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STUDIES ON INTERRELATIONSHIP AND PATH ANALYSIS IN WHEAT (*TRITICUM AESTIVUM* L. EM THELL) FOR YIELD AND COMPONENT TRAITS

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Abstract

The present investigation was carried out at Mountain Research Centre for Field Crops. SKUAST-K, Khudwani, Anantnag, Kashmir with 30 genotypes of wheat *(Triticum aestivum* L.). Data was analyzed for correlation and path analysis studies at both genotypic and phenotypic level. Results showed that biomass yield (0.891, 0.511), number of grains per spike (0.844, 0.538), and thousand seed weight (0.544, 0.359) exhibited significant positive correlation with grain yield at both genotypic and phenotypic level while as, days to maturity (-0.473, -0.609) exhibited negative correlation with grain yield per running meter at both genotypic and phenotypic level. Path analysis showed that characters *viz.* number of grains per spike (0.835, 0.035), biomass yield (0.71, 0.765) and harvest index (0.089, 0.598) had direct positive effect on grain yield per running meter at both genotypic and phenotypic level and the characters like days to maturity (-0.005, -0.0055) had negative direct effect on grain yield per running meter at both phenotypic and genotypic level, hence it is recommended that due preferences should be given to these character while selection for high yielding genotypes.

Keywords **:** Wheat, *Triticum aestivum*, interrelationship and path analysis.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important cereal crop of the world. It belongs to family graminae (Poaceae). Wheat is a crop of global significance grown in diversified environments ranging from temperate high mountainous regions to sea level and plays an important role in food and nutritional security of world. It provides food for 36% of the global population and contributes 20% of the food calories (Singh and Choudhary, 2006). Wheat is widely grown all over the world and stands first among the cereals both in area and production. Genetically wheat is more complicated than other domesticated cereals. Some wheat species are diploid (2n=2x=14), with two sets of chromosomes, but many are stable polyploids, with four sets of chromosomes (tetraploid) 2n=4x=28 or with six sets of chromosomes (hexaploid) 2n=6x=42.

In Jammu and Kashmir state wheat crop ranks second in cultivation after maize but third in production. In Kashmir wheat is cultivated in limited area due to climatic and geographical conditions. The area under wheat in Jammu and Kashmir is about 2.62 lakh hectares with an annual production of 36.68 lakh tones (Anonymous, 2012). The productivity is low 14 quintals per hectare as compared to national average of 27.13 quintals per hectare (Jagshoran and Mishra, 2005). Grain yield is a complex polygenic character controlled by many genes interacting with the environment and is the product of many factors. The selection of parents based on yield alone is often misleading (Selvaraj *et al*., 2011). Knowledge regarding the relative contribution of individual traits to yield may be accomplished by correlation studies. Correlation coefficient is a statistical measure, which is used to find out the degree and diversion of relationship between two or more variables. Correlation coefficient analysis measure the nature of relationship between various plant characters and determines economically important characters. However, simple correlation does not provide the adequate information about the contribution of each factor towards yield. Therefore, the techniques of path coefficient analysis are being used to get an idea of direct and indirect contribution of a trait towards the yield (Nandan *et al*., 2010).

Materials and Methods

The present investigation was conducted at Mountain Research Centre for Field Crops, Khudwani (34˚ N latitude and 74˚longitude) of Sher-e-Kashmir University of Agricultural Sciences and Technology- Kashmir. The experimental material of the study comprised of 30 genetically diverse genotypes of wheat *(T. aestivum* L.) Segregated Stock Nursery (SSN) which was maintained at Department of Genetics and Plant Breeding , MRCFFC, SKUAST- K, Khudwani, Anantnag. The experiment was sown in RBD with three replications, each comprising of 3 rows of 2m length and row to row spacing was maintained at 20 cm. Five randomly selected plants per lines and per three replication were used for recording data the observation on the following characters *viz.*, days to 50% flowering, days to maturity, plant height, number of tillers per running meter, flag leaf length (cm), flag leaf width (cm), spike length (cm), number of spikelets per spike, number of grains per spike, biomass yield (gms), harvest index, thousand seed weight (gms) and grain yield per running meter (gms) was recorded on plot basis. Analysis of variance was done for partitioning the total variation into variation due to treatments and replications according to procedure given by Panse and Sukhatme (1967). Estimation of genotypic and phenotypic correlation coefficient analysis levels between pair of characters adopting following formula given by Johnson *et al.* (1955).This technique was firstly used by Dewey and Lu (1959). Estimation of genotypic and phenotypic Direct and indirect path analysis was worked out by using the estimates of correlation coefficient in all possible combinations among the dependent variables.

Results and Discussion

Analysis of variance for 13 traits in 30 genotypes of wheat was done. Perusal of Table 1 revealed significant differences for MSS values of all the traits, which indicates relatively high magnitude of genetic variability among all the

genotypes under study at 1 % level of significance. Analysis of variance (ANOVA) revealed significant differences among all the genotypes for almost all the traits under study. Similar results were also reported by Ali *et al.* (2016), Kallim Ullah *et al.* (2012), Lal *et al.* (2009) and Kumar *et al.* (2018).

The mean sum of squares due to the genotypes (Table 1) were significant for all the characters except for flag leaf width, suggesting the existence of high genetic variability among the genotypes for all the traits. The genotypes SSN7 (343.687) followed by SSN4 and SSN25 recorded highest mean performance for grain yield. Similar findings were earlier also recorded by Maqbool *et al.* (2010), Sajjad *et al.* (2011) and Mecha *et al.* (2016).

In correlation studies (Table.2) the characters like biomass yield (0.891, 0.511) number of grains per spikes (0.844, 0.538), and thousand seed weight (0.544, 0.359) exhibited significant positive correlation with grain yield at both genotypic and phenotypic level. The character like days to maturity exhibited negative significant correlation with grain yield per running meter at both genotypic and phenotypic levels. (-0.473, –0.609). The same trend was previously reported by Khaliq *et al.* (2004), Masood *et al.* (2014), Sokoto *et al.* (2012) and Nawaz *et al.* (2013). Grain yield per plant has further been observed to have positive association with spike weight and grain weight per spike as well. Earlier Mahmood *et al.* (2006), Ali *et al.* (2008), Riaz-ud-Din *et al.* (2010); Ali and Shakor (2012) and Dutamo *et al.* (2015) have recorded the similar pattern of significant positive correlation with grain yield.

As the correlation studies can provide only one way information of effect of a character on yield therefore there is a need to find out the indirect effect i.e. via other characters on yield hence, path coefficient analysis was done to partitioned the effect into direct and indirect. From the perusal of Path analysis (Table 3) was revealed that characters like number of grains per spike (0.835, 0.035), biomass yield (0.71, 0.765) and harvest index (0.089, 0.598) had direct positive effect on grain yield per running meter at both genotypic and phenotypic level. Similar findings were also reported earlier by Lad *et al.* (2003), Saktipada *et al.* (2008). The high direct effects of the traits namely tillers per plant followed by number of grains per spike and hundred grain weight in the present investigation are in agreement with the earlier findings of Dwivedi *et al.* (2002), Okuyama *et al.* (2004) and Ali *et al.* (2008) and Subhash chandra *et al.* (2009) in wheat. The characters like days to maturity (-0.005, -0.0055) had negative direct effect on grain yield per running meter at both genotypic and phenotypic level.

Conclusion

From the experimental results it has been concluded that significant variation was existed among 30 wheat genotypes. Genotype SSN7 showed high mean performance for grain yield per running meter (343.687gms) correlation and path analysis revealed that biomass yield number of grains per spike, number of spikelets per spike, harvest index are the most important component characters that could be used as selection indices for further improvement in grain yield under any climatic condition.

Table 1 : Analysis of variance for mean sum of squares agro-morphological characters in wheat (*T. aestivum* L.*)*

	d.f.	Characters												
		DF	DM	PH	NTPRM	FLL	FLW	SL	NSPS	NGPS	BY	HI	1000 SW	GYPRM
Replications	**2**	88.033	83.411	121.544	29.303	2.616	0.072	1.303	92.144	55.681	4361.111	84.770	7.433	6915.137
Treatments	**29**	44.197**	72.235**	2551.635**	1190.653**	12.981**	0.079	3.500*	54.705**	48.938**	11119.738**	119.596**	72.526**	4816.125**
Error	**58**	6.804	18.993	305.747	29.719	2.826	0.029	2.032	17.482	9.937	3240.424	48.184	8.689	1984.763

where, * and ** Significant at 1% and 5% level of significance respectively, DF=Days to 50% flowering, DM=Days to maturity, PH=Plant height, NTPRM=Number of tillers per running meter, FLL=Flag leaf length, FLW=Flag leaf width, SL=Spike length, NSPS=Number of spikelets per spike, NGPS=Number of grains per spike, BY=Biomass yield, HI=Harvest index, 1000SW=1000 seed weight and GYPRM=grain yield per running meter

Table 2: Correlation coefficient analysis between grain yield and its component traits in wheat (*T. aestivum* L.*)* at genotypic and phenotypic level

Characters / Characters	Correlation coefficient	Days to 50% flowering	Days to maturity	Plant height	Number of tillers per running meter	Flag leaf length	Flag leaf width	Spike length	Number of spikelets per spike	Number of grains per spike	Biomass yield	Harvest index	1000 seed weight	Grain yield per running meter
Days to maturity	G	0.242*												
	P	0.170NS												
plant height(cm)	G	0.408**	-0.155NS											
	P	0.005NS	0.043NS											
No. of tillers per running meter	G	0.016NS	0.100NS	0.431**										
	P	-0.017NS	-0.004NS	0.135NS										
Flag leaf length(cm)	G	0.122NS	-0.016NS	0.030NS	0.107NS									
	P	0.148NS	-0.132NS	-0.030NS	0.092NS									
Flag leaf width(cm)	G	0.099NS	-0.312**	-0.252*	-0.093NS	0.545**								
	P	0.131NS	-0.133NS	-0.124NS	-0.082NS	0.418**								
Spike length	G	0.212*	-0.445**	-1.320**	-1.159**	0.279**	0.604**							
	P	0.102NS	0.002NS	0.006NS	-0.367**	-0.007NS	0.150NS							
No. of spike lets per spike	G	0.095NS	-0.311**	-0.638**	-0.559**	0.334**	0.197NS	1.015**						
	P	0.026NS	-0.173NS	-0.015NS	-0.380**	0.221*	0.185NS	0.198NS						
No. of grains per spike	G	0.239*	-0.254*	-0.293**	-0.231*	0.335**	0.346**	1.222**	0.583**					
	P	0.124NS	-0.058NS	-0.095NS	-0.181NS	0.329**	0.215*	0.166NS	0.252*					

Biomass yield(gm)	G	0.082^{NS}	-0.465**	1.242**	0.408**	0.345**	0.086^{NS}	0.128^{NS}	0.302**	0.533**				
	P	0.088^{NS}	-0.024^{NS}	0.045^{NS}	0.233*	0.181^{NS}	-0.006^{NS}	-0.005^{NS}	0.131^{NS}	0.400**				
Harvest index	G	-0.190^{NS}	-0.067^{NS}	-0.662**	-0.483**	-0.160^{NS}	0.321**	0.691**	0.008^{NS}	0.273**	-0.443**			
	P	-0.086^{NS}	-0.037^{NS}	0.049^{NS}	-0.216*	-0.016^{NS}	0.100^{NS}	0.142^{NS}	-0.033^{NS}	0.312**	-0.418**			
1000 seed weight(gm)	G	-0.178^{NS}	-0.465**	-0.004^{NS}	-0.386**	0.249*	0.377**	0.538**	0.574**	0.450**	0.267*	0.532**		
	P	-0.072^{NS}	-0.085^{NS}	-0.095^{NS}	-0.350**	0.145^{NS}	0.175^{NS}	0.149^{NS}	0.307**	0.335**	0.459**	0.110^{NS}		
Grain yield per running meter	G	-0.049^{NS}	-0.473**	0.698**	0.117^{NS}	0.165^{NS}	0.359**	0.810**	0.311**	0.844**	0.891**	0.129^{NS}	0.544**	
	P	0.038^{NS}	-0.609**	0.065^{NS}	0.087^{NS}	0.209*	0.116^{NS}	0.082^{NS}	0.181^{NS}	0.538**	0.511**	0.284**	0.359**	

Where, * and ** Significant at 1% and 5% level of significance respectively,

Table 3 : Direct and indirect effects between grain yield and its component traits in wheat (*T. aestivum* L.*)* at genotypic and phenotypic level

Character	Direct and indirect effects	Days to 50% flowering	Days to maturity	plant height (cm)	No. of tillers /meter	Flag leaf length(cm)	Flag leaf width(cm)	Spike length	No. of spike lets	No. of grains/ spike	Biomass yield(gm)	Harvest index	1000 seed weight(gm)
Days to 50% flowering	G	-0.23831	-0.00474	-0.00272	-0.001	-0.03153	0.04156	-0.01699	0.02442	0.16595	0.05801	-0.01693	-0.01859
	P	0.11478	-0.10093	0.00008	-0.00022	-0.00821	-0.01058	0.00026	0.00071	0.00436	0.06746	-0.0512	0.00801
Days to maturity	G	-0.21535	-0.00525	-0.03912	-0.0947	0.08485	0.94826	-0.03293	0.85665	-1.81065	0.33127	-0.0949	-0.09003
	P	-0.07573	0.30726	-0.01348	-0.01144	0.00643	-0.18676	0.03307	0.00304	-0.14248	-0.43746	-0.01375	0.01851
plant height(CM)	G	-0.09733	-0.03085	-0.00666	-0.02697	-0.00787	-0.10574	0.10583	0.14345	-0.1112	0.88114	-0.05894	-0.00042
	P	-0.12771	-0.0476	0.08701	-0.04931	-0.01253	-0.15093	0.09803	0.00625	-0.16432	1.16788	-0.13615	0.00016
No. of tillers per running meter	G	-0.00382	-0.00795	-0.00287	-0.06254	-0.0278	-0.03888	0.09289	0.16567	-0.2072	0.28963	-0.04301	-0.0403
	P	-0.00501	0.03074	0.03752	-0.11436	-0.04426	-0.0555	0.08605	0.00547	-0.12949	0.38388	-0.09935	0.01539
Flag leaf length(cm)	G	-0.02898	0.00172	-0.0002	-0.00671	-0.25923	0.2287	-0.02233	-0.105	0.17111	0.24494	-0.01427	0.02601
	P	-0.03802	-0.00478	0.00264	-0.01227	-0.41271	0.32644	-0.02068	-0.00327	0.18816	0.32464	-0.03297	-0.00994
Flag leaf width(cm)	G	-0.02362	-0.01187	0.00168	0.0058	-0.1414	0.41928	-0.04845	-0.06462	0.17069	0.06108	0.02858	0.03932
	P	-0.03099	-0.09588	-0.02194	0.01061	-0.22512	0.59847	-0.04488	-0.00193	0.19431	0.08096	0.06603	-0.01502
Spike length	G	-0.05051	-0.00216	0.00879	0.07248	-0.0722	0.25345	-0.08016	-0.49066	1.00974	0.0908	0.06151	0.05608
	P	-0.06627	-0.13685	-0.11488	0.13253	-0.11495	0.36176	-0.07425	-0.00993	0.68608	0.12035	0.1421	-0.02143
No. of spike lets per spike	G	0.01417	0.01095	0.00233	0.02523	-0.06628	0.06597	-0.09576	-0.4107	0.61853	0.2921	0.02041	0.06796
	P	-0.02964	-0.09558	-0.05555	0.06392	-0.13774	0.11793	-0.07536	-0.00978	0.32748	0.28448	0.00164	-0.02286
No. of grains per spike	G	-0.04736	0.01138	0.00089	0.01552	-0.05312	0.08571	-0.09693	-0.30422	0.83501	0.42433	0.02179	0.04753
	P	-0.07483	-0.07799	-0.02547	0.02638	-0.13835	0.20718	-0.09076	-0.00571	0.5613	0.5013	0.05617	-0.01793
Biomass yield(gm)	G	-0.01948	-0.00245	-0.00827	-0.02553	-0.08949	0.0361	-0.01026	-0.16908	0.49938	0.70953	-0.03946	0.02787
	P	-0.02556	-0.14293	0.10806	-0.04668	-0.14247	0.05152	-0.0095	-0.00296	0.29921	0.94042	-0.09115	-0.01065
Harvest index	G	0.04536	0.0056	0.00441	0.03023	0.04159	0.1347	-0.05541	-0.09423	0.20452	-0.31465	0.08897	0.05545
	P	0.05951	-0.02056	-0.05764	0.05528	0.06621	0.19226	-0.05133	-0.00008	0.1534	-0.41705	0.20554	-0.02118
1000 seed weight(gm)	G	0.04246	0.00453	0.00003	0.02416	-0.06465	0.15806	-0.0431	-0.26757	0.38045	0.18956	0.0473	0.10431
	P	0.05571	-0.14273	-0.00035	0.04418	-0.10292	0.22561	-0.03992	-0.00561	0.25256	0.25125	0.10926	-0.03985

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