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Analysis of yield components and their association for enhancing grain yield in bread wheat (*Triticum aestivum* L. em Thell.) under saline-sodicity reclaimed condition

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Abstract

Experiment was conducted to assess direction, magnitude of association of different characters and contribution of various traits on yield for 143 wheat genotypes in which grain yield was assumed as dependent character. The variation due to checks was significant for all the character except for peduncle length and plant height while mean squares due to blocks were non-significant for all the characters except plant height and grain yield which indicated that the experimental site was heterogeneous. Highly significant and positive correlations were exerted in case of biological yield followed by productive tillers per plant, grains per spike, test weight, spike length while significant and positive association was observed for flag leaf area, harvest index and plant height. Path-coefficient analysis revealed that biological yield has high order of direct positive effect followed by harvest index, test weight, spike length, plant height, Productive tillers plant^{-1} and flag leaf area while other traits exhibited very low or negative direct effect on grain yield. The characters identified above can practiced for obtaining high yielding cultivar.

Keywords: Wheat, quantitative characters, correlation coefficient, path analysis and salt stress

Introduction

Soil salinity is a major restriction to food grain production because it bounds crop yield and confines use of land previously uncultivated, approximately 20 per cent of agricultural land and 50 per cent of cropland in the world is salt-stressed (Flowers and Yeo, 1995). Usually salt-affected soils develop due to low-rainfall, lack of leaching, high concentration of cations, poor drainage facility and exceeded precipitation, accumulation of soluble salts on the soil surface. These types of soils come under "salt- affected" and are classified as "saline-sodic". Many salt-affected soils develop due to the changes in the water balance, usually brought by human activities, increased evaporation and waterlogging. Salt affected soils can be improved by adopting modern technique such as eradication, conversion and gypsum applications which are widely used present days. Eradication techniques which is applicable for saline soils, involve improving soil drainage by soil flooding. The objective of eradication is to lower the soluble salt content in the root zone. Conversion techniques are used for saline-sodic and sodic soils. Conversion involves improving soil drainage and the incorporation of gypsum prior to leaching. Gypsum applications replace the exchangeable sodium with calcium in order to promote flocculation.

Wheat is being grown in 122 countries and occupies an area of 215.61 million hectare producing nearly 630.0 million tons of wheat (Anonymous, 2009). Wheat contributes about 34 per cent of total food grain production of country (Anonymous, 2010). Correlation coefficient is very important to measure the degree and direction of association of various traits which affect grain yield positively or negatively. Path analysis identifies the yield components which directly or indirectly influence the yield (Wright, 1921). Higher yield potential could be achieved by manipulating a plant type that is well adapted to the commercial practice of sowing high-density monocultures (Searle, 1961).

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Materials and methods

A total of 143 wheat lines along with three checks (KRL 210, NW 2036 and NW 1067) were evaluated in augmented design at main experiment station ND University of Agriculture & Technology, Kumarganj, Faizabad during *rabi*-2010-11. The entire experimental field was divided into 7 blocks of equal size and each block having 23 plots. Out of 23 plots in a block, 20 plots were used for accommodating the test genotypes which were not replicated while remaining 3 plots had checks (KRL 210, NW 2036, NW 1067) which were replicated in three rows plot of 3 m long with inter and intra-row spacing of 25cm and 15 cm, respectively. Experimental site was reclaimed salt affected soil having (EC =0.39; pH = >8.5; ESP= <15) and rich in potash and low in organic carbon, nitrogen and phosphorus. Recommended dose of fertilizers (N:P:K @ 150:60:60) and cultural packages were applied to raise a good and healthy crop. The observation were recorded in five randomly competitive plants for all

the quantitative characters *viz*, plant height (cm), number of productive tillers per plant, spike length (cm), peduncle length (cm), grains per spike, 1000-grain weight (g), biological yield per plant (g), grain yield per plant (g), harvest index (%), flag leaf angle, flag leaf area (cm^2), while days to maturity, recorded on plot basis. The data were subjected to analysis of correlation coefficient of different characters (Dewey and Lu, 1959) and contribution of various traits through path coefficient analysis (Kumar *et al.,* 2000).

Results and discussion

The analysis of variance for eleven characters showed highly significant differences among the genotypes under study, indicated presence of considerable amount of variability in the genotypes (Table-1).

The variation due to checks was significant for all the characters except peduncle length and plant height while mean squares due to blocks were non-significant for all the characters except plant height and grain yield which indicated that the experimental site was heterogeneous. The high order of least significant difference (LSD_1) between two checks mean were recorded in case of plant height (3.42) followed by peduncle length (2.11) indicated that high variation was present in the metric measurement of both the character. Least significant difference between adjusted mean of two genotypes in same (LSD_2) and different block (LSD_3) was observed in case of plant height (9.05), peduncle length (5.58) biological yield (4.79) and plant height (10.45), peduncle length (6.45). Plant height (8.06), peduncle length (4.97), and biological yield (4.27) showed highest least significant difference between adjusted means of genotype and check mean (LSD_4).

The correlation coefficients of the experiment presented (Table-2) indicated strong positive association of grain yield with biological yield followed by productive tillers per plant, grains per spike, test weight, spike length and positive significant association was observed in case of flag leaf area, harvest index and plant height, while, remaining were non-significant. Thus, these characters were identified as most important traits for enhancing grain yield (Subhani, 2000); (Korkut *et al.,* 2001); (Muhammad and Ihsan, 2004); Ayccek and Yldrm 2006; Singh *et al.,* 2008; Saktipada *et al.,* 2008; Aydin *et al.,* 2010; Khan *et al.,* 2010; Dhananjay *et al.,* 2012 and Bharat *et al.,* 2013. Harvest index exhibited significant and positive relationship with productive tillers per plant, while, test weight and days to maturity showed negative association. Biological yield showed strong positive association with productive tillers per plant, grains per spike, test weight, spike length, flag leaf area and positive significant association was observed only for plant height. Grains per spike had strong positive association with spike length, flag leaf area, plant height and days to maturity exerted only significant and positive association. Spike length was positively correlated with plant height, flag leaf area and peduncle length. Plant height was positively and significantly associated with peduncle length and significant and positive association with flag leaf area while, significant and negative association was recorded with days to maturity (Table-2). The strong positive association between yield characters may be used as donor

Table 1. Analysis of variance of augmented design for 11 characters and least significant differences in wheat germplasm

Character	Source of variation			Range of parameter			
	Blocks d. f. (6)	Checks d. f. (2)	Error d. f. (12)	LSD_1 5%	LSD_2 5%	LSD_3 5%	LSD_4 5%
Flag leaf area	2.45	17.62**	1.44	1.39	3.69	4.26	3.29
Days to maturity	1.72	80.62**	1.28	1.32	3.492	4.03	3.11
Peduncle length	2.76	5.67	3.29	2.12	5.58	6.45	4.98
Plant height	43.10**	4.51	8.63	3.42	9.04	10.44	8.06
Spike length	0.04	2.25**	0.03	0.19	0.50	0.58	0.45
Grains/spike	2.61	12.56**	1.34	1.35	3.56	4.12	3.18
Productive tillers/ plant	0.06	2.31**	0.07	0.32	0.83	0.96	0.7
1000-grain weight	2.32	14.38**	1.14	1.24	3.28	3.79	2.93
Biological yield/ plant	4.09	40.73**	2.42	1.81	4.79	5.53	4.27
Harvest index	0.65	17.35*	0.34	0.68	1.79	2.07	1.60
Grain yield/ plant	2.14*	5.40**	0.52	0.84	2.25	2.55	1.97

*, ** significant at 5 and 1 percent level of probability, respectively

Table 2. Estimates of simple correlation coefficients between different characters in exotic and indigenous lines of wheat

Character	Flag leaf area	Days to maturity	Peduncle length	Plant height	Spike length	Grains/ Spike	Tillers/ plant	1000- grain weight	Biological yield/ plant	Harvest index	Grain yield/ plant
Flag leaf area	1.000	-0.056	0.127	0.170*	0.319**	0.304**	0.151	0.008	0.220**	0.077	0.238*
Days to maturity		1.000	-0.148	-0.166*	0.124	0.156*	-0.206**	0.084	0.023	-0.213**	-0.045
Peduncle length			1.000	0.832**	0.221**	0.147	-0.075	0.045	0.040	0.011	0.033
Plant height				1.000	0.325**	0.261**	0.025	0.078	0.167*	0.059	0.176*
Spike length					1.000	0.831**	0.095	0.128	0.479**	0.077	0.482**
Grains/ spike						1.0000	0.106	0.135	0.547**	0.089	0.543**
Tillers/ plant							1.000	0.014	0.699**	0.199*	0.722**
1000-grain weight								1.000	0.487**	0.164*	0.519**
Biological yield/ plant									1.000	-0.024	0.955**
Harvest index										1.000	0.233*
Grain yield/ plant											1.000

*,** Significant at 5 and 1 per cent probability level, respectively

Table 3. Direct (diagonal) and indirect effects of different characters on grain yield per plant in exotic and indigenous lines of wheat

Character	Flag leaf area	Days to maturity	Peduncle length	Plant height	Spike length	Grains/ spike	Tillers/plant	1000- grain weight	Biological yield/ plant	Harvest index	Correlation with grain/ yield
Flag leaf area	0.0080	0.0009	-0.0039	0.0036	0.0074	-0.0034	0.0027	0.0002	0.2035	0.0186	0.2376
Days to maturity	-0.0004	-0.0155	0.0046	-0.0035	0.0029	-0.0017	-0.0037	0.0025	0.0212	-0.0514	-0.0452
Peduncle length	0.0010	0.0023	-0.0311	0.0176	0.0051	-0.0016	-0.0014	0.0013	0.0370	0.0025	0.032
Plant height	0.0014	0.0026	-0.0259	0.0212	0.0075	-0.0029	0.0004	0.0023	0.1546	0.0143	0.1755
Spike length	0.0026	-0.0019	-0.0069	0.0069	0.0231	-0.0092	0.0017	0.0037	0.4430	0.0187	0.4818
Grains/ spike	0.0024	-0.0024	-0.0046	0.0055	0.0192	-0.0111	0.0019	0.0040	0.5063	0.0216	0.5428
Tillers/ plant	0.0012	0.0032	0.0023	0.0005	0.0022	-0.0012	0.0180	0.0004	0.6475	0.0481	0.7223
1000- grain weight	0.0001	-0.0013	-0.0014	0.0017	0.0030	-0.0015	0.0002	0.0293	0.4502	0.0395	0.5198
Biological yield/ plant	0.0018	-0.0004	-0.0012	0.0035	0.0111	-0.0061	0.0126	0.0143	0.9251	-0.0058	0.9549
Harvest index	0.0006	0.0033	-0.0003	0.0013	0.0018	-0.0010	0.0036	0.0048	-0.0223	0.2417	0.2334

Diagonal figures indicate direct effects, Residual effect = 0.14

parent which lead to rapid and high improvement through crop modeling during selection because improvement in one characters may bring improvement in other one.

Path coefficient analysis (Table-3) indicated that biological yield followed by harvest index, test weight, spike length, plant height, productive tillers per plant, and flag leaf area exerted very high order positive direct effect on grain yield. Similar results were reported by Singh *et al.* (2008), Kumar *et al* (2010), Chaitali and Bini (2007), Khan *et al.* (2005) and Bharat *et al.* (2013). Thus, biological yield and harvest index emerged as most important direct grain yield influencing characters followed by test weight and spike length on be taken for developing high yielding cultivar through selection. Highest negative direct effect on grain yield was noted by peduncle length, days to maturity and a very minute negative direct effect was recorded for grains per spike. These characters have a very low magnitude of negative direct effect that can't be considered in any breeding programme. Considerable positive indirect effect was observed for the productive tillers per plant, grains per spike, test weight, spike length, flag leaf area, plant height, days to maturity, and peduncle length *via,* biological yield resulted as most important indirect contributors towards grain yield. It can be revealed that characters like biological yield followed by harvest index, test weight, spike length, plant height, productive tillers per plant, and flag leaf area can be taken under selection for developing desirable high yielding cultivar.

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