM*

Programme of Field Crops, Bingöl Trade College, Firat University, Bingöl, Turkey.

Abstract

With the trials conducted across two locations and over two years, the correlation coefficients and path analysis were calculated between grain yield and yield components of 20 bread wheat genotypes. Positive and significant correlation was found between yield and plant density, plant height, grain number per spike, grain weight per spike and 1000 kernels weight. Grain yield was negatively and significantly correlated with time to heading. Positive direct effect of plant height and grain weight spike^{-1} and negative direct effect of time to heading associated with significant correlation with grain yield suggested that these yield components may be a good selection criteria to improve yield of wheat genotypes.

Introduction

Yield, as a function of various components, is a complex character. It was suggested that yield depends on the number of spikes per unit area, the number of kernels per spike and the average kernel weight (Poehlman, 1994).

The grain yield and yield components of wheat are affected very much by the genotype and the environment. Therefore, as new cultivars are being produced by breeding, the relationships between yield and its components are studied by the breeders. To increase the yield, study of direct and indirect effects of yield components provides the basis for its successful breeding programme and hence the problem of yield increase can be more effectively tackled on the basis of performance of yield components and selection for closely related characters (Choudhry *et al*., 1986).

The aim of this study was to determine the correlations and path analysis of yield and yield components in bread wheat and evaluate their suitabilities in a breeding program.

Material and Methods

The experiments were conducted in two consecutive growing years (1999-2000 and 2000-2001) at the research plots at Pasinler and Ilica locations of Erzurum Province Center in Turkey (39^{o} 55' North, 41^{o} 16' East), with 1680 m and 1812 m above sea levels, respectively.

In Erzurum long-term average total precipitation is 389,9 mm year^{-1}, mean temperature for the whole year is 4.0^{o}C, and relative humidity is 67%. Precipitation during the experiments growing period for 1999-2000 and 2000-2001 was 238,8 mm and 364,5 mm in Ilica and 279,8 mm and 330,9 mm in Pasinler, respectively.

*Eastern Anatolia Agriculture Research Institute

Table 1. Bread wheat genotypes used in the experiment.

No.	Cultivars or lines	Pedigree
1.	DOGU-88	Commercial variety
2.	PALANDÖKEN-97	Commercial variety
3.	GEREK-79	Commercial variety
4.	KIRIK	Local variety
5.	TIR	Local variety
6.	BVDB-1	F.12.71/COC/BALL
7.	BVDB-2	WWY860243/3/SPN//63.189.66.7/BEZ
8.	BVDB-3	MLC/4/VPM/MOS951//HILL/3/SPN
9.	BVDB-4	NY242-20A-2USA-NY
10.	BVDB-5	ABN/JUN
11.	KARASU-90	Commercial variety
12.	HAWK	Commercial variety
13.	BVDK-1	KIRAC66/SERI/4/YMH/TUB//MCD/3/LIRA
14.	BVDK-2	PYN/BOW
15.	BVDK-3	GRK79/KAUZ//TXIA374-4/TX71A1039-V
16.	BVDK-4	SPN/VEE//SDY/NAC76
17.	BVDK-5	CLLF/BEZ//SU92/CII3645/3/NAI60/4/EMU/5/DYBR836
18.	BVDK-6	SB-285-2
19.	BVDK-7	KSB2142
20.	BVDK-8	N91L121

Twenty bread wheat genotypes (5 soft winter wheat lines, 8 red winter wheat lines, 2 local and 5 commercial cultivars) were used as genetic material in the trials (Table 1). The experiments were designed in a randomized complete block with three replications. The plot size was 6 m length with 6 rows and row spacing was 20 cm.

Genotypes were sown at the seed rate of 500 seed m^{-2} in November and harvested in the first half of August. Mineral fertilizer was applied at the rate of 60 kg N and 60 kg P_2O_5 per hectare.

In research, direct and indirect effects of traits were evaluated by correlation and path coefficients. Correlation and path coefficients were calculated by using **TARPOPGEN** Statistical Computer Programme.

Results and Discussion

Average values: The genotypes differed significantly for all traits indicating the presence of sufficient genetic variability for selection to identify the superior genotypes (Table 2). Data belong to investigated traits, as average of two years, two locations and 20 genotypes are shown in Table 3. Among these genotypes, grain yield ranged from 1030 to 7560 kg per hectare.

Correlation coefficients: Simple correlation coefficients calculated in every location and year and over locations and years are given in Table 4. Simple coefficient showed that there was a very strong (r=0,719) positive correlation between plant number and grain yield. Previous authors had reported similar results between grain yield and spike number (Hadjichristodoulou, 1989; Sharma & Rao, 1989; Mohan *et al*., 1993; Akanda & Mundt, 1996; Dokuyucu & Akkaya, 1999; Mondal *et al*., 2001). Grain yield was positively and

Table 3. Data belong to SN, PH, GN, GW, 1000 KW, TH and GY by the average of locations, years and genotypes.

Traits	Range	Mean
Spike number M^{-2}	344-1613	719
Plant height (cm)	50.0-120.0	83.6
Grain number $spike^{-1}$	35.0-44.0	40.2
Grain weight $spike^{-1}$ (g)	0.75-1.39	1.15
1000 kernel weight (g)	33.0-43.1	38.3
Time to heading (days)	152-168	162
Grain yield $hectare^{-1}$ (kg)	1030-7560	3030

significantly correlated with plant height (r=0,731). Some authors also reported positive and significant correlations between yield and plant height (Subhani & Khaliq, 1994; Chaturvedi & Gupta, 1995; Sharma *et al*., 1995; Khan *et al*., 1999). Simple correlation coefficient was positive and significant between grain yield and grain number per spike (r=0,250). In most of the previous studies, similar results have been reported between grain yield and grain number per spike (Sharma & Rao, 1989; Mohan *et al*., 1993; Singh & Sharma, 1994; Subhani & Khaliq, 1994; Sharma *et al*., 1995; Aruna & Raghavaiah, 1997; Dokuyucu & Akkaya 1999; Narwal *et al*., 1999; Khan *et al*., 1999; Mondal & Khadjura, 2001; Mohammad *et al*., 2002). Grain yield was positively and significantly correlated with grain weight per spike (r=0,488). Mohan *et al*., (1993), Aruna & Raghavaiah, (1997), Moghaddam *et al*., (1998), Dokuyucu & Akaya (1999) and Ismail (2001) had reported similar results between grain yield and grain weight. 1000 kernels weight showed significant positive association with grain yield (r=0,518). This result is in agreement with the results of Sarkar *et al*., (1988), Hadjichristodoulou, (1989), El-Marakby *et al*., (1994), Subhani & Khaliq (1994), Mondal *et al*., (1997), Dokuyucu & Akaya, (1999), Mondal & Khajuria (2001) and Sarkar *et al*., (2002). In the study highly negative correlation of time to heading and grain yield was observed (r=0,899). Yildirm *et al*., (1996), Mondal *et al*., (1997), Narwal *et al*., (1999) and Ismail (2001) found similar results in their studies. On the other hand, in some studies, negative correlations between grain yield and plant height (Mondal *et al*., 1997; Mohammad *et al*., 2002) and grain weight (Esmail, 2001; Mohammad *et al*., 2002) and positive correlations between grain yield and time to heading (Chaturvedi & Gupta, 1995; Aruna & Raghavaiah, 1997) had been found.

Path coefficient analysis: In this research, the response variable grain yield (GY) and six predictor variables, spike number $meter^{-2}$ (SN), plant height (PH), grain number $spike^{-1}$ (GN), grain weight $spike^{-1}$ (GW), 1000 kernel weight (1000 KW) and time to heading (TH), were studied for path coefficient (Table 5).

The direct effect of spike number M^{-2} (SN) on grain yield (GN) was too small (0.0627). The indirect effects of SN via GN, GW and 1000 KW were also small (0.0040, 0.0422 and 0.0183 respectively), via PH was moderate (0.1208) and via TH was high (0.4706). In most of the previous studies, SN had positive direct effect on the GY (Gebeyehou *et al*., 1982; Sharma & Rao, 1989; Garcia *et al*., 1991; Dofing & Knight, 1992; Chaturvedi & Gupta, 1995; Akanda & Mundt, 1996; Dokuyucu & Akaya, 1992; Mohammed *et al*., 2002).

Plant height (PH) had a strong positive direct effect on grain yield (GY) (0.2255). Some authors also indicated the positive direct effect of PH on GY (Chaturvedi & Gupta, 1995; Khan *et al*., 1999; Moghaddam *et al*., 1998). On the other hand some authors pointed that PH had negative direct effect on GY (Subhani & Khaliq, 1994; Mondal *et al*., 1997; Mohammed *et al*., 2002). The indirect effect of PH via SN, GN, GW and 1000 KW were small, via TH was great.

The direct effect of grain number spike^{-1} (GN) on GY was positive but small (0.0199). Similarly, there are reports indicating the positive effect of GW on GY (Sarkar *et al*., 1988; Sharma & Rao, 1989; Singh & Sharma, 1994; Subhani & Khaliq, 1994; Moghaddam *et al*., 1998; Narwal *et al*., 1999; Khan *et al*., 1999; Mohammed *et al*., 2002). The indirect effect of GN due to SN and 1000 KW was small, due to PH, GW and TH were great.

Grain weight spike^{-1} (GW) had a positive direct effect on GY (0.1320). Similar results had been reported by some authors (Mohan *et al*., 1993; Aruna & Raghavaiah, 1997; Moghaddam *et al*., 1998; Dokuyucu & Akaya, 1999; Ismail, 2001). The indirect effects of GW via all components were positive. These indirect positive effects were small via SN, GN and 1000 KW and great via PH and TH.

The direct effect of 1000 kernel weight (1000 KW) on GY was positive and small (0.0392). In some of the previous studies this positively direct effect had been found (Sharma & Rao, 1989; El-Marakby *et al*., 1994; Mohammed *et al*., 2002). The indirect effects of 1000 KW via SN, PH, GN and GW were positive and small, but via TH was also positive but great.

The only character having negative direct effect on GY in the trial was time to heading (TH). The negative direct effect of TH on GY was highly great (0.6406). Some authors also indicated the negative effect of TH on GY (Yildirim *et al*., 1996; Narwal *et al*., 1999). The indirect effect of TH due to, SN, GN, GW and 1000 KW was negative and small, due to PH was negative moderate.

Conclusion

Our results obtained from 20 bread wheat genotypes and combined 2 years and 2 locations showed that grain yield was significantly and positively correlated with all the characters, except time to heading. Grain yield was significantly and negatively related with time to heading.

Path coefficient analysis indicated that the direct effects of spike number meter^{-2}, grain number spike^{-1} and 1000 kernel weight on grain yield were weakly positive, the direct effects of plant height and grain weight spike^{-1} were strongly positive, time to heading was strongly negative. Therefore, the characteristics of plant height, grain weight spike^{-1} and time to heading can be used as selection criteria to increase grain yield in bread wheat in the region.

References

Akanda, S.I. and C.C. Mundt. 1996. Path coefficient analysis of the effects of stripe rust and cultivar mixtures on yield and yield components of winter wheat. *Theoretical and Applied Genetics*, 92(6): 666-672.

Aruna, C. and P. Raghavaiah. 1997. Correlations and analysis of yield and quality in aestivum wheat (*Triticum aestivum* L.). *Journal of Research ANGRAU*, 25(4): 21-25.

Chaturvedi, B.K. and R.R. Gupta. 1995. Selection parameters for some grain and quality attributes in spring wheat (*Triticum aestivum* L.). *Agricultural Science Digest Kernal*, 15(4): 186-190.

Choudhry, A.R., A.H. Shah, L. Ali and M. Bashir. 1986. Path coefficient analysis of yield and yield components in wheat. *Pak. J. Agric. Res*., 7(2): 71-75.

Dofing, S.M. and C.W. Knight. 1992. Alternative model for path analysis of small grain yield. *Crop Sci*., 32: 487-489.

Dokuyucu, T. and A. Akaya. 1999. Path coefficient analysis of correlation of grain yield and yield components of wheat (*Triticum aestivum* L.) genotypes. *Rachis*, 18(2): 17-20.

El-Marakby, A.M., M. Yasein, A.A. Mohammed and A.M. Tolba. 1994. Correlation and path analysis for yield attributes in F_2 and F_3 segregating populations of five wheat crosses. *Annals of Agricultural Science*, Moshtohor, 32(3): 1065-1072.

Esmail, R.M. 2001. Correlation and path coefficient analysis of some quantitative traits with grain yield in bread wheat (*Triticum aestivum* L.). *Bulletin of the National Research Centre*, Cairo, 26(3): 395-408.

Garcia, M.L.F., F.M. Ramos, M.B. Garcia and T.M.P. Jimenez. 1991. Ontogenetic approach to grain production in spring barley based on path coefficient analysis. *Crop Sci*., 31: 1179-1185.

Gebeyehou, G., D.R. Knott and R.J. Baker. 1982. Relationships among durations of vegetative and grain filling phases. Yield components and grain yield in durum wheat cultivars. *Crop Sci*., 22: 287-290.

Hadjichristodoulou, A. 1989. Environmental correlations among grain yield and other important traits of wheat in drylands. *Euphytica*, 44(1-2): 143-150.

Ismail, A.A. 2001. Identification of selection traits for yield improvement of bread wheat using path analysis. *Assuit Journal of Agricultural Sciences*, 32(2): 63-84.

Khan, H.A., M. Shaik and S. Mohammad. 1999. Character association and path coefficient analysis of grain yield and yield components in wheat. *Crop Research*, Hisar, 17(2): 229-233.

Moghaddam, M., B. Ehdaie and J.G. Waines. 1998. Genetic variation for and interrelationships among agronomic traits in landraces of bread wheat from southwestern Iran. *Journal of Genetics and Breeding*, 52(1): 73-81.

Mohammad, S., M. Fida and T. Mohammad. 2002. Path coefficient analysis in wheat. *Sarhad Journal of Agriculture*, 18(4): 383-388.

Hohan, D.S.R., S. Harbir, O.P.S. Khola and H. Singh. 1993. Correlation and path analysis is late sown bread wheat (*Triticum aestivum* L.) cv WH 291. *Crop Research*, Hisar, 6(1): 72-77.

Mondal, A.B., D.P. Sadhu and K.K. Sarkar. 1997. Correlation and path analysis in bread wheat. *Environment and Ecology*, 15(3): 537-539.

Mondal, S.K. and M.R. Khajuria. 2001. Correlation and path analysis in bread wheat (*Triticum aestivum* L.) under rainfed condition. *Environment and Ecology*, 18(2): 405-408.

Narwal, N.K., P.K. Verma and M.S. Narwal. 1999. Genetic variability, correlation and path coefficient analysis in bread wheat in two climatic zones of Hayrana. *Agricultural Science Digest*, Karnal. 19(2): 73-76.

Poehlman, J.M. 1994. *Breeding Field Crops*. Third Ed. Iowa State University Press.

Sarkar, A.K., J.M.C. Gulati and B. Misra. 1988. Path coefficient and correlation study in wheat. *Environment and Ecology*, 6(3): 774-775.

Sharma, S.C. and S.R.G. Rao. 1989. Genetic variability, association among metric traits and path coefficient analysis in Triticale. *Annals of Agricultural Research*, 10(2): 145-152.

Sharma, D.J., R.K. Yadav and R.K. Sharma. 1985. Genetic variability and association of some yield components in winter spring nursery of wheat. *Advances in Plant Sciences*, 8(1): 95-99.

Singh, I. and S.K. Sharma. 1994. Inter-relationship of harvest index and other traits in wheat. *Hayrana Agricultural University Journal of Research*, 24(1): 33038.

Subhani, G.M. and I. Khaliq 1994. Path coefficient analysis in wheat. *Pakistan journal of Scientific and Industrial Research*, 37(11): 474-476.

Yildirim, M.B., N. Budak and Y. Arshad. 1996. Factor analysis of yield and related traits in bread wheat. *Turkish Journal of Field Crops*, 1(1): 11-15.

(Received for publication 30 March 2005)