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Genetic studies of durum wheat (*Triticum durum* L.) genotypes for yield and its attributing traits under restricted irrigation condition

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Abstract
Genetic variability, correlation and path analysis was studied for yield and its attributing traits in forty diverse durum wheat genotypes under restricted irrigation conditions in north Gujarat conditions and studied 11 morphological, 3 physiological and 2 biochemical traits which contributes for yield in durum wheat. The analysis of variance revealed that the significance difference among the genotypes for all the studied traits except canopy temperature after 5 days and 15 days of anthesis. Traits *viz.*, grain yield per plot, number of grains per spike, spike length, peduncle length, 1000 grains weight, harvest index and chlorophyll content showed moderate GCV and PCV values. High heritability with high genetic advance recorded in five traits. Under restricted irrigation conditions number of grains per spike, spike length, peduncle length, 1000 grains weight, biological yield per plot was positive correlated with grain yield per plot. Harvest index showed highest direct effect towards the grain yield per plot followed by biological yield per plot and number of grains per spike. For selection of yield contributing traits number of grains per spike, spike length, 1000 grains weight, harvest index and biological yield per plot are important for future breeding strategies.

Keywords: Genetic variability, correlation, path analysis, restricted irrigation conditions, durum wheat

1. Introduction
A ‘King of Cereals’ wheat is most important cereal crop due to prominent position in the world food grain trade which comes from Graminae (*poaceae*) family. A durum wheat (2n=4x=28) is most cultivated spp. after bread wheat provides more nourishment of the people in the world. It used in making of macroni pasta, baklava, semolina, biscuits, etc. The total area and production of durum wheat is about 20 million hectars and 30 million metric tonnes globally (Kahrizi *et al*., 2010) [12].

Due to uneven rainfall and higher deep ground water table, water scarcity is one the major problems faced by farmers for crop production. The global wheat area exposed to drought double between 1979 and 2006 (Li *et al*., 2013j) [13]. Productivity and sustainability of a crop like wheat which is highly susceptibility to water stress could be affected by drought and heat stress. Abdipur *et al*., 2013 [1] reported that canopy temperature was useful to select for water stress environments and high correlations with grain yield. To sustain with the future challenges of water stress the requirements to develop drought tolerant durum wheat. Illuminating and growing such varieties of durum wheat which could thrive under restricted irrigation could solve the problem.

2. Materials and Method
The present investigation was carried out with 40 diverse durum wheat genotypes received from Wheat Research Station, Vijapur and evaluated with four replications in Randomized Block Design (RBD) during *Rabi* 2020-21 at Vanbandhu Polytechnic in Agriculture, S. D. Agricultural University, Khedbrahma. The centre lying between 240˚ 11’ to 240˚ 17’ latitude and 730˚ 01’ to 730˚ 04’ longitude. Two rows of each genotype were sown having 3.0 m length with spacing 18 cm between the rows. Observations are recorded and its averages was made on randomly selected 5 tagged plants for different yield attributing traits. The mean performance of each genotype for all traits are subjected to statistical analysis. The analysis was carried out by adopting genetic parameters of variability, estimation of heritability and genetic advance were computed as per Johnson *et al.* (1955) [11]. Correlation studies are conducted as per Panse and Sukhatame (1978) [16] Whereas, construction of Path coefficient analysis suggested by Dewey and Lu (1959) [9].

3. Results and Discussion

For any breeding programme the main important parameter is genetic variability which provides the knowledge for selection of diverse parents which can be use in future hybridization programme. Highly significant difference among the genotypes for all the traits except canopy temperature after 5 days and 15 days of anthesis which shows the presence of.

3.1 Genotypic and Phenotypic coefficient of variation (GCV and PCV)

The highest genotypic and phenotypic variance was recorded for grain yield per plot followed by chlorophyll content, number of effective tillers per meter, 1000 grains weight, harvest index and so on for other traits.

Table 1: GCV (%), PCV (%), Broad sense heritability and genetic advance as percent of mean of 16 characters of forty durum wheat

Sr. No.	Characters	GCV (%)	PCV (%)	$h^2_{(b.s)}$ (%)	GA (%)
1.	Days to heading	5.60	5.79	94	11.16
2.	Days to maturity	2.69	2.78	93	5.35
3.	Plant height (cm)	3.48	8.24	18	3.04
4.	Number of effective tillers per meter	7.08	10.75	43	9.60
5.	Number of grains per spike	15.78	16.46	92	31.16
6.	Spike length (cm)	11.96	13.92	74	21.19
7.	Peduncle length (cm)	12.66	14.42	77	22.89
8.	1000 grain weight (g)	13.38	15.32	65	20.61
9.	Biological yield per plot (kg)	9.98	16.26	38	12.62
10.	Protein content (%)	6.05	8.15	55	9.26
11.	Sedimentation value (ml)	4.07	6.01	46	5.68
12.	Harvest index (%)	13.24	20.65	41	17.68
13.	Canopy temperature after 5 days (˚C)	0.56	9.06	0.004	0.07
14.	Canopy temperature after 15 days (˚C)	0.38	5.60	0.005	0.05
15.	Chlorophyll content	11.74	16.04	54	17.69
16.	Grain yield per plot (g)	18.78	23.07	66	31.51

3.2 Heritability and Genetic Advance as percent mean

The degree of inheritance of particular traits from parents to offspring is provided by heritability. In present investigation the grain yield per plot, days to heading same as reported by Adhikari *et al.* (2018) [3], Mohapatra *et al.* (2019) [15], Zemede *et al.* (2019) [24], Elahi *et al.* (2020) [10], Alemu *et al.* (2020) [4], Malbhage *et al.* (2020) [14] and Singh *et al.* (2020) [20],

Table 2: Genotypic correlation and phenotypic correlation coefficient for different sixteen characters in durum wheat

		DH	DM	PH	TIL/M	GPS	SL	PL	TGW	BYP	Pro	SV	HI	TEMP5	TEMP15	CC	GY
DH	r_g	1**	0.686**	0.652**	0.217	-0.048	-0.275	-0.084	-0.371*	0.021	0.590**	0.362*	-0.529**	-0.016**	-0.303**	0.135	-0.383*
	r_p	1**	0.677**	0.290**	0.132	-0.045	-0.246**	-0.057	-0.316**	0.037	0.383**	0.213**	-0.333**	-0.172*	-0.072	0.078	-0.286**
DM	r_g		1**	0.387**	0.091	-0.073	-0.205	-0.280	-0.433**	-0.280*	0.521**	0.233	-0.517**	-0.023**	-0.356**	-0.135	-0.515**
	r_p		1**	0.171**	0.067	-0.062	-0.177**	-0.219**	-0.372**	0.161**	0.366**	0.156**	-0.309**	-0.029	-0.74	-0.128	-0.388**
PH	r_g			1**	0.289	-0.23	0.047	0.241	0.025	0.626**	0.466**	0.411**	-0.462**	0.266	0.639	0.405**	-0.033
	r_p			1**	0.184*	-0.093	0.023	0.171*	0.001	0.294**	0.056	-0.021	-0.095	-0.219**	-0.325**	0.065	0.108
TIL/M	r_g			¤	1**	-0.243	-0.319	-0.015	-0.156	0.207	0.290	0.315*	0.009	-0.094**	-0.708**	-0.066	0.087
	r_p				1**	-0.166*	-0.186*	-0.006	-0.062	0.165**	0.118	0.132	0.057	-0.169**	-0.060*	-0.053	0.150
GPS	r_g					1**	0.694**	0.237	0.349*	0.462**	-0.348*	-0.407**	0.435**	-0.769	0.294	0.052	0.560**
	r_p					1**	0.583*	0.185*	0.296**	0.256**	-0.259**	-0.259**	0.313**	-0.101	-0.054	0.036	0.473**
SL	r_g						1**	0.230	0.731**	0.619**	-0.591**	-0.531**	0.577**	0.687	0.767	0.166	0.752**
	r_p						1**	0.209**	0.537**	0.354**	-0.428**	-0.354	0.333**	-0.058	0.073	0.101	0.571**
PL	r_g							1**	0.197	0.066	-0.490**	-0.183**	0.465**	0.974**	-0.2231	0.365*	0.338*
	r_p							1**	0.787	0.083	-0.383**	-0.199*	0.294**	0.011	-0.081	0.251**	0.299**
TGW	r_g								1**	0.537**	-0.544**	-0.371*	0.623**	-0.666**	-0.057**	0.080	0.735**
	r_p								1**	0.247**	-0.337**	-0.199*	0.354**	0.115	0.127	0.060	0.498**
BYP	r_g									1**	-0.045	-0.059	0.344*	-0.709	0.847	-0.067	0.735**
	r_p									1**	-0.229**	-0.121	-0.219**	-0.26**	-0.066	-0.005	0.514**
Pro	r_g										1**	0.776**	-1.000**	-0.283**	-0.151**	-0.221	-0.751**
	r_p										1**	0.667**	-0.464**	0.073	0.024	-0.034	-0.589**
SV	r_g											1**	-0.640**	-0.468**	-0.719**	-0.334*	-0.485**
	r_p											1**	-0.335**	0.228	-0.015	-0.143	-0.395**
HI	r_g												1**	-0.585*	-0.834*	0.066	0.884**
	r_p												1**	0.092	0.072	0.032	0.711

Table 2: Conti…

		DH	DM	PH	TIL/M	GPS	SL	PL	TGW	BYP	Pro	SV	HI	TEMP5	TEMP15	CC	GY
TEMP5	r_g													1**	0.279	0.796	-0.231
	r_p													1**	0.197**	-0.008	-0.123
TEMP15	r_g														1**	-0.116	-0.577
	r_p														1**	0.171*	0.005
CC	r_g															1**	0.019
	r_p															1**	0.022
GY	r_g																1**
	r_p																1**

*, ** significant at 5% and 1% level of significance, respectively.

DH= Days to heading, DM= Days to maturity, PH= Plant height, TIL/M=Number of effective tillers per meter, GPS= number of grains per spike, SL= Spike length, PL= Peduncle length, TGW= Thousand grains weight, BYP= Biological yield per plot, Pro= Protein content, SV= Sedimentation value, HI= Harvest Index, TEMP5= Canopy temperature after 5 days of anthesis, TEMP15= Canopy temperature after 15 days of anthesis, CC= Chlorophyll content, GY= Grain yield per plot.

Table 3: Direct and indirect effects of yield component on grain yield in durum wheat

Sr. No	Character	DH	DM	PH	TIL/M	GPS	SL	PL	TGW	BYP	Pro	Sedi	HI	TEMP5	TEMP15	CC	Genotypic correlation with GY
1	DH	-0.037	-0.033	0.044	0.017	-0.005	-0.005	0.003	-0.023	0.008	-0.114	0.027	-0.240	0.002	-0.023	-0.004	-0.383**
2	DM	-0.025	-0.047	0.026	0.007	-0.008	-0.004	0.010	-0.027	-0.111	-0.101	0.017	-0.234	0.001	-0.024	0.004	-0.515**
3	PH	-0.024	-0.018	0.068	0.022	-0.025	0.001	-0.009	0.002	0.247	-0.090	0.031	-0.209	-0.003	-0.011	-0.013	-0.330
4	TIL/M	-0.008	-0.004	0.020	0.077	-0.026	-0.006	0.001	-0.010	0.082	-0.056	0.024	0.004	0.001	-0.012	0.002	0.087
5	GPS	0.002	0.003	-0.015	-0.019	0.108	0.012	-0.009	0.022	0.182	0.067	-0.031	0.197	0.001	0.040	-0.002	0.560**
6	SL	0.010	0.010	0.003	-0.025	0.075	0.018	-0.009	0.046	0.244	0.114	-0.040	0.262	0.003	0.048	-0.005	0.752**
7	PL	0.003	0.013	0.016	-0.001	0.026	0.004	-0.037	0.012	0.026	0.095	-0.014	0.211	-0.001	-0.004	-0.012	0.338**
8	TGW	0.014	0.021	0.002	-0.012	0.038	0.013	-0.007	0.063	0.212	0.105	-0.028	0.282	0.005	0.036	-0.003	0.735**
9	BYP	-0.001	0.013	0.042	0.016	0.050	0.011	-0.002	0.034	0.395	0.009	-0.004	0.156	0.001	0.015	0.002	0.735**
10	Pro	-0.022	-0.025	0.031	0.022	-0.038	-0.011	0.018	-0.034	-0.018	-0.194	0.058	-0.478	0.002	-0.072	0.007	-0.751**
11	Sedi	-0.013	-0.011	0.028	0.024	-0.044	-0.009	0.007	-0.023	-0.024	-0.150	0.075	-0.290	0.004	-0.065	0.011	-0.485**
12	HI	0.020	0.024	-0.031	0.001	0.047	0.010	-0.017	0.039	0.136	0.204	-0.048	0.454	-0.001	0.049	-0.002	0.884**
13	TEMP5	0.111	0.048	0.288	-0.084	-0.191	-0.012	-0.036	0.042	-0.280	0.442	-0.035	0.724	-0.001	-0.352	0.039	-0.231
14	TEMP15	0.048	0.064	-0.043	-0.055	0.248	0.049	0.008	0.129	0.334	0.803	-0.279	0.285	0.014	0.017	-0 .011	-0.577
15	CC	-0.005	0.006	0.027	-0.005	0.006	0.003	-0.013	0.005	-0.027	0.043	-0.025	0.030	0.001	0.006	-0.033	0.019

(Residual effect = 0.005)

DH= Days to heading, DM= Days to maturity, PH= Plant height, TIL/M=Number of effective tillers per meter, GPS= number of grains per spike, SL= Spike length, PL= Peduncle length, TGW= Thousand grains weight, BYP= Biological yield per plot, Pro= Protein content, SV= Sedimentation value, HI= Harvest Index, TEMP5= Canopy temperature after 5 days of anthesis, TEMP15= Canopy temperature after 15 days of anthesis, CC= Chlorophyll content, GY= Grain yield per plot.

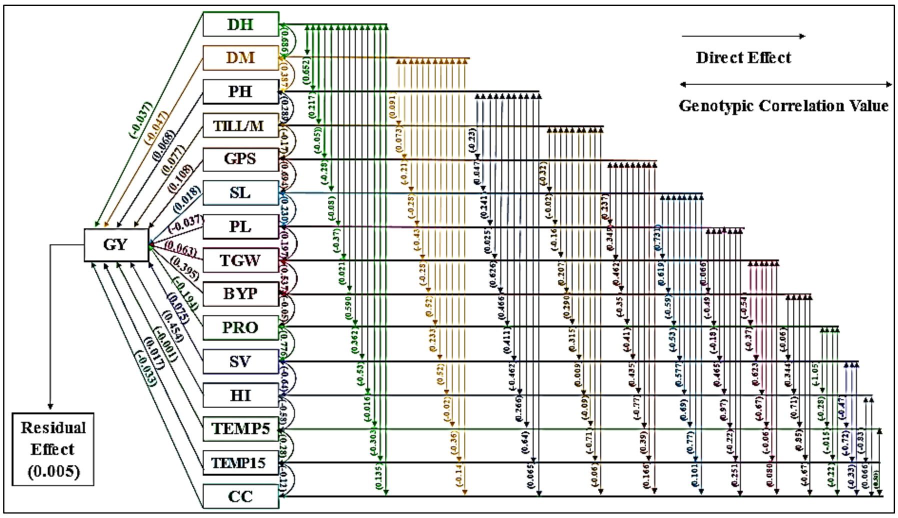

Fig 1: Diagrammatic representation of genotypic path analysis in durum wheat

number of grains per spike [same as Adhikari *et al.* (2018) [3], Zemede *et al.* (2019) [24], Alemu *et al.* (2020) [4], Elahi *et al.* (2020) [10], Malbhage *et al.* (2020) [14], Singh *et al.* (2020) [20] and Vaghela *et al.* (2021) [23]], spike length [same to the Tambe *et al.* (2013) [21] and Mohapatra *et al.* (2019) [15] findings], peduncle length [similar to Vaghela *et al.* (2021) [23]] and 1000 grains weight [Tambe *et al.* (2013) [21], Malbhage *et al.* (2020) [14], Mohapatra *et al.* (2019) [15] and Elahi *et al.* (2020) [10]] shows high heritability with high genetic advance both which indicates that the traits were simply inherited in nature and controlled by few major genes or possessed additive gene effects.

3.3 Correlation analysis (Genotypic and Phenotypic)
Correlation studies provides the information about degree and direction of traits with grain yield which is useful for selection of elite genotypes from population. Genotypic and phenotypic correlation coefficient among grain yield per plot and its contributing traits are presented in table 2. For all traits genotypic correlation values are higher than phenotypic correlation values which indicates little influence of environment. Number of grains per spike, spike length, peduncle length, 1000 grains weight and biological yield per plot showed positive and significant correlation with grain yield per plot which is similar to the findings of Adhikari *et al.* (2018) [3], Rashidi *et al.* (2012), Vaghela *et al*. (2021) [23], Tambe *et al*. (2013) [21], Elahi *et al*. (2020) [10], Dabi *et al.* (2016) [8], Alemu *et al.* (2020) [4] and Ayer *et al.* (2018).

3.4 Path coefficient analysis
The information about the cause and effect situation in understanding the cause of association between two variables; the examination of the direct effect of various characters on yield as well as their indirect effects via other component traits was permitted by path analysis. Table 3 revealed that highest positive direct effect towards the grain yield per plot was observed by harvest index followed by biological yield per plot, number of grains per spike. The residual value is 0.005 in path analysis was considerably low indicating a appropriate explanations of the characters under study and a high contribution of independent traits to the dependent traits (grain yield per plot) as shown in table 3 and figure 1. These findings are in confirmation with Abinasa *et al.* (2011) [2], Tsegaye *et al.* (2012) [22], Ayer *et al.* (2017) [5], Baye *et al.* (2020) [6], Elahi *et al.* (2020) [10], Rajput (2018) [17], Saha *et al.* (2018) [19], Alemu *et al.* (2020) [4], Baye *et al.* (2020) [6], Choudhary *et al.* (2021) [7] and Vaghela *et al.* (2021) [21].

4. Conclusion
High heritability values coupled with high genetic advance were recorded for days to heading, days to maturity, number of grains per spike, spike length, peduncle length, 1000 grains weight and grain yield per plot indicating that these traits are governed by additive gene effects and direct selection for these traits would be more effective for desired genetic improvement.

Correlation between grain yield per plot and number of grains per spike, spike length, peduncle length, 1000 grains weight and biological yield per plot, harvest index was found positive and significant and therefore selection for these traits can directly be followed for yield improvement in durum wheat.

From path analysis we concluded that some traits *viz.*, Harvest index, biological yield per plot, number of grains per spike exhibited highest positive effect on grain yield and each trait must be given preference in selecting of superior genotypes.

5. References

1. Abdipur M, Ramezani HR, Bavei V, Talaee S. Effectiveness of canopy temperature and chlorophyll content measurements at different plant growth stages for screening of drought tolerant wheat genotypes. Environmental Science. 2013;13:1325-1338.
2. Abinasa M, Ayana A, Bultosa G. Genetic variability, heritability and trait associations in durum wheat (*Triticum turgidum* L. *var. durum*) genotypes. African Journal of Agricultural Research. 2011;6(17):3972-3979.
3. Adhikari SK, Rana N, Ojha BR, Khare R, Chauhan S, Thapa DB. Study of variability and association of yield attributing traits in durum wheat genotypes. Journal of Agriculture and Ecology Research International. 2018;1:1-12.
4. Alemu YA, Anley AM, Abebe TD. Genetic variability and association of traits in ethiopian durum wheat (*Triticum turgidium* L. *var. durum*) landraces at Dabat Research Station, North Gondar. Cogent Food and Agriculture. 2020;6(1):177-8604.
5. Ayer DK, Sharma A, Ojha BR, Paudel A, Dhakal K. Correlation and path coefficient analysis in advanced wheat genotypes. SAARC Journal of Agriculture. 2017;15(1):1-12.
6. Baye A, Berihun B, Bantayehu M, Derebe B. Genotypic and phenotypic correlation and path coefficient analysis for yield and yield-related traits in advanced bread wheat (*Triticum aestivum* L.) lines. Cogent Food and Agriculture. 2020;6(1):175-2603.
7. Choudhary RN, Suthar KJ, Doba SD, Maheriaya VD. Effect of varying levels of silicon and restricted irrigation on productivity of wheat (*Triticum aestivum* L.) under Bhal condition of Gujarat. International Journal of Chemical Studies. 2021;9(1):1269-1272.
8. Dabi A, Mekbib Firew, Desalegn Tadesse. Estimation of genetic and phenotypic correlation coefficients and path analysis of yield and yield contributing traits of bread wheat (*Triticum aestivum* L.) genotypes. International Journal of Natural Resource Ecology and Management. 2016;1(4):145-154.
9. Dewey DR, Lu K. A correlation and path coefficient analysis of components of crested wheatgrass seed production. Agronomy journal. 1959;51(9):515-518.
10. Elahi T, Pandey S, Shukla RS. Genetic variability among wheat genotypes based on Agro-morphological traits under restricted irrigated conditions. Journal of Pharmacognosy and Phytochemistry. 2020;9(3):801-805.
11. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soyabean. Agronomy Journal. 1955;47:314-318.
12. Kahrizi D, Cheghamirza K, Kakaei M, Mohammadi R, Ebadi A. Heritability and genetic gain of some morpho-physiological variables of durum wheat (*Triticum turgidum* var. *durum*). African Journal of Biotechnology. 2010;9(30):4687-4691.
13. Li YF, Wu Y, Hernandez-Espinosa N, Peña RJ. Heat and drought stress on durum wheat: responses of genotypes, yield and quality parameters. Journal of Cereal Science. 2013;57:398-404.
14. Malbhage AB, Talpada MM, Shekhawat VS, Mehta DR. Genetic variability, heritability and genetic advance in durum wheat (*Triticum durum* L.). Journal of Pharmacognosy and Phytochemistry. 2020;9(4):3233-3236.
15. Mohapatra SS, Priya B, Mukherjee S. Studies on variability, heritability and genetic advance in some quantitative and qualitative traits in bread wheat (*Triticum aestivum* L.) under rainfed condition. International Journal of Current Microbiology and Applied Science. 2019;8(9):1040-1050.
16. Panse and Sukhatme. Statistical method for Agricultural workers. Indian council of Agricultural Research, New Delhi, 1978, 381.

17. Rajput R. Correlation, path analysis, heritability and genetic advance for morpho-physiological characters in bread wheat (*Triticum aestivum* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(2):107-112.
18. Rashidi V, Tarinejad AR, Kazemiarbat H. Genotypic variation of spikes related traits and path analysis of grain yield in durum wheat lines. African Journal of Agricultural Research. 2013;8(16):1559-1562.
19. Saha R, Singh HP, Kumar S, Hussain ME, Shukla RS. Wheat genotypes under restricted irrigated conditions. International Journal of Current Microbiological Application Science. 2018;7(6):3251-3263.
20. Singh KP, Singh V, Singh T, Tripathi RM, Gupta P, Chauhan MP, *et al*. Analysis of variability, heritability and genetic advance of yield, its components and quality traits in wheat. Journal of Pharmacognosy and Phytochemistry. 2020;9(6):380-383.
21. Tambe A, Mehta DR, Chovatia VP, Bhatiya VJ. Genetic variability, character association and path coefficient analysis in durum wheat (*Triticum durum* Desf.). Electronic Journal of Plant Breeding. 2013;4(4):1303-1308.
22. Tsegaye D, Dessalegn T, Dessalegn Y, Share G. Genetic variability, correlation and path analysis in durum wheat germplasm (*Triticum durum* Desf). Agricultural Research and Reviews. 2012;1(4):107-112.
23. Vaghela GK, Patel JM, Rahevar P. Assessment of genetic variability and character association for morpho-chemical traits in bread wheat (*Triticum aestivum* L.). Emergent Life Sciences Research. 2021;7:14-20.
24. Zemede A, Mekbib F, Assefa K, Bishaw Z. Variability in Ethiopian durum wheat under rainfed environment subjected to drought at anthesis. Ethiopian Journal of Agricultural Sciences. 2019;29:17-29.