International Scholars Journals

African Journal of Agricultural Economics and Rural Development ISSN 2375-0693 Vol. 2 (6), pp. 001-004, March, 2014. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Genetic parameters of some morphological and physiological traits in durum wheat genotypes (*TRITICUM DURUM* L.)

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Accepted 21 February, 2014

In order to estimate the genetic parameters of some morphological and physiological traits in durum wheat, a simple lattice experimental was carried out by using 58 advanced lines and 6 landraces for two years during 2006 to 2008 at the Agriculture Research Station of Islamic Azad University, Tabriz Branch, Iran. In this investigation traits like plant height, stomatal resistance, stoma-density and stoma-dimension in under and over surface of flag leaf; flag leaf area, number of fertile tiller, number of grains/spike, 1000-grain weight, grain yield, biomass, and harvest index were measured. Combined analysis of data for two years showed that there were significant differences, for the traits among the genotypes under study at 1% probability level. Phenotypic correlation coefficients between traits revealed a significant and positive relationship of grain yield with traits such as number of fertile tiller, grains/spike, biomass and harvest index. Estimates of GCV (genetics coefficient variance) showed that, stoma-density and stoma-dimension in under and over surface of flag leaf; grains/spike and grain yields were high, as compares other traits. Also estimates of broad sense heritability showed that, traits such as plant height, stomatal resistance, stoma-density and stoma-dimension in under and over surface of flag leaf; and grains/spike were high, as compares other traits; but for traits like grain yields, biomass, harvest index and number of fertile tiller was moderate.

Key words: Durum wheat, genetic variance, genetic coefficient variance, broad sense heritability.

INTRODUCTION

The development of high yielding wheat cultivars is a major objective in breeding programs (Ehdaie and Waines, 1989). The genetic variation for the trait under selection and a higher heritability are necessary to have response to selection (Falconer and Mackay, 1996). Breeding programs depend on the knowledge of key traits, genetic systems controlling their inheritance, genetic and environmental factors that influence their expression (Kashif et al., 2003; Ali and Awan, 2009; Mohammadi et al., 2010). The study of statistical parameters like mean, variance, CV%, habitability and genetic advance is a measure to evaluate genetic potential, diversity and stability performance of any genotype for effective selection of particular traits in that genotype (Firouzian, 2003; Ali et al., 2009). Determination of correlation coefficients between various traits helps to obtain best combinations of attributes in crop for obtaining higher return per unit area.

Several researchers reported positive correlation of grain yield with plant height (Silva et al., 1998; Dokuyueu and Akkaya, 1999), number of seeds/spike (Feil, 1992; Calderini et al., 1995; Silva et al., 1998; Dokuyueu and

Table 1. Combined analysis of traits in durum wheat genotypes based on RCB design.

		MS												
S.O.V.	**D.F.**	**Stomatal resistance**	**Stoma-density in under F.L.**	**Stoma-density in over F.L.**	**Stoma-dimension in under F.L.**	**Stoma-dimension in over F.L.**	**Flag leaf area**	**Plant high**	**Number of fertile tiller**	**Biomass**	**Grains/ spike**	**1000 grain weight**	**Grain yield**	**Harvest index**
Years	1	0.138^{ns}	0.002^{ns}	0.038^{ns}	0.022^{ns}	0.285**	377.06^{ns}	11807.53^{ns}	7.99^{ns}	169021.93^{ns}	3247.57^{ns}	8276.36^{ns}	3257.14^{ns}	532.07^{ns}
Error A	2	0.047	4.919	1.370	0.095	0.004	596.73	10184.62	14.26	1720081.94	529.71	670.43	35080.72	591.87
Genotypes	63	0.168**	20.571**	56.347**	1.108**	1.561**	65.74**	377.44**	1.29**	44114.64**	204.39**	72.33**	2992.77**	76.38**
Years × genotypes	63	0.028^{ns}	0.014^{ns}	0.022^{ns}	0.008^{ns}	0.003^{ns}	38.58**	23.39	0.51^{ns}	22910.66^{ns}	27.73^{ns}	19.39^{ns}	1219.67^{ns}	36.67^{ns}
Error B	126	0.083	1.266	1.758	0.285	0.398	21.70	22.52	9.73	15235.63	67.00	14.51	885.10	35.71
C.V.%	-	29.56	14.33	12.77	26.80	23.04	23.39	7.73	23.78	25.62	24.84	15.61	29.31	26.91

ns, * and **: non significant, significant at 0.05 and 0.01 of probability levels respectively.

Akkaya, 1999), number of tillers (Sedgley, 1991; Reynolds et al., 1999; Silva et al., 1998; Dokuyueu and Akkaya, 1999), grain weight (Hucl and Baker, 1987; Nabi et al., 1998; Amar, 1999; Shah et al., 1999) and harvest index (Feil, 1992 and Reynolds et al., 1994) both at genotypic and phenotypic levels in wheat. Ehdaie and Waines (1989) reported moderate to high heritability for developmental and quantitative traits in Iranian wheat landraces. Several researchers obtained the value of grain yield heritability to be low (Zaheer and Ahmad, 1991; Fida et al., 2001; Aycicek and Yildirim, 2006), but some authors reported moderate values of grain yield heritability in wheat (Moghaddam et al., 1997). Sharma and Sharma (2007) reported high heritability values for grain yield/plant also they were estimated high GCV (genetic coefficient of variation) for number of effective tillers, grain yield/plant, harvest index and 1000 grain weight.

Main quantitative traits associated with high heritability and high genetic advance has great importance in selection of genotype in early generations (Memon et al., 2005). Success in using pure line selection for traits with low heritability and high G × E interactions is low, thus using family selection method may increase success in breeding for improvements (Aycicek and Yildirim, 2006). The objective of this experiment was to estimate the genetic parameters for some traits in durum wheat lines, their GCV (genetic coefficient of variation), broad sense heritability and relationships of traits with yield in durum wheat genotypes under environmental conditions of Tabriz, Iran.

MATERIALS AND METHODS

Sixty-four durum genotypes (58 exotic and 6 locals' genotypes) were included in this study. This experiment was conducted using a simple lattice (8 × 8) at Research Station of Tabriz Islamic Azad University, Iran, during 2006 to 2008 growing seasons. Each plot consisted of a three row with 20 and 5 cm between and within rows respectively. All agronomic works in plots were similar. In this research several traits including plant height, stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; flag leaf area, number of fertile tiller, number of grains/spike, 1000-grain weight, grain yield, biomass, and harvest index were measured. Combined analysis of variance was computed for two years based on complete randomized block design (because the lattice analysis has not efficiency for any traits). Mean comparisons were made using LSD test at 5% probability level. The phonotypical variance (σ^2_p) will be constituted basically by three components:

$$\sigma^2_p = \sigma^2_G + \sigma^2_E + \sigma^2_{GE}$$

Here, σ^2_G = the variance of genetic effect, σ^2_E = the environmental variance and σ^2_{GE} = the variance of genotype × environmental interaction effects. Broad sense heritability of traits was computed by using expected value of variance (E (MS)) and equation of $h^2 = \sigma^2_G / \sigma^2_p$, that in these equation h^2 is the heritability.

Phenotypical CV (PhCV) and genetic CV (GCV) were computed by using these equations:

PhCV = (PhSD/Mean) × 100
GCV = (GSD/ Mean) × 100

In these two equations, PhSD and GSD are phenotypical and genetic standard deviation respectively. The MSTAT-C, SPSS and EXCEL procedures and programs were used in these calculations.

RESULTS AND DISCUSSION

Combined analysis of variance showed that, values of F-test were significant for all of traits at 1% probability level (Table 1). This indicates that

Table 2. Ranges, total means, LSD5% and traits means of superior lines in durum wheat genotypes.

Traits	Range	Total mean	Superior line				LSD5%
			33	55	62	64	
Somatal resistance.	0.40 to 1.40	0.91	1.11	0.83	0.98	1.15	0.3992
Somat density in under F. L.	2.16 to 13.55	7.58	10.05	6.30	8.65	7.50	1.5557
Somat density in over F. L.	1.50 to 16.10	10.38	13.45	11.26	10.95	11.25	1.8234
Somat dimensione in under F. L.	1.55 to 4.55	2.35	2.40	2.40	1.58	2.05	0.7223
Somat dimensione in over F. L.	1.60 to 3.98	2.73	1.62	3.23	2.11	3.70	0.8655
Flag leaf area (cm^2).	11.31to 30.56	19.92	18.39	15.97	14.79	12.07	6.0865
Plant height (cm).	50.05 to110.5	61.40	57.65	61.53	62.45	74.47	3.8587
Number of fertile tiller.	3.02 to 6.40	3.59	4.13	3.03	4.43	4.93	0.8468
Grains/spike.	19.34 to 52.70	32.95	47.76	33.51	24.50	25.21	11.3550
1000 grain weight (g).	32.09 to 47.70	42.60	44.45	43.26	39.08	34.52	4.9839
Grain yield (g).	47.09 to160.50	92.52	160.50	156.41	152.71	141.15	41.2300
Biomass (g).	306.16 to 850.02	481.75	575.45	550.28	749.30	591.27	159.6900
Harvest index.	9.86 to 32.80	19.98	28.58	27.55	21.93	24.83	6.8522

there is genetic diversity among durum wheat lines for these traits. Several researchers reported phenotypic divergence and extensive variation for agronomic and other traits in wheat germplasem (Spagnoletti and Qualset, 1987; Jaradat, 1991; Garcia et al., 2003; Kashif and Khliq, 2004). Combined analysis of data revealed that genotype × year interaction expect flag leaf area was not significant, indicating that lines responded for those traits similarly to weather condition in both years (Table 1). Comparison of means showed that the genotypes number 62 (YAZLIG), 33 (ARAMIDES), 55 (PLC/RD.) and 64 (YAZLIG) had the highest seed yield, since genotypes number 62, 64 and 33, 55 were local and imported respectively. Although there was no significant difference between these four genotypes, it showed higher yield potential of local genotypes. Range, total means and values of traits for superior lines are shown in Table 2.

The genetic variance, heritability and genetic CV% showed that there were differences between of traits in durum wheat (Table 3). Heritability estimates showed that broad sense heritability of traits such as stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; plant height, grains/spike and 1000-grain weight were higher than those of other characters. Broad sense heritability of grain yield, biomass, harvest index, fertile tiller and leaf area was moderate (Table 3). The heritability of grain yield and yield components in this study were generally moderate. These results supported by Moghaddam et al. (1997), but heritability value estimated by Zaheer and Ahmad (1991) and Fida et al. (2001) were low. Whereas Sharma and Sharma (2007) reported high heritability values for grain yield/plant and Ajmal et al. (2009) found high broad sense heritability values of plant height, tillers per plant, grains per spike and grain yield with values 0.94, 0.98, 0.92 and 0.91 respectively, and was low in case of number of spikelets per spike (0.24). Estimates of GCV (genetic coefficient of variation) showed that stoma-density and stomata-dimensions in under and over surface of flag leaf, spike length, grains/spike and grain yields were high, as compares other traits. So it was showed that genetic diversity in durum wheat for these traits were high as compared as other traits.

Sharma and Sharma (2007) were estimated high GCV for number of effective tillers, grain yield/plant, harvest index and 1000-grain weight.

Conclusion

Heritability estimates showed that broad sense heritability of traits such as stomatal resistance, stoma-density, and stoma-dimension in under and over surface of flag leaf; plant height, grains/spike and 1000-grain weight were high, but heritability of traits such as grain yield, biomass, harvest index, fertile tiller and leaf area were moderate. Generally in this research, genetic parameters for the traits was reasonable as expected, because this experiment was conducted for two consecutive years and also evaluation of genotypes was based on genetics variance. Moderate heritability and low G × E interactions indicate that yield and yield components of durum wheat can be improved by pure line selection.

ACKNOWLEDGEMENTS

The author acknowledged Dr. H. Kazemi Arbat, for reviewing the manuscript and Dr. M. Yarnia, Dr. A. R. Tarinajad and other cooperators for their recommendations during research.

Table 3. Phenotypic, genetic and environmental variances; Phenotypic and genetic SD and CV and heritability of traits in durum wheat.

Genetic parameter	Stomatal resistance	Stoma-density in under F. L.	Stoma-density in over F. L.	Stoma-dimensione in under F. L.	Syoma-dimensione in over F. L.	Flag leaf area	Plant height	Number of fertile tiller	Biomass	Number of grains/spike	1000 grain weight	Grain yield	Harvest index
Phenotypic variance	0.042	5.142	14.086	0.277	0.390	16.43	94.36	0.32	11028.66	51.09	18.08	748.19	19.09
Genetic variance	0.035	5.139	14.081	0.275	0.389	6.79	82.76	0.19	5300.99	44.16	13.23	443.27	9.92
environmental variance	0.007	0.003	0.005	0.002	0.001	9.64	11.60	0.13	5727.67	6.93	4.85	304.92	9.17
Broad sense heritability	0.83	0.99	0.99	0.99	0.99	0.41	0.87	0.59	0.48	0.86	0.73	0.59	0.51
Phenotypic SD	0.20	2.26	3.76	0.52	0.62	4.05	9.71	0.56	105.01	7.14	4.25	27.35	4.36
Genetic SD	0.18	2.26	3.75	0.52	0.62	2.60	9.09	0.43	72.80	6.64	3.63	21.05	3.14
Phenotypic CV%	21.97	29.81	36.22	22.12	22.71	20.33	15.81	15.59	21.79	21.66	9.97	29.56	21.82
Genetic CV%	19.78	29.81	36.12	22.12	22.71	13.05	14.80	11.97	15.11	20.15	8.52	22.75	15.71

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