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Correlation and Regression Analysis for Heading Date, Yield and Yield Contributing Characters in Wheat under Water and Phosphorus Stress

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Abstract: Data on heading date, biomass, yield and yield components were collected to study the correlation coefficient and simple regression under water and phosphorus stress conditions. Yield per plant and plant height showed significant positive association with effective tillers per plant, spike length, spikelets per spike, florets per spike, grains per spike, biomass per plant, and negatively correlated with total tillers per plant. Total tillers per plant also showed significant positive correlation with 100-grain weight. Effective tillers per plant exhibited high positive correlation with grains per spike and biomass per plant. Grains per spike was positively correlated with biomass per plant but negatively with 100-grains weight. Hundred-grains weight had positive correlation with yield. The regression coefficients for plant height, spikelets per spike, florets per spike, spike length, biomass per plant, effective tillers per plant and grains per spike on yield per plant were positively significant.

Key words: Correlation, regression, yield, wheat, stress

Introduction

Yield is the product of its several component traits developing sequentially in the ontogeny of wheat plant. Heading date plays an important role in the determination of biomass. The yield, yield components, biomass and heading date are all influenced by the changes in growing environment and the plants heredity. Soil moisture, soil fertility and atmospheric temperature affect the growth processes development and expression of yield components. The degree of association between plant traits are judged by correlation coefficients and the rate of change in one trait due to changes in the other are measured by regression coefficient. This information is of considerable importance in selection practice for the prediction of correlated response (Larner, 1958). Considering the importance of correlation and regression the present study was conducted to examine the best combination of characters for yield determination.

Materials and Methods

A pot experiment was carried out in the net house of the experimental farm of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh during the period from 1996 to 1997. The experiment was laid out in a factorial design comprising seven genotypes, two levels each of water and phosphorus in three replications. Thus, 28 pots were allotted for each replication. Forty two out of 84 pots received recommended rates of urea, TSP and MP. The remaining 42 plastic pots also received similar rates of fertilizers without phosphorus. Two levels of water were as follows: well-watered, fully watered throughout the growing period (I_1) and water stressed, withholding of water application from 26 to 52 days after transplanting to develop stress at peak tillering stage (I_0).

Following two levels of Phosphorus (mg/kg soil) were used

(1) P-stressed ___ 0 (P_0)

(2) P-treated ___ 100 (P_1)

Three seedlings of 4 days age were transplanted to each pot. After establishment of seedlings only one was removed from each pot. In pots assigned to the stress treatments, watering was stopped from 26 to 52 days after transplantation. Thereafter, the pots were watered normally as before the onset of water stress. Other intercultural operations were done as and when necessary. Data on heading date, yield components, yield, biomass and other characters were recorded from a sample of six plants.

The correlation coefficients were computed from the pooled data for each pair of characters in all possible combinations following the formula used by Singh and Chawdhary (1979). The functional form of the linear relationship between a dependent variable Y and an independent variable X was calculated according to equation given by Gomez and Gomez, (1984). X represents the amount of change in Y for each unit change in X.

Results and Discussion

The significant positive correlation of heading date with plant height indicated that lateness was associated with tallness of the genotypes. This character had significant positive correlation with plant height, effective tillers per plant, spike length, spikelets per spike, florets per spike and grains per spike (Table 1). The results indicated that late headed genotypes produced higher magnitude of mean value of these characters. The relationships of heading date with total tillers per plant and 100-grains weight were significantly negative indicating that early headed genotypes would not increase grain plumpness and number of total tillers. Barma *et al*. (1990) observed negative correlation between heading date and 100-grains weight. The correlation of heading date with biomass per plant and yield per plant were positive but not significant. Singh (1972) observed similar relationships between yield and heading date. Ehdaie and Waines (1989) reported positive correlation between heading date and biomass.

In this study plant height showed highly significant positive correlation with effective tillers per plant, spikelets per spike, spike length, florets per spike, grains per spike, biomass per plant and yield per plant indicating that taller plants performed better for these characters. Shandhu and Mangat, (1985), Eunus *et al*. (1986) and Belay *et al*. (1993) observed positive correlation between plant height and yield. These results suggested that tall genotypes produced higher biomass and

Table 1: Interrelationships among different yield contributing characters of seven genotypes

Characters correlated	Plant height	Total tillers /plant	Effective tillers/ plant	Spike length	Spikelets /spike	Florets/ spike	Grains/ spike	100-grains grains	Biomass /plant	Yield/ plant
Heading date	0.48**	-0.29**	0.27*	0.39**	0.56**	0.39**	0.38**	-0.55**	0.095	0.16
Plant height		-0.51**	0.35**	0.74**	0.64**	0.68**	0.78**	-0.28**	0.53**	0.57**
Total tillers/plant			-0.17	-0.56**	-0.54**	-0.70**	-0.69**	0.25*	0.11	-0.39**
Effective tillers/plant				0.11	0.08	0.13	0.42**	-0.03	0.47**	0.71**
Spike length					0.72**	0.74**	0.68**	-0.34**	0.26*	0.36**
Spikelets/ spike						0.72**	0.66**	-0.33**	0.31**	0.35**
Florets/spike							0.84**	-0.39**	0.17	0.48**
Grains/spike								-0.32**	0.43**	0.76**
100-grains weight									0.29**	0.08
Biomass/plant										0.70**

Df = 82, * = Significant at 5% level ** = Significant at 1% level

Table 2: Simple regression between yield and other plant characters

Plant characters	Intercept (a)	Slope (b)
Heading date	-0.42	0.080^{ns}
Plant height	-14.48	0.244**
Spikelets/spike	-3.61	0.437**
Florets/spike	-0.59	0.160**
Spike length	-3.54	0.778**
Grains/spike	0.078	0.171**
100-grain weight	3.47	0.320ns
Total tillers/ plant	8.09	-0.369**
Effective tillers/plant	-1.02	0.988**
Biomass/plant	-8.50	0.621**

ns = Non significant ** = significant at 1% level

yield. Plant height was found to have significant negative correlation with total tillers per plant and 100-grains weight. This indicated that increase in plant height would not increase number of total tillers per plant and 100-grains weight (Table 1).

Total tillers per plant showed significant positive correlation with 100-grains weight possibly due to increased supply of assimilates to the developing grains by tillers (Table 1). The relationship of total tillers per plant with other characters except biomass were negative but magnitudes of correlation values were low. Cantrell and Haro-Arias (1986) reported negative correlation between total tillers and spikelets per spike. Effective tillers per plant exhibited significant positive correlation with grains per spike, biomass per plant and yield per plant. Other characters were either not correlated or weakly correlated with effective tillers per plant. The positive correlation of effective tillers per plant with biomass and yield per plant suggested that increase in effective tillers per plant would increase the yield and biomass through the increased grains per spike. Sandhu and Mangat (1985) and Srivastava (1988) reported significant positive correlation between yield and effective tillers. Singh *et al*. (1999) also showed positive correlation between yield and effective tillers Sharma (1993) observed positive correlation between biomass and effective tillers.

The relationship of spike length with spikelets per spike, florets per spike, grains per spike, biomass per plant and yield per plant were highly significant and positive (Table 1). These results suggested that the longer the spike length the higher would be the number of spikelets per spike, florets per spike and grains per spike, biomass and yield per plant. Spike length was found to be negatively correlated with 100-grains weight. The reasons for such negative relationship between these characters could be due to the increased number of spikelets per spike, florets per spike and grains per spike competing for photosynthetic substances. Gasper and Zama (1990) observed significant correlation between grains number and spike length. Eunus *et al*. (1986) reported positive correlation between yield and spike length.

Spikelets per spike showed significant positive correlation with florets per spike, grains per spike, biomass per plant and yield per plant (Table 1). The results indicated that higher spikelet number would be accompanied by higher florets and grains per spike which in turn could increase the biomass and yield per plant. Jaimini *et al*. (1974) observed positive and significant correlation between yield and spikelets per spike.

Florets per spike displayed significant positive correlation with grains per spike and yield per plant. This indicated that increase in the number of florets per spike would also increase the grains per spike provided florets fertility was not limited by environmental factors. The relationship between florets per spike and 100-grains weight was significant and negative. This inverse relationship could possibly be due to the higher number of grains set per spike competent for phosphorus. The magnitude of correlation between florets per spike and biomass per plant was moderate but not significant.

Grains per spike had significant positive correlation with biomass per plant and yield per plant, and significant negative correlation with 100-grains weight (Table 1). The inverse relationship between grains per spike and 100-grains weight could be due to the compensation of grain weight by earlier formed grains per spike for photosynthetic substances. Raina *et al*. (1982) observed negative correlation of grains per spike with 100-grains weight and positive correlation with grain yield per plant. Singh *et al*. (1999) and Singh and Singh (2001) observed grains per spike had positive correlation with yield per plant. The results of present study showed conformity with these findings.

The relationship between 100-grains weight and biomass was significant and positive indicating that an increase in biomass would also increase 100-grains weight. But this character failed to contribute significantly to yield per plant perhaps due to the inverse relationship between grains per spike and 100-grains weight. Hossain (1995) observed non-significant positive correlation between grains yield and 100-grains weight.

The relationship between biomass and yield per plant was highly significant and positive. This result suggested that higher yield would be associated with the higher biomass. Shamsuddin (1990), Sanjari (1994) Yagbasanilar *et al*. (1995) and Chaturvedi and Gupta (1995) observed the similar results in wheat.

From the simple regression (Table 2) it was found that the regression coefficients for plant height, spikelets per spike, florets per spike, spike length, biomass, effective tillers per plant, grains per spike, were positively significant with yield indicating that increase in the values of these characters would increase the yield per plant. Total tillers per plant showed significant negative regression coefficient with yield

suggesting that yield would be decreased with the increase in total tillers per plant due to tiller mortality. The regression coefficients of heading date and 100-grains weight with yield per plant were not significant. This indicated that these characters had no influence on yield per plant.

Yield per plant was highly influenced by effective tillers per plant followed by spike length, biomass per plant and spikelets per spike (Table 2). In case of effective tillers per plant, if 1.0 unit of effective tillers per plant were increased then yield would be increased by 0.99 unit. Similarly, in case of spike length yield would be increased by 0.78 unit. On the other hand, if 1.0 unit of total tillers per plant was increased then yield would be decreased by 0.37 unit. The findings of the present study are based on a limited number of genotypes grown in pot conditions. Any future study on this aspect should include more number of genotypes to confirm these findings under field conditions.

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