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Morphological Response of Various Genotypes to Drought Conditions

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Abstract: The experiment was conducted in greenhouse and field under moisture stress condition using twenty four spring wheat genotypes. Inter-relationship among different characters were estimated by simple correlation and path-coefficient analysis. Simple correlation indicated that survival rate, root/shoot ratio, root density, number of veins, flag leaf area, plant height, number of tillers per plant and 1000-grain weight showed positive and significant association with grain yield. Whereas, path-coefficient analysis revealed that 1000-grain weight, root density and stomatal frequency, are the characters which exerted maximum direct positive effect on yield, respectively.

Key words: Wheat genotypes, artificial moisture stress, correlation and path coefficient analysis

Introduction

Wheat stand top among the cereal crops of Pakistan and cultivated annually on an area 7.983 million ha (Anonymous, 2002). Crop produced in irrigated and rainfed area is subjected to variable and unpredictable period of drought stress limiting its production and area expansion.

Grain yield is considered the most reliable criteria for selection in wheat breeding programme. It is a polygenic character and is associated with other yield components/characters. It is therefore, become imperative to study degree to which different component characters are correlated among themselves as well as with yield. Which is considered a pre-requisite for an effective breeding program. Path coefficient is one of the effective techniques used to sort out inter-relationship of different yield components and their direct and indirect effects on grain yield through correlation values. The present study was, therefore, designed to evaluate morpho-physiological response of various genotypes to drought condition.

Bhutta and Chowdhry (1999) observed positive significant association of number of veins with grain yield. Bruns and Croy (1985) studied positive and significant association between root density and grain yield. Khaliq *et al.* (2000) reported that stomatal frequency has positive direct effect on grain yield. Khan and Shaik (1997) revealed direct positive effect on grain yield. Chowdhry *et al.* (1996) found direct negative effect of number of veins on grain yield.

Materials and Methods

The experiment was conducted in greenhouse (drought chamber) and also in field under drought stress conditions in the experimental area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during 2001-02. Twenty four genotypes were under study for various morpho-physiological characters at seedling and mature plant stage.

Greenhouse experiment: The genotypes evaluated for seedling taints were grown in drought-chamber in polythene bags filled with fresh river sand. Two seed of each of genotype were sown in each bag. Each genotype comprised of ten bags per replication. A completely randomized design with three replication was used. Data were recorded for survival rate for different combinations of drought components. For root/shoot ratio and root density ten seed of each genotype were sown in trays filled with sand and data were recorded at three leaf stage.

Field experiment: Seed of same genotypes were also planted in experimental field under drought stress condition in randomized complete block design with three replications. Each block consisted of two rows of five meter length of each genotypes. All cultural practices were adopted uniformally in all plots throughout growing season. At maturity ten guarded plants were selected randomly and data were recorded for number of veins, stomatal frequency, stomata size, epidermal cell size, flag leaf area, hygrophilic colloids, plant height, number of tillers per plant, 1000-grain weight and grain yield per plant.

Analysis of variance was done using the method of Steel and Torrie (1980). The correlation coefficient were calculated according to method given by Kwon and Torrie (1964). Whereas path-coefficient analysis was computed the method as given by Dewey and Lu (1959).

Table 1: Genotypic and phenotypic correlations among grain yield and some other drought related parameters

		Treat. II	Treat. III	Treat. IV	Root/ shoot ratio	Root density	Number of veins	Stomatal frequency	Stomatal size	Epidermal cell size	Flag leaf area	Hygroph ilie colloids	Plant height	Number of tiller per plant	1000-grain weight	Grain yield per plant
Survival rate treat. I	rg	0.8567*	0.8215*	0.7734*	0.08104*	0.8170*	0.8533*	-0.1546	0.1464	-0.0910	0.9712*	0.0115	0.6912*	0.3829*	0.8505*	0.9589*
	rp	0.8207**	0.7983**	0.7406**	0.7299**	0.6454**	0.6041**	-0.1436	0.1359	-0.0767	0.9234**	0.0147	0.6345**	0.3695*	0.8066**	0.8961**
Treat. II	rg		0.8985*	0.8498*	0.9964*	0.7975*	0.9332	-0.1338	0.1689	-0.0046	0.9454*	0.0661	0.7421*	0.4389*	0.9774*	0.9355*
	rp		0.8805**	0.8114**	0.8672**	0.6513**	0.6746**	-0.1300	0.1674	-0.0076	0.9078**	0.0175	0.7044**	0.4116**	0.9268**	0.8765**
Treat. III	rg			0.8972*	0.9443*	0.8369*	0.8630*	-0.1294	0.0684	-0.1875	0.8891*	-0.0193	0.8237*	0.4588*	0.8779*	0.9651*
	rp			0.8576**	0.8476**	0.6624**	0.6198**	-0.1228	0.0683	-0.1756	0.8639**	0.0068	0.7829**	0.4335**	0.8438**	0.9079**
Treat. IV	rg				0.9193*	0.8372*	0.9101*	-0.0267	0.0656	-0.0901	0.8852*	-0.1015	0.7381*	0.4771*	0.8312*	0.8888*
	rp				0.8251**	0.6519**	0.671**	-0.0182	0.0625	-0.0820	0.8443**	-0.0707	0.6982**	0.4481**	0.7898**	0.8266**
Root/Shoot ratio	rg					0.7295*	0.9155*	-0.0310	0.1873	-0.0794	0.9837*	-0.1002	0.7177*	0.3804*	0.9798*	0.9111*
	rp					0.5165**	0.6013**	-0.0304	0.1648	-0.0573	0.8544**	-0.0815	0.6244**	0.3343*	0.8432**	-0.7436**
Root density	rg						0.9523*	-0.4335*	0.1916	-0.1119	0.8103*	0.2289	0.667*	0.4184*	0.7749*	0.8981*
	rp						0.4416**	-0.3492	0.1510	-0.0876	0.6264**	0.1489	0.553**	0.3197*	0.6238**	0.7053**
Number of veins	rg							-0.0228	0.3074	-0.05811	0.9289*	-0.4092	0.9467*	0.6210*	0.7422*	0.918*
	rp							-0.0130	0.2358	-0.00713	0.6604**	-0.2031	0.621**	0.4048**	0.4950**	0.6148**
Stomatal frequency	rg								0.1595	-0.1226	0.1290	-0.3701	-0.215	-0.4696*	-0.1120	-0.0809
	rp								0.1571	-0.1191	0.1222	-0.2744	-0.207	-0.4425**	-0.1030	-0.0746
Stomata size	rg									-0.1217	0.2272	-0.2003	0.3873	-0.2014	0.1952	0.2162
	rp									-0.1105	0.2226	-0.1436	0.3714	-0.1792	0.1876	0.2092
Epidermal cell size	rg										0.0863	0.4251	0.1553	-0.0315	0.1138	0.0069
	rp										0.0814	0.2623	0.1504	-0.0501	0.0061	0.0060
Flag Leaf area	rg											-0.1073	0.7707*	0.4339*	0.9853*	0.8715
	rp											-0.071	0.7316**	0.4126**	0.9118**	0.8121**
Hygrophilic colleids	rg												0.049	0.4140	-0.1210	-0.1408
	rp												0.057	0. 3151*	-0.073	-0.1057
Plant heigh	rg													0.3584	0.7635*	0.8309*
	rp													0.3290	0.7090**	0.7599*
Number of tillers/plant	rg														0.4810*	0.4484*
	rp														0.4583**	0.4327**
1000-grain weight	rg															0.8748*
	rp															0.8017

Table 2: Path coefficient of survival treat. I (SRT-I) survival rate treat. II (SRT-II) survival rate treat. III (SRT-III), survival rate treat. IV (SRT-IV), root/shoot ratio (RSR), root density (RD), number of veins (NV), stomatal plant height (PH), number of tiller (NT) and 1000-grain weight (GW) under drought stress condition

	SRT-I	SRT-II	SRT-III	SRT-IV	RSR	RD	NV	SP	SS	ECS	PLA	HC	PH	NT	GW	rg
Survival rate treat. I	(3.0909)	2.6478	2.5392	2.3903	2.5048	2.5251	2.6373	-0.4780	0.4525	-0.2810	3.0019	0.0357	2.1365	1.1833	2.6289	0.9589
Survival treat. II	3.1928	(3.7270)	3.3486	3.1672	3.7136	2.9724	3.4782	-0.4990	0.6293	-0.017	3.5235	0.02462	2.7659	1.6357	3.6426	0.9355
Survival treat. III	4.9698	5.4354	(6.0497)	5.4008	5.7126	5.0632	5.2210	-0.7830	0.4140	1.1348	5.3787	-0.1170	4.9831	2.7757	5.3112	0.9651
Survival treat. IV	-7.5470	-0.2920	-0.7110	(-9.7580)	-8.9710	-8.1690	-8.8810	0.2606	0.6400	0.8792	-8.6380	0.9903	-7.2020	-4.6550	-8.1110	0.0888
Root/shoot ratio	-10.0800	-12.390	-11.7400	-11.430	(-12.440)	-9.720	-11.3800	-0.3860	-2.3290	0.9877	-12.2300	1.2463	-8.9250	-4.7300	-12.1800	0.9111
Root density	9.5744	8.3706	8.7842	8.7867	7.6568	(10.4960)	9.9949	-4.5500	2.0109	-0.1740	8.5042	2.4026	7.007	4.3915	8.1331	0.8981
Number of veins	-3.3170	-3.6280	-3.3550	-3.5380	-3.5590	-3.7020	(-3.8880)	0.0887	-1.1950	-0.266	-3.6220	1.5910	-3.6800	-2.4150	-2.8860	0.918
Stomatal frequency	-1.5960	-1.3810	-1.3350	-0.2760	0.3205	-4.747	-0.235	(10.3210)	1.6467	1.2652	1.3310	-3.8200	-2.2190	-4.8470	-1.1590	-0.0809
Stomatal size	-0.5380	-0.6210	-0.2520	-0.2410	-0.6890	-0.704	-1.1300	-0.5870	(-3.6770)	0.4473	-0.8350	0.7364	-1.4240	0.7406	-0.7080	0.2162
Epidermal cell size	0.7179	0.0365	-0.4820	0.7120	0.6276	0.8840	-0.4590	0.9690	0.9614	(-7.902)	0.6823	-3.3590	-1.2270	0.2491	-0.9000	0.0069
Flag leaf area	-20.0500	-19.520	-18.3600	-18.2800	-20.310	-16.730	-19.1800	2.6635	-4.6900	1.7827	(-20.6500)	2.2157	-15.9100	-8.9600	-20.3400	0.8715
Hygrophilic collaids	-0.0090	-0.0530	0.0154	0.0810	0.080	0.1830	0.3266	0.2953	0.1598	-0.3390	0.0856	(-0.7980)	0.0394	-0.3300	0.0969	-0.1408
Plant height	6.0336	6.4777	7.1898	6.4426	6.2645	5.8221	8.2631	-1.8770	3.3807	1.3557	6.7276	-0.4310	(8.7287)	3.1284	6.6640	0.8309
Number of tillers/plant	1.1603	1.3301	1.3906	1.4459	1.1529	1.2681	1.8822	-1.4230	-0.6110	-0.096	1.3152	1.2548	1.0863	(3.0308)	1.4579	0.4484
1000-grain weight	16.3570	18.796	16.8830	15.9850	18.8420	14.902	14.2730	-2.1600	3.7024	2.1894	18.9480	-2.3350	14.6820	9.2508	(19.231)	0.8748

Results and Discussion

Genotypic and phenotypic correlation for all possible combinations are presented in Table 1. A review of table shows that survival rate for treat. I, II, III and treat IV were positive and had significant correlation with grain yield (Table 2). It means that survival rate contribute towards increasing yield. Similar have also been reported by Kumar and Yadav (1987) and Chowdhry *et al.* (1996). Positive and significant associations were observed for root/shoot ratio, root density and number of veins. Positive and significant association of root density with grain yield were also observed by Bruns and Croy (1985). Whereas Bhutta and Chowdhry (1999) observed positive significant association of number of veins with grain yield. Stomatal frequency had negative and non-significant association with yield at both genotypic and phenotypic levels as also found by Nayeem and Nerker (1988). Stomata size and epidermal cell size were positively and non-significantly correlated with yield at genotypic level. Flag leaf area exhibited positive and significant correlation with yield at genotype level. Subhani and Chowdhry (2000) also observed positive and non-significant correlation of flag leaf area with yield. Negative and non-significant association were observed between hygrophilic colloids and grain yield per plant at both genotypic and phenotypic level. The result are in agreement with the findings of Chowdhry *et al.* (1996). Correlation between plant height and grain yield were positive and significant at both genotypic and phenotypic levels. Number of tiller had positive and significant correlation with yield at genotypic level but positive and highly significant correlation at phenotypic level. Similar results have also been reported by Ramzan *et al.* (1994). Positive and significant association were recorded at genotypic level between 1000-grain weight and grain yield per plant and positive non-significant phenotypic level agreeing with Subhani and Khaliq (1994).

Path-coefficient analysis: The direct effect of survival rate I, II and treat. III were positive with respective values (3.0909), (3.7270) and (6.0497). The direct effect of survival rate treat. IV was negative (-9.758). Roots/shoot ration exhibited negative direct effect on grain yield. The direct effect of root density on grain yield was positive (10.496) and maximum indirect effects were observed through 1000-grain weight. The direct effect of number of veins were negative. Similar results have also been reported by Chowdhry *et al.* (1996). Stomatal frequency on grain yield had positive direct effect on grain yield. This result got support from the finding of Khaliq *et al.* (2000). Stomata size, epidermal cell size, flag leaf area and hygrophilic colloids had negative direct effects on grain yield with respective values (-3.677), (-7.902), (-20.65) and (-0.798). Plant height showed direct positive effect on grain yield (8.7287). The result is in agreement with Khan and Shaik (1997) and Subhani and Chowdhry (2000). Number of tillers per plant on grain yield was positive (3.0308). 1000-grain weight also showed direct positive effect (19.2311). The result got support from the finding of Wei, (1993).

Present study confer that those characters showing positive significant association with yield and those exerting maximum direct positive effect should be considered suitable for further breeding programme.

References

Akhtar, M., K. Alam and M.A. Chowdhry, 1992. Genotypic and phenotypic correlation studies of yield and other morphological characters in *Triticum aestivum* L. J. Agri. Res., 30: 301-305.

Anonymous, 2002. Economic survey of Pakistan. Finance Div. Govt. Pakistan, Islamabad, Pakistan.

Butta, W.M. and M.A. Chowdhry, 1999. Association analysis of some drought related traits in spring wheat. JAPS., 9: 77-80.

Bruns, H.A. and L.I. Croy, 1985. Root volume and root dry weight measuring system for wheat cultivars. Cereal Res. Commun, 13: 177-183.

Dewey, D.R. and K.H. Lu, 1959. Acrorrelation and path-coefficient analysis of components of crested wheat grass seed prouction.

Khaliq, I., S.A.H. Shah, M. Ahsan and M. Khalid, 2000. Evaluation of spring wheat (*Triticum aestivum* L.) for drought field conditions. A morphological study. Pak. J. Bio. Sci., 2: 1006-1009.

Khan, H.A. and M. Shaik, 1997. Character association and path coeficient analysis of grain yield and yield components in wheat. Crop Res., 17: 229-233.

Kumar, A. and S.K. Yadav, 1987. Relationship between yield structure and grain yield of *T. aestivum* and drum wheats. Haryana Agric, Univ. J. Res., 17: 329-333.

Kwon, S.H. and J.H. Torrie, 1964. Heritability and inter-relationship among reaits of two soybean population. Crop Sci., 4: 196-198.

Nayeem, K.A. and Y.S. Nerker, 1988. Assodiciation of drought and heat tolerance parameters in wheat. Indian J. Genet. and Pl. Br., 48: 371-376.

Ramzan, M., M.A. Chowdhry and I. Khaliq, 1994. Correlation between grain yield and its components. J. Agric. Res., 32: 223-226.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and procedures of statistics. A biometrical approach. McGraw Hill Book Co., New York.

Subhani, G.M. and I. Khaliq, 1994. Path-coefficient analysis in wheat. Pak. J. Agric. Sci., 37: 474-476.

Subhani, G.M. and M.A. Chowdhry, 2000. Correlation and path-coefficient analysis in bread wheat under stress and normal conditions. Pak. J. Biol. Sci., 3: 72-77.

Wei, Y.Q., 1993. Yield performance of Nigchum 16 wheat and an analysis of its yield components. Ningxia. J. Agro. Forestry Sci. Technol., 3: 5-8.