Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7129

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (6):** 1298-1303 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Comparative Approach of Wheat (I.E. Aestivum Group, Durum Group and Synthetic Wheat Group) with Triticale Genotypes for Nutreint Uptake and Use Efficiency

Akshay Kumar Vats*, S. S. Dhanda and R. K. Behl

Department of Genetics and Plant Breeding,

Chaudhary Charan Singh Haryana Agricultural University Hisar - 125004

*Corresponding Author E-mail: akshayvts@gmail.com

Received: 10.11.2018 | Revised: 14.12.2018 | Accepted: 20.12.2018

ABSTRACT

The objectives of present investigation were to study the genotypes of wheat (T. aestivum, T. durum, synthetics and triticale) for various characters under low and optimum input conditions, to determine the genotypic and phenotypic variability and indices of yield and its components for nutrient uptake and use efficiency. Results revealed that the mean squares due to genotypes were significant for all the characters except for spikelets per spike. Genotype × fertilizer (G × F) interaction was significant for majority of the characters in T. aestivum, T. durum, triticale and synthetics. Correlation coefficients revealed that the genotypes having high grain yield also had more tillers per plant, high 100–grain weight, lower plant height and high harvest index under both optimum and low input conditions. But the correlations of grain yield with grains per spike and biological yield were not similar under both conditions, the grains per spike was important component of grain yield under optimum input conditions, while biological yield under low input conditions. This may be due to the fact that some genotypes adaptable to low input conditions might have more responded fertilizer dose by increasing the vegetative phase and decreasing the productive phase under optimum input conditions leading to non-significant correlations with biological yield. With regard to their comparative response for nitrogen use efficiency from low to optimum input conditions, T. durum had the highest mean response followed by triticale then synthetic wheat and T. aestivum. With regard to phosphorous use efficiency, percentage of response from low input to optimum input conditions. T. aestivum had the highest response followed by synthetic wheat, triticale and T. durum. With regard to response of zinc from low to optimum input conditions, T. aestivum had the highest response followed by synthetic wheat, triticale and durum. The T. aestivum group in general had better response followed by synthetics, triticale and durum groups for Nitrogen, phosphorous and Zinc use efficiencies, which may probably be due to high selection pressure on T. aestivum and T. durum for fertilizer responsiveness.

Key words: *T. aestivum, Fertilizer, Genotype, Biological yield*

Cite this article: Vats, A.K., Dhanda, S.S. and Behl, R.K., Comparative Approach of Wheat (I.E. Aestivum Group, Durum Group and Synthetic Wheat Group) with Triticale Genotypes for Nutreint Uptake and Use Efficiency, *Int. J. Pure App. Biosci.* **6(6):** 1298-1303 (2018). doi: http://dx.doi.org/10.18782/2320-7051.7129

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in the world. The area, production and productivity of wheat in India is approximately 305.97 lakh hectare, 98.38 million tones, 32.16 qtl/ha, respectively during the year 2016-17[3]. The corresponding figures in Haryana are 25.58 lakh ha, 48.41 lakh tones, 123.84 qtl/ha[2]. Due to high demand of food and increasing population the increased productivity of wheat is an urgent requirement and to achieve high productivity the use of fertilizer also increases. The steadily increasing demand of consumers for environmentally sound produced food encourages farmers to switch production towards low input and in particular organic production systems. Cereal production under low-input conditions can be biased by large fluctuations between years and between fields in terms of of grain yield and baking quality. Adapted varieties might help stabilise yield and quality performances[4]. Triticale is known for good forage yield, good disease break from Barley crop, Good stress tolerance, high whole plant yield, winter types available for flex printing, high whole plant yield, late fall, early spring grage, good energy source, low glucan content in grains, exhibit lodging resistance under high fertility/rain conditions, nutrient sink for removing nutrients with high yield and standability, potential for industrial fiber[1].

The present investigation was planned with following objectives:-

1) To evaluate the various genotypes of wheat, synthetic wheat and triticale for various characters under low and optimum input conditions.

2) To determine the genotypic and phenotypic variability for the grain yield, its components and morpho- physiological traits under low and optimum input conditions.

3) To determine the various indices of yield, its components and other morpho-physiological traits for the traits for nutrient uptake and use efficiency.

4) To draw the inferences on the comparative nutrient uptake and use efficiency of different genomes in wheat and triticale.

MATERIAL AND METHODS

Experimental material comprised four groups of genotypes, namely, *T. aestivum*, *T.durum*, Triticale and synthetic wheat. Each group consisted of 8 genotypes, thus making a total of 32 genotypes. The detail of experimental material is given below.

Genotype	Source	Pedigree	Characteristics
T. aestivum			
WH 1021	CCSHAU, Hisar	GW296/ SONAK	Medium height, suitable for heat stress conditions
WH 1025	CCSHAU, Hisar	PBW 231 / C 591	Medium height, suitable for low input conditions
DBW 17	DWR , Karnal	CMH79A.95/3*CN079//RAJ3777	Dwarf, high yielding
PBW 343	PAU, Ludhiana	ND/VG1944//KAL//BB/3/YACO'S'/4/VEE#5'S'	Dwarf, high yielding
WH 147	CCSHAU, Hisar	E4870-C303/S339-PV18	Medium height, suitable for medium input conditions
LOK 1	LOK Bharti, Gujarat	S308/S331	Medium height, suitable for low input conditions
HD 2687	IARI, New delhi	CPAN20099/HD2329	Medium height, suitable for high input conditions
HD 2285	IARI, New delhi	249/HD2160//HD2186	Dwarf, suitable for heat stress conditions
T. durum			
P 7531	CCSHAU, Hisar	SUAYACAN INIA/ YUAN -// GREEN-18/3/CAD01…	Dwarf, High yielding, lodging resistant
WH 912	CCSHAU, Hisar	HUI"S"/YAV"S"//FUJI"S"/ALTAR84	Medium height, suitable for high input conditions
WHD 943	CCSHAU, Hisar	GLARE/PLATA-16//AJAIA-3/SILVER16	High yielding, disease resistant
P 7307	CCSHAU, Hisar	HIMAN-9/LOTUS-1	High yielding, suitable for low input conditions
HI 8498	CCSHAU, Hisar	RAJ6070/RAJ911	dwarf, High yielding, lodging resistant
P 7536	CCSHAU, Hisar	DIPPER2/BUSHAN3//SANITAN	dwarf, High yielding, lodging resistant, good grains
PDW 291	CCSHAU, Hisar	BOOMER21/MOJO2	dwarf, High yielding, lodging resistant, high tillering
WH 896	CCSHAU, Hisar	SIN'S'/WH852	Bold seeded
Triticale			
TL 2963	PAU, Ludhiana	T2492/T2521	High yielding, lodging resistant
TL 2969	PAU, Ludhiana	JNIT141/TL1210/JNIT141	lodging resistant
TL 2942	PAU, Ludhiana	TL2732/DT54	lodging resistant
TL 2908	PAU, Ludhiana	T2614/JNIT141/3/TL2902	Suitable for low input conditions, lodging resistant
TL 2971	PAU, Ludhiana	JNIT128*2/TL2603	lodging resistant

TL 2968	PAU, Ludhiana	TL2702/TL2421	High yielding, lodging resistant,
TL 2967	PAU, Ludhiana	DT57/TL2619//JNIT141/3/TL2902	High yielding, lodging resistant
TL 2966	PAU, Ludhiana	DT57/TL2619//JNIT141/3/TL2902	lodging resistant
Synthetic			
Syn 36	CIMMYT, Mexico	CROC-1/*Ae.sq*.(205)//OPATA	Suitable for low input conditions, lodging susceptible
Syn 5	CIMMYT, Mexico	CROC-1/*Ae.sq*.(224)//OPATA	Suitable for low input conditions, lodging susceptible
Syn 20	CIMMYT, Mexico	OPATA//CROC-1/*Ae.sq*.(879)	Suitable for medium input conditions, heat tolerant
Syn 34	CIMMYT, Mexico	OPATA//CROC-1/*Ae.sq*.(879)	Suitable for medium input conditions, drought tolerant
Syn 27	CIMMYT, Mexico	BCN//YUK//*Ae.sq*.(434)	Suitable for high input conditions
Syn 28	CIMMYT, Mexico	BCN//YUK//*Ae.sq*.(434)	High chlorophyll content, Suitable for high input conditions
Syn 24	CIMMYT, Mexico	BCN//SORA//*Ae.sq*.(323)	Suitable for medium and high input conditions
Syn 7	CIMMYT, Mexico	CROC-1/*Ae.sq*.(205)//JUP/BJY/3/…	Suitable for medium input conditions, drought tolerant

Environments: The experiment was conducted in following environments

- **Low input**: On the basis of soil test the doses of fertilizer were corrected up to 60 kg N, 30 kg P2O5/ha. In addition to this two irrigations were applied. First irrigation was applied on CRI stage and second irrigation was applied on flowering stage.
- **Optimum input:** On the basis of soil test the doses of fertilizer were corrected up to 150 kg N, 60 kg P2O5/ha. In addition, four irrigations were applied, first irrigation was applied on CRI stage, second irrigation was applied on tillering, third on flowering stage, and fourth on dough stage.

Layout: The design was laid out in split plot design. Plot size was of single row of 3 m length. Observations were taken as 5 plants / entry / replication.

Observations recorded were grain yield per plant, number of tillers per plant, spikelets per spike, plant height, spike length, number of grains per spike, 100-grain weight, days to heading, days to maturity, biomass per plant, harvest index, estimation of N, P, Zn use and uptake efficiency.

Physiological parameters recorded were photosynthetic rate, chlorophyll content, chlorophyll fluorescence, stomatal conductance and transpiration rate

Experimental results:

Mean squares due to genotypes were significant for all the characters except for spikelets per spike. Therefore spikelet per spike was dropped from further analysis (Table1). Significant differences due to genotypes for various traits indicated that there was considerable variation among the genotypes. Genotype × fertilizer (G × F) interaction was significant for majority of the characters in *T. aestivum*, *T. durum*, triticale and synthetics. This indicated that genotypes differed in their response from low to optimum input conditions for the characters under study.

Nutrient uptake parameters

The increase in mean performance of genotypes for N content in grains in various groups from low to optimum input conditions was upto 129.62% in *T. aestivum* group followed by 33.81% in *T. durum* group followed by 30.36% in triticale group followed 26.62% in synthetic wheat group. The percentage of increase for P content in grams from low to optimum input conditions in various groups was upto 20.48% in *T. aestivum* group followed by 8.39% in synthetic wheat group followed by 5.26% in *T.durum* group followed by 3.12% in triticale group. The genotypes Lok1 in *T. aestivum* group, P7531 in *T. durum* group, TL 2968 in triticale group and Syn24 in synthetic wheat group were highly responsive for Zn content in grains (Table 2).

Path coefficient

Path coefficient analysis revealed that harvest index followed by biological yield had the direct effect under both conditions, but the direct contribution of 100- grain weight, grains per spike and plant height was changed in both degree and direction from low to optimum input conditions (Table 3).

Table 1: Mean squares for various characters of wheat genotypes evaluated under Low and optimum input conditions

Grain yield	Replication (2)†	Fertilizer(F) (1)	Error(a) (2)	Genotype(G) (7)	G X F (7)	Error (b) (28)
T.aestivum	1.44	1062.58*	5.28	58.75*	17.82*	3.18
T.durum	3.06	1543.15*	4.85	47.82*	16.03	5.42
Triticale	19.89	740.49*	7.36	22.71	24.45*	5.60
Synthetic wheat	3.64	322.51*	0.71	15.85*	4.02	1.85
Number of tillers per plant						
T.aestivum	1.98	505.831*	0.24	9.83*	7.62*	1.20
T.durum	1.29	189.52*	0.38	2.19	3.49*	0.67
Triticale	0.08	273.94*	0.20	3.35	3.09	1.22
Synthetic wheat	1.62	321.83*	6.97	34.01*	16.60*	1.15
100- grain weight						
T.aestivum	0.02	1.57*	0.01	0.80*	0.13	0.63
T.durum	0.03	5.64*	0.03	0.70*	0.49*	0.02
Triticale	0.01	2.39*	0.03	0.69*	1.21*	0.04
Synthetic wheat	0.06	6.00*	0.04	0.80*	1.73*	0.02
Grains per spike						
T.aestivum	0.72	195.62*	7.41	77.73*	10.67	3.98
T.durum	5.10	35.66	16.51	7.48*	8.97*	2.30
Triticale	23.48	227.81*	25.75	34.76*	18.20	7.40
Synthetic wheat	2.06	297.21*	2.02	31.45*	38.00*	4.97
Number of spikelets per spike						
T.aestivum	2.44	0.14	14.96	7.37	8.58	3.36
T.durum	19.32	26.54	47.26	2.43	2.65	2.41
Triticale	45.51	43.66	44.64	3.76	5.00*	3.59
Synthetic wheat	2.33	8.18	0.98	8.93	7.75	4.32
Plant height						
T.aestivum	34.36	5267.25*	56.89	331.06*	554.73*	13.38
T.durum	8.37	4.39	0.85	78.91*	43.38*	6.33
Triticale	17.65*	2100.66*	0.50	150.15*	64.98*	6.78
Synthetic wheat	6.89	2025.40*	5.06	273.35*	295.89*	11.81
Biological yield per plant						
T.aestivum	20.33	2898.92*	10.05	307.36*	177.70*	12.58
T.durum	17.37	3584.53*	22.86	259.10*	162.54*	11.42
Triticale	148.61	1699.37*	77.85	190.23*	164.38*	41.45
Synthetic wheat	59.26	938.99*	4.82	168.57*	35.58	20.52
Days to heading						
T.aestivum	4.19	12.00	3.06	47.86*	11.38*	1.82
T.durum	5.15	30.08	8.40	15.24*	14.42*	2.68
Triticale	3.08	1.33	6.33	5.62	15.62*	1.85
Synthetic wheat	13.27	161.33*	16.52	82.57*	7.00	4.35
Days to maturity						
T.aestivum	3.06	17.52	5.40	52.07*	10.43*	2.16
T.durum	2.27	21.33	4.52	16.32*	15.38*	2.32
Triticale	1.58	1.33	5.58	4.85	15.33*	2.54
Synthetic wheat	18.25	172.52*	14.08	79.95*	8.04	3.95
Nitrogen content in grain						
T.aestivum	>0.01	13.38*	0.01	0.14*	0.10*	0.06
T.durum	0.01	2.72*	0.05	0.34*	0.18*	0.03
Triticale	0.01	4.09*	0.02	0.55*	0.20*	0.01
Synthetic wheat	0.01	1.94*	>0.01	0.22*	0.33*	>0.01
Phosphorous content in grain						
T.aestivum	>0.01	0.09*	>0.01	0.03*	0.01*	>0.01
T.durum	>0.01	0.02*	>0.01	0.01*	0.02*	>0.01
Triticale	>0.01	>0.01	>0.01	0.03*	0.01*	>0.01
Synthetic wheat	>0.01	0.03*	>0.01	0.03*	0.01*	>0.01
Zinc content in grain						
T.aestivum	34.31	1914.85*	64.31	98.45*	24.46*	>0.01
T.durum	34.31	2167.72*	64.31	67.23*	22.52*	>0.01
Triticale	34.31	1040.06*	3.99	31.89*	34.35*	5.67
Synthetic wheat	1.94	381.10*	7.92	533.49*	5.65*	>0.01
Nitrogen use efficiency						
T.aestivum	473.74	533314.77*	2035.30	27680.89*	8937.17*	1631
T.durum	1512.79	762110.91*	2398.31	23633.10*	7917.26*	2674.92
Triticale	9811.03	365640.71*	3639.32	11211.18*	12074.28*	2764.71
Synthetic wheat	34.50	450.80*	64.10	22.13*	1985.73	915.07
Phosphorous use efficiency						
T.aestivum	9.19	3665.73*	79.13	1289.16*	364.13*	>0.01
T.durum	9.16	1453.10*	78.76	811.17*	253.92*	>0.01
Triticale	9.20	1381.38*	79.40	383.61*	413.95*	>0.01
Synthetic wheat	9.19	679.51*	79.19	298.33*	89.35*	>0.01
Zinc use efficiency						
T.aestivum	31.44	121962.46*	>0.01	10002.86*	3343.72*	>0.01
T.durum	31.28	76632.09*	120.70	6169.46*	2147.48*	>0.01
Triticale	31.44	53243.10*	120.54	3017.97*	3238.95*	>0.01
Synthetic wheat	31.15	24838.45*	120.99	2325.27*	827.47*	>0.01

*, **: significant at 5% and 1% level of significance respectively. Values in parenthesis denote degrees of freedom. †: figure in parenthesis denotes degrees of freedom

Table 2: Mean performance of genotypes for Nitrogen use efficiency and phosphorous use efficiency under low and optimum input conditions

Nitrogen use efficiency				Phosphorous use efficiency			
Genotypes	**Low input**	**Optimum input**	**% of increase over low input conditions**	**Genotypes**	**Low input**	**Optimum input**	**% of increase over low input conditions**
T.aestivum							
DBW17	15.92	25.98	63.19	DBW17	64.96	79.60	22.53
HD2285	18.92	34.17	80.60	HD2285	85.42	94.64	10.79
HD2687	15.34	26.41	72.16	HD2687	66.02	76.72	16.20
Lok 1	25.43	31.76	24.89	Lok 1	79.38	127.15	60.18
PBW343	21.24	38.95	83.38	PBW343	97.38	106.24	9.09
WH1021	17.51	35.47	102.57	WH1021	88.69	87.57	-1.26
WH1025	17.34	27.97	61.30	WH1025	69.92	86.73	24.04
WH147	25.24	37.31	47.82	WH147	93.29	126.24	35.31
Mean	19.61	32.25	64.45	**Mean**	80.63	98.11	21.67
C.D. (a)	7.93	10.05		C.D. (a)	25.11	39.66	
T.durum							
HI8498	19.31	36.34	88.19	HI8498	90.84	96.59	6.32
P7307	24.20*	33.97	40.37	P7307	84.91	121.04*	42.55
P7531	14.84	30.51	105.59	P7531	76.26	74.20	-2.70
P7536	17.17	32.71	90.50	P7536	81.75	85.84	5.00
PDW291	17.24	34.56	100.46	PDW291	86.38	86.24	-0.16
WH896	14.65	23.24	58.63	WH896	58.10	73.29	26.14
WH912	17.39	25.64	47.44	WH912	64.11	86.98	35.67
WHD943	17.87	33.29	86.28	WHD943	83.23	89.39	7.40
Mean	17.83	31.28	75.43	**Mean**	78.19	89.19	14.06
C.D. (a)	5.99	9.15		C.D. (a)	22.87	29.96	
Triticale							
TL2908	19.54*	24.32	24.46	TL2908	60.79	97.73	60.76
TL2942	14.27	24.12	69.02	TL2942	60.29	71.36	18.36
TL2963	12.36	24.63	99.27	TL2963	61.58	61.83	0.40
TL2966	13.87	18.02	29.92	TL2966	45.05	69.35	53.94
TL2967	10.86	26.28	141.98	TL2967	65.70	54.31	-17.33
TL2968	12.31	26.46	114.94	TL2968	66.15	61.58	-6.90
TL2969	12.78	15.72	23.01	TL2969	39.30	63.93	62.67
TL2971	12.83	23.77	85.26	TL2971	59.44	64.16	7.94
Mean	13.60	22.91	68.45	**Mean**	57.28	68.03	18.76
C.D. (a)	5.22	7.80		C.D. (a)	19.52	26.13	
Synthetic wheat							
SYN20	6.90	15.05	118.11	SYN20	37.64	34.52	-8.28
SYN24	9.64	13.72	42.32	SYN24	34.29	48.23	40.65
SYN27	11.58	17.02	46.97	SYN27	42.55	57.90	36.07
SYN28	8.87	12.90	45.43	SYN28	32.25	44.39	37.64
SYN34	8.98	14.41	60.46	SYN34	36.04	44.93	24.66
SYN36	12.19	19.93*	63.49	SYN36	49.82	60.98	22.40
SYN5	6.98	16.13	131.08	SYN5	40.34	34.92	-13.43
SYN7	8.03	13.19	64.25	SYN7	32.98	40.12	21.64
Mean	9.14	15.29	67.28	**Mean**	38.23	45.74	19.64
C.D. (a)	3.89	4.69		C.D. (a)	11.74	19.46	

*, **: significant at 5% and 1% level of significance respectively. C.D. (a): denote critical difference for main effects at 5 % level of significance; C.D. (b): denote critical difference for interaction effects at 5% level of significance.

Table 3: Direct and indirect effects of various characters on grain yield under low and optimum input conditions

Character		Tillers per plant	100- grain weight	Grains per spike	Plant height	Biological yield	Harvest index	r(g) with grain yield
Tillers per plant	O	**0.0576**	0.0005	0.0554	0.0180	0.1580	0.6164	0.9016
	L	**0.0128**	-0.0139	0.0047	0.0035	0.3537	0.2616	0.6224
100 grain weight	O	0.0229	**0.0012**	0.0414	0.0131	0.0614	0.3737	0.5138
	L	0.0064	**-0.0277**	0.0007	-0.0047	0.1081	0.3866	0.4695
Grains per spike	O	0.0326	0.0005	**0.0978**	0.0019	0.0650	0.4787	0.6766
	L	-0.0018	0.0006	**-0.0336**	-0.0076	-0.0080	-0.1441	-0.1945
Plant height	O	-0.0213	-0.0004	-0.0049	**-0.0374**	-0.1662	-0.2838	-0.5140
	L	0.0005	0.0015	0.0030	**0.0846**	-0.1093	-0.5037	-0.5233
Biological yield	O	0.0224	0.0002	0.0156	0.0153	**0.4068**	-0.1027	0.3575
	L	0.0084	-0.0055	0.0005	-0.0172	**0.5389**	0.1483	0.6734
Harvest index	O	0.0439	0.0006	0.0579	0.0131	-0.0517	**0.8088**	0.8727
	L	0.0041	-0.0133	0.0060	-0.0529	0.0992	**0.8058**	0.8489

*, ** Significant at 5%, and 1% level of significance respectively

REFERENCES

1. Anonymous, The General Perception of the Role and Potential for the Triticale Crop in its Current Marketing Situation. A Compilation of Views Obtained from a Conference Call with Representative Cereal Crops Specialists of AAFRD, and Others Agronomic and other limitations of triticale for various applications, A conference call held on December 5, 2000, at AAFRD (2000).
2. Anonymous, http://agriharyana.gov.in/assets/images/whatsnew/Five_Year_AYP_Targeted_2016 17__N__Ek_Patti.pdf (2016-17).
3. Anonymous, Annual report 2017-18, Department of agriculture, co-operation and farmers welfare, Ministry of agriculture, co-operation and farmers welfare, Government of India, Krishi Bhawan, New Delhi: 110001, www.agricoop.nic.in (2017-18).
4. Fabio Mascher-Frutschi, Monitoring of wheat and triticale genotypes adapted to low-input and organic production and mixtures, COST-Switzerland, Multilateral Research Unit, Hallwylstrasse **4:** http://www.aramis.admin.ch/Default.aspx?page=Texte&ProjectID=21166 (2008).