CORRELATION AND PATH COEFFICIENT ANALYSES OF SOME BREEDING LINES OF THE MAN-MADE CROP, TRITICALE (X.*TRITICOSECALE* WITTMAK)

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Abstract

No information exists on association among traits in triticale genotypes is concerned in Ethiopia. Forty-nine triticale (X. triticosecaleWittmak) genotypes were evaluated for 13 traits in simple lattice design at Kulumsa and Assasa to study the association among grain yield and 12 yield-related traits. Grain yield showed positive and significant phenotypic correlation with biological yield, harvest index, and hectoliter weight at both locations. Path coefficient analysis showed biological yield, thousand kernel weight and number of kernels/spike exerted positive direct effect on grain yield at both phenotypic and genotypic levelsat each site and over the two locations.. Exceptions were genotypic path at Kulumsa, where only biological yield showed positive direct effect and at Assasa where number of kernels found to have negative direct effect. Among these characters biological yield showed the highest direct effect except for the genotypic path combined over the two locations. The indirect effects these characters had with other traits were either positive but negligible or negative for most instances. Therefore, the direct effect is the cause of the correlations among the traits. Overall, inattempts to improve the grain yield of these lines through selection, selecting for character biological yield will be rewarding.

Key words: Correlation; genotypes; path; triticale, *X.Triticosecale*

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Introduction

Triticale (X. t*riticosecale*Witmack) is a hybrid of wheat *(Triticum)* and rye (*Secalecereale*). It is the first man-made cereal with greater sink capacity, seedling vigor and tolerance to unfavorable conditions and superior nutritional quality (Reddy and Reddy, 1993). In 2011, the crop covered 4 million hectares yielding more than 13.5 million tons in 36 countries, of which, the primary producers werePoland, Germany, France, Belarus and China (FAO, 2011). Triticale was introduced and tested in Ethiopia in the1970's(Manfered and Tesfaye, 2003).It was very much restricted to the northern part of the country with very limited area coverage. The official release of the "Manyet" and "Sinan" varieties in 2002 by Adet Agricultural Research Center paved the way to a large scale seed multiplication and dissemination of the crop. Hence, large number of CIMMYT triticale genotypes have been introduced and tested under Ethiopian bread wheat improvement project. As a result, two improved varieties, Dilfekar and Logawshibo were released in 2007 by Kulumsa Agricultural Research Center. Besides, Derselign, a recent variety, was registered by Adet Agricultural Research Center in 2012. (Ministry of Agriculture, 2012)

Inadequate knowledge of interrelationships among various traits and the practice of unilateral selection for agronomic traits frequently end up with less than optimum result in plant breeding (Bhatt, 1973). The practical utility of selecting for a given character (yield related trait) as means of improving another character depends on the extent to which improvement in the major character is facilitated by selection for the indicators. Such improvement depends not only on the genotypic correlation but also on phenotypic correlation (Johnson *et al*. 1955b). Hence, correlation studies particularly between grain yield and yield related traits will give the opportunity to select most desirable traits which can bring about higher yield. Mohammadi*et al*. (2003) reported high correlation between grain yield and harvest index. Although correlation estimates are helpful in determining the components of complex trait such as yield, they do not provide an exact picture of the relative importance of direct and indirect influences of each of the component characteristics of this trait. Path-coefficient analysis partitions the correlation into direct and indirect effect (Dewey and Lu, 1959). Mohamad*et al*.(2006) found positive and high direct effect of harvest index on grain yield.

In Ethiopia, despite the introduction of large number of triticale breeding materials, no work has been done with regard to the interrelationships among characters. Hence, the present study was undertaken with the objective of assessing the associations among grain yield and yield- related traits of triticale in Ethiopia.

Material and Methods

Study areas

The experiment was conducted at Kulumsa and Assasa in 2005. Kulumsa Agricultural Research Center is located at an altitude of 2200 meters above sea level. The annual rainfall and average annual maximum and minimum temperatures are 828 mm, 22.2^0C and 9.12^0C, respectively. Assasa Agricultural Research sub-center is located at an altitude of 2000 meters above sea level. The average annual rainfall and average annual maximum and minimum temperatures of the area are 660 mm, 34^0C and 24^0C, respectively.

Experimental design and trial management

In this study, 49 triticale genotypes were taken from the different sets of triticale variety trials of the Wheat Breeding Section of Kulumsa Agricultural Research Center were laid out in 7x7 simple lattice design. The plot size was six rows of 2.5 m length with 0.2 m row spacing i.e. 1.2 m x 2.5 m = 3 m^{2}..Planting was done by hand drilling at seed rate of 150 kg/ha (45 g/plot), and fertilizer was applied at a rate of 60/69 kg/ha N/P_2O_5 in the form of Urea and DAP at both locations.

Data were collected on days to heading, days to maturity grain filling period, biomass yield (kg/plot), grain yield (kg/ha), harvest index, thousand kernel weight (g), hectoliter weight (kg/hl), tiller number per plant, plant height (cm),spike length (cm), number of spikelets per spike, and kernel number per spike,

Statistical Analyses

For all individual plant traits, the average of the 5 random samples of plants per plot were used for data analyses. The data were subjected to phenotypic and genotypic correlation and path coefficient analysis using SPAR1 software. For all traits, the mean data of the 49 triticale genotypes over the two test locations were used for simple linear correlation, as well as, for path coefficient analyses.

For linerarphenotypic and genotypic correlation coefficients, significant levels were determined by utilizing the formula suggested by Robertson (1959), using the t- table at (g-2) degrees of freedom at 5% and 1% levels of of probability.

In the path analyses, the path coefficient and the residual factor were estimated using the formula given by Dewey and Lu (1959), and for this, only six out of 13 characters that are believed to have direct relationship with grain yield were included in the path analysis (Dewy and Lu, 1959) and both the phenotypic and genotypic correlations were partitioned into direct and indirect effects using grain yield as a dependent variable.

Resultsand Discussion

Simple character correlations

Overall the phenotypic (r_p)and genotypic (r_g) correlation coefficient estimates between the pairs of the various characters of the 49 test genotypes over the two test locations showed that the genotypic correlation coefficients were higher than the respective phenotypic correlation coefficients for harvest index and thousand kernel weight (Table1). This indicates that the effectsof the genetic factors for these characters were more pronounced than that of the environmental ones.

Combined over the two locations, grain yield had positive and highly significant correlation coefficient with plant height, number of kernels/spikelet, biological yield, harvest index, hectoliter weight and thousand kernel weight phenotypically, and with harvest index,hectoliter and thousand kernel weight genotypically (Table 1). Likewise, Mollasadeghi*et al*.(2011)had reported positive and significant correlation of grain yield with thousand kernel weight. The correlation grainyield had with days to heading and days to maturity were significant and negative at both phenotypic and genotypic levels. This result was not consistent with the results reported by Mohammad*et al*. (2006).

Table 1. Phenotypic and genotypic correlation coefficient of the 13 characters forty nine triticale genotypes combined over Kulumsa and Assasa

		DM	**GFP**	**PH**	**SLN**	**SPL**	**KN**	**TI**	**BY**	**GY**	**HI**	**HW**	**TK**
DH	r_g	0.958*	0.841	-0.128	-0.136	0.617	-0.614	0.081	0.574	-0.998*	-0.932*	-0.916*	-0.972*
	r_p	0.871**	0.398**	0.141	0.055	0.562**	0.043	0.002	0.298*	-0.397**	-0.661**	-0.687**	-0.725**
DM	r_g		0.963*	-0.134	0.002	0.472	-0.692	-0.412	0.766	-0.981*	-0.974*	-0.982*	-0.993*
	r_p		0.721**	0.099	0.064	0.410**	-0.071	0.017	0.369**	-0.363*	-0.692 **	-0.728**	-0.726**
GFP	r_g			-0.158	-0.002	0.208	-0.725	-1.376**	0.831	-0.909*	-0.937*	-0.944 *	-0.955*
	r_p			0.012	0.050	0.089	-0.171	0.050	0.361*	-0.188	-0.505**	-0.488**	-0.462**
PH	r_g				0.254	0.231	0.210	0.831	0.308	0.423	0.287	0.292	0.217
	r_p				0.216	0.457**	0.459**	-0.066	.538**	0.487**	0.126	0.089	0.011
SLN	r_g					-0.045	-0.125	0.293	0.809	0.289	0.037	-0.075	0.134
	r_p					0.327*	0.248	0.129	0.338*	0.165	-0.071	-0.104	0.013
SPL	r_g						0.202	0.171	0.247	-0.251	-0.237	-0.367	-0.420
	r_p						0.483**	-0.035	0.353*	0.035	-0.220	-0.306*	-0.338*
KN	r_g							0.278	-0.924*	0.693	0.792	0.665	0.676
	r_p							-0.125	0.329*	0.446**	0.243	0.184	0.023
TI	r_g								0.679	0.715	0.142	-0.170	0.566
	r_p								-0.007	-0.025	-0.013	-0.031	-0.033
BY	r_g									-0.739	-0.807	-0.917*	-0.854

		DM	GFP	PH	SLN	SPL	KN	TI	BY	GY	HI	HW	TK
	r_p									0.520**	-0.243	-0.170	-0.190
GY	r_g										0.999*	0.884	0.917*
	r_p										0.687**	0.550**	0.499**
HI	r_g											0.951*	0.937**
	r_p											0.759**	0.706**
HW	r_g												0.847
	r_p												0.712*

Generally, in those characters with which grain yield showed positive and significant correlations, there appeared to be component interactions in which a gene conditioning an increase in one character (either biological yield or harvest index) will also influence another character (grain yield).On the other hand, the result of those characters thatshowed negative and significant correlation with grain yield,such as days to heading,indicates that after certain period any further increase in the number of days to heading will have adverse effect in the expected yield. Particularly in low moisture stress areas, those lines that exhibited longer number of days to heading do not fit well.

Path coefficient analysis

In the path coefficient analysis using the combined data over the two test locations, biological yield, which had positive and significant correlation coefficient, had the highest positive direct effect (0.539) phenotypically (Table 2). The direct effect was the cause of the correlation. This character genotypically had negative correlation coefficient and positive direct effect (Table 3). This suggests that the indirect effect was the cause of the correlation. Thousand kernel weight which also had positive and highly significant correlation phenotypically and significant correlationgenotypically, had positive direct effect phenotypically and the highest positive direct effect genotypically (Table 3). The indirect effect *via* other characters was either negative or negligible;hence, the direct effect was the cause of the correlation.Over and above, since biological yield had significant and positive correlation mostly and found to affect grain yield directly after path coefficient analysis selection based on this character will end up with locating the high yielder line.

Table 2. Estimates of direct (bold diagonal) and indirect effect (off diagonal) at phenotypic level of six traits on grain yield in 49 triticale genotypes combined over Kulumsa and Assasa

Traits	DH	PH	KN	TI	BY	TK	r_p
DH	**-0.328**	0.020	0.009	0.000	0.161	-0.260	-0.397**
PH	-0.046	**0.144**	0.097	-0.002	0.290	0.004	0.487**
KN	-0.014	0.066	**0.212**	-0.003	0.178	0.008	0.466**
TI	-0.001	-0.009	-0.027	**0.027**	-0.004	-0.012	-0.025
BY	-0.098	0.077	0.070	0.000	**0.539**	-0.068	0.520**
TK	0.237	0.002	0.005	-0.001	-0.102	**0.359**	0.499**

Residual= 0.2464

Table 3. Estimates of direct (bold diagonal) and indirect effect (off diagonal) at genotypic level of six traits on grain yield in 49 triticale genotypes combined over Kulumsa and Assasa.

Traits	DH	PH	KN	TI	BY	TK	r_g
DH	**5.489**	0.406	0.568	0.055	1.202	-8.719	-0.998*
PH	-0.702	**-3.176**	-0.194	1.901	0.644	1.949	0.423
KN	-3.373	-0.666	**-0.925**	1.530	-1.937	6.063	0.693
TI	0.446	-8.990	-2.106	**0.672**	5.613	5.081	0.715
BY	3.150	-0.977	0.855	1.799	**2.095**	-7.661	-0.739
TK	-5.333	-0.690	-0.625	0.380	-1.789	**8.973**	0.917*

Residual = 0.3001

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