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RESEARCH PAPER

Inter-relationship and path co-efficient analyses for yield components and seed quality parameters in wheat (*Triticum aestivum* L.)

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Abstract : Wheat attains unique position in agriculture and economy of our country because of being second most important food crop after rice. In the present investigation 72 Australian and Indian genotypes of bread wheat along with 3 checks *viz.*, HD-2329, DBW-17 and PBW-343 were evaluate during *Rabi* season, 2011-12. A very strong positive correlation of grain yield per plant at genotypic level was observed with 1000-seed weight, plant height, number of tillers per plant and days to 50 per cent flowering. Path co-efficient analysis, carried out at direct and indirect effects of different characters on seed yield per plant, identified plant height, days to 50 per cent flowering and number of spikelets per plant as major direct contributors towards seed yield per plant. 1000-seed weight, seedling length and number of tiller per plant emerged as most important indirect contributors to grain yield per plant.

Key Words : Wheat (*Triticum aestivum* L.), Character association, Path co-efficient, Grain yield

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INTRODUCTION

Wheat (*Triticum aestivum* L. em. Thell.; 2n=42), a self-pollinated crop of the Graminae family (Sub-family Poaceae) and genus *Triticum*, is the world's largest famous energy rich cereal crop. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. The majority of the cultivated wheat varieties belong to three main species of the genus *Triticum*, these are the hexaploid (2n=42), *T. aestivum* L. (bread wheat), the tetraploid (2n=28), *T. durum* Desf and the diploid (2n=14), *T. dicoccum* Schrank and *T. monococcum*. Gobally, *aestivum* wheat is most important species which covers 90 per cent of the area. Second popular wheat being durum wheat which covers about 9 per cent of the total area while *T. diccoum* wheat and *T. monococcum* wheat cover less than the one per cent of the total area. It has good nutrition profile with 12.10 per cent protein, 1.80 per cent lipids, 1.80 per cent ash, 2.0 per cent reducing sugars, 70 per cent total carbohydrates and provides 3.14 cal/100 g of food. Wheat is also used for whiskey and beer production and the husk can be separated and ground

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into bran.

At bio-chemical levels its involved energy, biosynthetic metabolism, co-ordination of cellular activity and transportation and utilization of reserve food. At germination levels it not only involves speed and totality germination but also punching power of the seedlings at different range of environmental condition. Thus, study of correlation and direct and indirect effects of seed traits provides the basis for successful breeding plant.

MATERIAL AND METHODS

In the present investigation 72 Australian and Indian genotypes of bread wheat along with 3 checks *viz.*, HD-2329, DBW-17 and PBW-343 were evaluated during *Rabi* season, 2011-12. The experiment was conducted in Augmented Block Design having 8 blocks of 12 plots each at Main Experiment Station Farm and seed quality parameters were tested in Seed Testing Laboratory of Seed Technology Section, Narendra Deva University of Agriculture and Technology, Narendra Nagar Kumarganj, Faizabad (U.P.). The observations were recorded on fifteen different traits *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of tillers per plant, length of spike (cm), number of spikelets per spike, number of grains per spike, 1000-grain weight (g), grain yield per plant, length of seed (mm), breadth of seed (mm), seed germination (%), root length (cm), shoot length (cm) and vigour index.

The nature of association among different characters was studied by using simple correlations (Searle, 1961) and path-co-efficient analysis (Wright, 1921 and Dewey and Lu, 1959). Seed germination percentage was investigated under lab condition, germination was estimated on the basis of 100 randomly selected kept for germination in germination papers at room temperature in germinator. The samples were kept in seed germinator maintained at 20^0C ± 1. Ten seedlings were randomly taken from each replication. On 8^{th} day seedlings were measured on meter scale. The unit length was in cm. The vigour index was calculated as per the method prescribed by Abdul-Baki and Anderson (1973) and expressed in whole number. The seeds were kept for germination following ISTA method.

RESULTS AND DISCUSSION

Seed is a basic input in agriculture and play a vital role in boosting up the productivity and economy of the country. Without the use of good quality seed, the investment, incurred on fertilizers, pesticides and water will not dividend which ought to be realized. The simple correlation co-efficient in the experiments was generally similar in sign, magnitude and nature to the corresponding characters. In the present investigation, simple correlation co-efficients were computed among 15 characters given in Table 1.

The grain yield per plant showed highly significant as positive correlation with number grains per spike (0.292), no. of spikelets per spike (0.298) and number of effective tillers per plant (0.383). The correlation of co-efficient of grain yield per plant with remaining twelve character was non-significant. Vigour index exhibited highly significant and positive correlation co-efficients with shoot length (0.868) and root length (0.850), while rest of characters were observed non-significant association with the character. Highly significant and positive correlation co-efficient of shoot length with root length (0.733), whereas the rest of fourteen characters had non-significant association with trait. Root length possessed highly significant and positive correlation with number of effective tillers per plant (0.322). The correlation co-efficient of root length was non-significant for remaining traits. Seed germination exhibited highly significant and positive correlation with 1000-seed weight (0.379) and remaining traits days to maturity, plant height, number of effective tillers per plant, length of seed, with of seed, root length, shoot length, vigour index and grain yield per plant were found non-significant. Breadth of seed indicated significant and positive association with 1000–seed weight (0.026) possessed non-significant correlation with rest of the characters. Length of seed showed significant association with all the character. 1000-seed weight possessed highly significant and positive correlation with number of grain per spike and number of effective tillers per plant while the rest of characters exhibited non-significant association with the character. Number of grains per spike, number of spikelets per spike, length of spike, number of effective tillers per plant, plant height and days to maturity expressed non-significant association with all the characters. Similar results were reported by previous workers (Bisht and Gahalain, 2009; Khokhar *et al.*, 2010; Soni *et al.*, 2011 and Singh *et al.*, 2012)

Path co-efficient analysis was worked out by using simple correlations among 15 characters to resolve the direct and indirect effect of different characters on grain

Table 1: Estimates of simple correlation co-efficients between different characters in wheat genotypes

Characters	Days to maturity	Plant height (cm)	No. of effective tillers /plant	Length of spike (cm)	No. of spikelets/ spike	No. of grains/ spike	1000-seed weight (g)	Length of seed (mm)	Breadth of seed (mm)	Seed germination (%)	Root length (cm)	Shoot length (cm)	Vigour index	Grain yield/ plant (g)
Days to 50% flowering	-0.012	0.063	0.083	-0.116	-0.014	0.176	0.067	-0.072	0.018	0.025	-0.056	-0.161	-0.117	0.021
Days to maturity		-0.051	0.112	-0.203	-0.091	0.065	-0.042	0.019	-0.165	-0.166	-0.028	0.061	0.051	0.032
Plant height (cm)			-0.008	0.144	0.071	-0.044	0.064	-0.066	0.060	0.053	0.147	0.001	0.047	-0.013
No. of effective tillers/plant				-0.0111	-0.140	0.066	0.341**	-0.118	0.052	0.068	0.322**	0.170	0.208	0.383**
Length of spike (cm)					0.040	0.012	-0.071	0.004	0.144	0.143	-0.080	-0.081	-0.138	0.041
No. of spikelets/spike						-0.164	-0.216	-0.024	0.218	-0.032	-0.003	-0.024	-0.026	0.298**
No. of grains/spike							-0.322**	0.133	0.050	-0.237*	0.099	0.080	0.187	0.292**
1000- seed weight (g)								-0.166	0.026*	0.379**	-0.148	0.081	0.057	-0.224
Length of seed (mm)									0.168	-0.137	-0.130	0.030	-0.052	0.021
Breadth of seed (mm)										-0.056	-0.017	-0.020	-0.030	0.073
Seed germination (%)											0.030	0.200	-0.219	0.059
Root length (cm)												0.733**	0.850**	0.053
Shoot length (cm)													0.868**	0.168
Vigour index														0.087

* and ** indicate significance of values at P=0.05 and 0.01, respectively.

Table 2 : Direct and indirect effects of different characters on grain yield / plant in wheat germplasm

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of effective tillers/plant/ plant	length of spike (cm)	No. of spikelets/ spike	No. of grain/ spike	1000 -seed weight	Length of seed (mm)	Breadth of seed (mm)	Seed germination (%)	Root length (cm)	Shoot length (cm)	vigour index	Correlation with grain yield (g)/ plant
Days to 50% flowering	0.851	-0.001	-0.812	0.008	-0.006	-0.001	0.019	-0.002	0.003	0.002	0.003	0.004	-0.057	0.019	0.021
Days to maturity	0.001	0.603	0.010	0.010	-0.610	0.006	-0.007	-0.007	-0.004	0.014	0.018	0.002	0.021	-0.008	0.032
Plant height (cm)	0.003	-0.001	-0.706	-0.001	0.006	0.705	-0.004	-0.011	0.002	0.005	0.006	-0.011	0.001	-0.007	-0.032
No. of effective tillers/plant	0.004	0.001	0.001	-0.797	-0.101	-0.102	0.007	-0.841	0.101	0.004	0.108	-0.017	0.137	-0.017	0.383
Length of spike (cm)	-0.006	-0.001	-0.029	-0.001	0.648	0.002	0.001	0.012	-0.600	0.012	0.001	0.006	-0.028	0.022	0.041
No. of spikelets/ spike	-0.001	0.001	-0.014	-0.003	0.001	0.970	-0.307	0.111	0.001	0.001	-0.703	0.001	-0.155	0.004	0.298
No. of grains/spike	0.009	-0.001	0.009	0.006	0.001	-0.004	0.908	0.250	-0.805	0.004	-0.228	-0.007	0.028	-0.039	0.292
1000˙ seed weight (g)	0.003	0.001	-0.013	0.023	0.001	-0.004	-0.031	-0.771	0.602	0.002	0.045	0.003	0.028	-0.009	-0.124
Length of seed (mm)	-0.003	-0.001	0.013	-0.001	0.003	-0.001	0.014	0.011	-0.039	0.014	-0.016	0.010	0.010	0.008	0.021
Breadth of seed (mm)	0.001	-0.001	-0.012	0.005	0.001	0.001	0.005	-0.004	-0.006	0.985	-0.906	0.001	-0.007	0.004	0.073
Seed germination (%)	0.001	0.001	-0.011	0.006	0.006	-0.002	-0.025	-0.065	0.005	-0.004	0.920	-0.802	0.071	-0.035	0.059
Root length (cm)	-0.003	-0.001	-0.030	0.021	-0.003	-0.001	0.010	-0.008	0.005	-0.001	0.003	-0.079	0.259	-0.137	0.053
Shoot ength (cm)	-0.008	0.001	-0.001	0.010	-0.003	-0.001	0.010	0.009	-0.001	-0.001	0.024	-0.058	0.954	-0.740	0.168
vigour index	-0.006	0.001	-0.009	0.010	-0.006	-0.001	0.006	-0.001	0.002	-0.002	0.026	-0.067	0.307	-0.161	0.087

yield per plant. The results of path co-efficient analysis are presented in Table 2. The highest positive direct effect on grain yield per plant was executed by breadth of seed (0.985), followed by number of spikelets per spike (0.970), shoot length (0.954), seed germination (0.920). Number of grains per spike (0.908), days to flowering (0.851). length of spike (0.648) and days to maturity (0.603) showed positive direct effect on grain yield. Number of effective tiller per plant exhibited highest negative direct effect (-0.797) followed by plant height (-0.706), 1000-grain weight (-0.771), length of seed (-0.039), root length (-0.079) and vigour index (-0.161).

Number of effective tillers per plant followed by 1000 seed weight, plant height, vigour index, root length and length of seed contributed negative direct effect on grain yield per plant. The direct effects of remaining characters were found to be too low to be considered of any consequence. The length seed and days to maturity exerted substantial positive indirect effect on grain yield per plant via breadth of seed. Length of spike, shoot length, vigour index, showed considerable negative indirect effect on grain yield per plant via days to maturity. Thus, above mentioned characters emerged as most important indirect yield contributing characters because they showed substantial positive indirect effects towards grain yield/plant via breadth of seed, which also made high direct contribution to grain yield. The six characters mentioned above have also been found as important contributors towards economic yield in wheat by earlier workers (Esmail, 2001; Sachan and Singh, 2003 and Zaeifizadeh *et al.*, 2011). The remaining estimates of indirect effects in this analysis were very low indicating their negligible indirect contribution towards grain yield/plant.

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