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Genetic architecture of yield and its components in wheat (*Triticum aestivum* L.)

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Abstract

The genetic analysis of wheat (*Triticum aestivum* L.) was carried out twenty three wheat germplasm and two released wheat variety under irrigated normal soil condition to determine mode of inheritance of yield and its contributing traits. The data was recorded on twelve characters viz, such as days to 50% flowering, flag leaf area, plant height ,tiller per plant, spike length per plant, number of seed per spike, days to maturity, biological yield per plant ,harvest index (%), 1000 grain weight(g.) and grain yield per plant(g.).The variation due to treatments was significant for all the characters. All the 25 genotypes showed vast range of variation for all the 11 characters under consideration. Genotypes such as HRWYT-31 produced highest grain yield per plant followed by STEMRRSN-6108, HD-2967 and PBW-502 these four genotypes significantly out yielded genotypes. The maximum heritability of was recorded for biological yield per plant, grain yield per plant, harvest index, number of seed per spike, flag leaf area, plant height and tiller per plant . Heritability estimates indicating for chance for selection of better genotypes with respect to these characters. Grain yield per plant showed positive and highly significant correlation with tiller per plant and biological yield per plant.

Key words- Wheat, variability, heritability, genetic advance and correlation

Introduction

The many species of wheat together make up the genus ***Triticum***; the most widely grown is common wheat (*Triticum aestivum* L.) is the world's leading cereal grain and main food crop for people over the entire world. Wheat occupying commanding position in Indian agriculture which occupies 25 percent of area under cereals and contributing 36 percent of the total food grain production in the country. India is second largest producer of wheat in the word after China. Wheat is the second most important food crop of the country after rice. Global demand for wheat is increasing due to the unique viscoelastic and adhesive properties of gluten proteins, which facilitate the production of processed foods, whose consumption is increasing as a result of the worldwide industrialization process. Wheat is an important source of carbohydrates. Globally, it is the leading source of vegetable protein in human food, having a protein content of about 9- 13%, which is relatively high compared to other major cereals but relatively low in protein quality for supplying essential amino acids. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber. Wheat is used as food, feed and seed as a processed commodity. Wheat is used as a food, feed and seed. Wheat gluten protein is necessary for the basic structure in forming drought system for bread, biscuits, cookies, macorni, malt*, maidas, suji, dalia* and other backed goods. Morphological and agronomic traits of wheat have a special role in determining the importance of each trait in increasing yield, so these trait were used in breeding programmes. The most important criteria of any crop improvement programme is the selection of genotypes with all possible desirable yield contributing traits, better knowledge of genetic architecture of favorable gene action often the greatest importance in improving yield and related traits.

Materials and methods

The present genotypes/ cultivars collected from various sources and was shown on Nidharia Agriculture Farm of Sri Murli Manohar Town Post Graduate College, Ballia. The experimental material consists of twenty five genotypes. Complete set of 25 genotype were evaluated in Randomized Block Design (RBD) with three replication during *Rabi* season. The experimental data were compiled and statistical parameters analysis of variance, co-variance, heritability and correlation co-efficient was calculated and presented and interpreted here.

Results and discussion

The most important criteria in crop improvement program are the selection of genotypes with all possible desirable yield contributing traits. The twenty three genotypes along with two checks showed vast range of variation for various yield contributing characters i.e. days to 50% flowering, flag leaf area, plant height, tillers per plant, number of seeds per spike, days to maturity, biological yield per plant, harvest index, 1000 grain weight, grain yield per plant. The variation due to treatments (table-1) was significant for all the characters under study. In addition to variability (table-3) HRWYT-31 produced highest grain yield per plant followed by STEMRRSN-6108, HD-2967, and PBW-502 these four genotypes significantly out yielded among remaining genotypes. In addition to seed yield some other characters can be used in breeding program as a donar parent despite having low to medium grain yield. In this term the genotypes which can be used in breeding programme on the basis of mean performance are IBWSN-11287,ESWYT-111, and HRWSN-2095 for 1000 grain weight, SAWSN-3073,STEMRRSN-6108 and

ESWYT-111 for harvest index, PBW-502,HRWYT-31 and HD-2967 for biological yield per plant, HRWSN-2114, HLBSN-41 and SAWSN-3048 for days to maturity, KBSN-48,HD-2967 and HTSBWON-6 for number of seed per spike, SAWSN-3073, HTSBWON-6 AND ESWYT-130 spike length, PBW-502, HRWYT-31 and HLBSN-20 for plant height, HRWYT-237,HLBSN-20 and KBSN-48 for flag leaf area and SAWYT-308, ESWYT-114 and HTSBWON-6 for days to 50% flowering. Nature of variation is most important factors in improvement of a population. It is very clear that interaction of the component completely depend upon heritable variation in the population. Present study revealed that maximum coefficient of variability (table-5) was observed for biological yield per plant, tillers per plant and harvest index. It is indicated that simple selection for biological yield per plant and tiller per plant and harvest index may be more advantageous as compared to other yield contributing traits under study. Grain yield per plant also show high genotypic and phenotypic coefficient of variation give an opportunity to bring improvement in yield**.** Kheirella (1993), Singh *et al.* (2001) and Kumar *et al*. (2017). The heritability estimates indicated heritable portion of variation from the parent to their off springs and genetic advance showed the extent of genetic part that would be expected through selection. Data was recorded for heritability in broad sense. The high heritability (table-6) of biological yield per plant, harvest index, grain yield per plant and number of seed per spike accompanied by high genetic gain. Presence of additive nature of genetic variability was indicated .It can be concluded that since these characters are highly responsible for selection. Superior genotypes evolved through selection on the basis of these characters. Most of the characters showed moderate to high heritability estimates, indicating chance for selection of better genotypes with respect to these characters. Spike length per plant and days to maturity showed discouraging result due to low heritability and genetic advance. Character exhibited high heritability indicated that these characters were least influenced by environment. This suggest that need of partitioning the overall variability into heritable and non heritable with the help of suitable heritable estimates and genetic advance. A heritability estimates alone is meaningless and along with genetic advance is more meaningful in predicting the ultimate effect of selection. The result are in conformity with the finding of Singh *et al*. (2006) and Ghawat and Sakher (2010).

Table -1. Analysis of variance for 11 characters in what.

S.No.	Traits	Mean squares		
		Replication	Treatments	Error
		2	24	48
1	Days to 50% flowering	0.37	30.25**	1.48
2	Flag leaf area	0.79	33.35**	0.43
3	Plant height(cm.)	0.33	46.23**	0.75
4	Tillers per plant	0.47	21.53**	0.47
5	Spike length per plant(cm.)	0.50	1.24**	0.13
6	Number of seeds per spike	0.08	119.83**	0.82
7	Days to maturity	0.65	17.18**	1.04
8	Biological yield per plant	0.30	626.03**	0.82
9	Harvest index (%)	0.37	186.04**	0.69
10	1000 grain weight per plant (g)	1.09	24.94**	0.78
11	Grain yield per plant (g)	0.11	27.52**	0.10

***and ** significant at 5% and 1% respectively**

Table. 2 Mean, Range and CV (%) for 11 Characters in 25 germplasm of wheat (*Triticum aestivum* L.)

S.No.	Traits	Mean	Range		CV (%)	CD
			Minimum	Maximum		
1	Days to 50% flowering	3.49	75.33	92.00	1.42	.95
2	Flag leaf area	3.6	27.38	42.15	1.96	.08
3	Plant height(cm.)	9.16	80.96	96.5	0.97	.43
4	Tillers per plant	0.71	7.13	18.36	6.43	.13
5	Spike length per plant(cm.)	1.4	10.17	12.51	3.21	.60
6	Number of seeds per spike	8.28	58.60	80.60	1.33	.49
7	Days to maturity	14.71	110.33	121.00	0.89	.68
8	Biological yield per plant	0.16	32.13	96.83	1.81	.49
9	Harvest index (%)	5.07	21.9	57.54	2.37	.37
10	1000grain weight per plant(g)	0.35	36.67	45.27	2.19	.45
11	Grain yield per plant (g)	6.96	11.89	23.40	1.86	.52

Table 3. Mean value for various plant characters in wheat

S.No.	Genotypes	Days to 50% flowering	lag leaf area	Plant height(cm.)	Tillers per plant	Spike length per plant(cm.)	Number of seeds per spike	Days to maturity	Biological yield per plant	Harvest index (%)	1000grain weight per plant(g)	Grain yield per plant (g)
1	IBWSN-1153	82.00	5.49	8.40	0.27	11.13	68.27	114.00	49.23	34.09	42.70	17.05
2	IBWSN-1287	81.33	7.54	96.05	13.27	11.87	80.60	112.67	46.07	28.76	45.27	15.06
3	HRWYT-237	81.00	2.15	92.23	9.10	12.14	74.10	113.33	46.07	38.83	38.73	18.00
4	HRWYT-31	82.00	4.92	92.30	15.27	11.84	68.24	117.00	71.16	33.32	42.47	23.40
5	HRWSN-2114	92.00	7.38	80.96	9.73	10.67	75.40	121.00	54.44	30.82	33.67	16.76
6	HLBSN-41	85.00	4.63	83.75	8.40	11.24	65.30	118.00	49.53	33.00	38.43	16.43
7	HRWYT-240	88.00	0.80	95.19	8.53	11.79	68.93	117.00	49.50	30.90	40.10	15.80
8	SAWSN-3048	84.67	3.33	88.13	7.13	10.68	63.60	117.67	45.33	29.41	40.17	12.31
9	HRWYT-241	87.00	2.69	91.25	8.27	11.34	73.33	116.33	43.96	32.10	38.07	14.35
10	ESWYT-130	83.00	6.27	89.93	10.23	12.22	60.27	116.00	34.39	43.07	43.40	14.68
11	HTSBWON-6	81.00	6.36	90.69	8.63	12.44	76.07	111.67	37.20	41.61	35.87	15.27
12	SAWYT-3003	82.33	1.13	91.01	9.47	11.53	58.80	114.00	50.00	35.14	41.60	17.94
13	SAWYT-348	83.33	8.65	88.00	11.10	11.11	62.73	113.67	64.74	23.80	43.73	15.35
14	KBSN-48	81.33	7.55	91.07	8.13	11.97	77.40	113.33	37.40	40.32	41.37	15.05
15	SAWSN-373	83.00	1.60	88.00	12.13	12.51	71.20	113.00	35.49	57.54	38.00	20.09
16	ESWYT-111	85.00	3.54	90.69	10.40	10.91	63.10	115.33	42.63	44.94	45.00	19.09
17	ESBWYT-48	83.67	1.78	85.01	10.13	11.37	64.40	114.00	56.11	32.07	38.87	18.00
18	HRWSN-2095	86.00	2.80	88.48	11.27	11.28	60.63	115.67	63.02	26.86	44.00	17.13
19	SAWYT-308	75.33	8.71	90.16	10.20	11.08	66.10	110.33	32.13	36.92	38.80	11.89
20	ESWYT-114	80.33	1.47	86.40	8.30	10.91	58.60	112.33	33.23	37.91	37.20	12.75
21	HLBSN-20	82.00	7.78	93.19	14.20	10.17	69.47	113.00	52.40	33.82	42.53	17.95
22	HTEYT-35	83.33	5.14	82.17	8.47	10.86	72.33	113.33	48.18	30.45	40.67	14.83
23	STEMRRSN-6108	82.00	4.57	91.59	13.67	10.51	70.53	112.67	45.71	48.58	39.87	22.22
24	HD-2967(Check)	87.33	2.31	91.94	13.20	12.36	76.10	117.00	69.35	30.68	40.37	21.28
25	PBW-502(Check)	84.67	1.46	82.52	18.36	11.08	61.51	115.33.	96.83	21.90	38.00	21.20
	Mean	**83.49**	**3.60**	**89.16**	**10.71**	**11.40**	**68.28**	**114.71**	**50.16**	**35.07**	**40.35**	**16.96**

Table 4. Genotypic and phenotypic correlation coefficient for 11 characters in wheat (*Triticum aestivum* L.)

S. No.	Character	Days to 50% flowering	Flag leaf area	Plant height(cm.)	Tillers per plant	Spike length per plant (cm.)	Number of seeds per spike	Days to maturity	Biological yield per plant	Harvest index (%)	1000 grain weight per plant(g)	Grain yield per plant(g)
1	Days to 50% flowering	r(g) (p)	-0.338** -0.297**	-0.305** -0.259*	-0.043 -0.056	-0.091 -0.062	0.094 0.083	0.902** 0.800**	0.391** 0.364**	-0.32** -0.297**	-0.206 -0.186	0.212 0.197
2	Flag leaf area		r(g) r(p)	0.412** 0.402**	-0.007 -0.011	0.28* 0.23*	0.379** 0.366**	-0.276* -0.253*	-0.204 -0.199	0.233* 0.224*	0.304** 0.276*	0.089 0088
3	Plant height(cm.)			r(g) r(p)	0.089 0074	0381** 0.313**	0.299** 0.282*	-0.303 -0.26*	-0.249* -0.24*	0.217 0.212	0.496** 0.451**	0.072 0.068
4	Tillers per plant				r(g) r(p)	-0.045 -0.048	-0.012 -0.002	-0.059 -0.039	0.639** 0.667**	-0.134 -0.129	0.224 0.209	0.731** 0.702**
5	Spike length per plant(cm.)					r(g) r(p)	0.340** 0.312**	-0.084 -0.079	-0.129 -0.114	0.32** 0.263*	-0.027 -0.014	0.137 0.11
6	Number of seeds per spike						r(g) r(p)	-0.043 -0.04	-0.148 -0.138	0.124 0.123	-0.197 -0.174	0.069 0.07
7	Days to maturity							r(g) r(p)	0.388/** 0.354**	-0.355** -0.325**	-0.16 -0.154	0.177 0164
8	Biological yield per plant								r(g) r(p)	-0.659** -0.656**	0.08 0.076	0.581** 0.578**
9	Harvest index (%)									r(g) r(p)	-0.119 -0.112	0.165 0.167
10	1000 grain weight per plant(g)										r(g) r(p)	0.09 0.186

* Significant at 5% and ** significant at 1% level of significant

Table 5. Grand mean, PCV, GCV, ECV, Standerd error and CD of 11 Characters in Wheat (*Triticum aestivum* L.)

S.No.	Traits	Mean	ECV	GCV	PCV	Standard error	CD 5%
1	Days to 50% flowering	83.49	1.43	.71	3.98	0.69	.95
2	Flag leaf area	33.6	1.96	.86	10.05	0.38	.08
3	Plant height(cm.)	89.16	0.97	.37	4.47	0.50	.43
4	Tillers per plant	10.71	6.43	4.72	25.55	0.40	.13
5	Spike length per plant(cm.)	11.4	3.21	.32	6.21	0.21	.60
6	Number of seeds per spike	68.28	1.33	.22	9.32	0.52	.49
7	Days to maturity	114.71	0.89	.02	2.21	0.59	.68
8	Biological yield per plant	50.16	1.81	8.78	28.83	0.52	.49
9	Harvest index (%)	35.07	2.37	2.41	22.54	0.48	.37
10	1000grain weight per plant(g)	40.35	2.19	.03	7.37	0.51	.45
11	Grain yield per plant (g)	16.96	1.86	7.83	17.93	0.18	.52

The heritability estimates indicated heritable portion of variation from the parent to their off springs and genetic advance showed the extent of genetic part that would be expected through selection. Data was recorded for heritability in broad sense. The high heritability (table-6) of biological yield per plant, harvest index, grain yield per plant and number of seed per spike accompanied by high genetic gain. Presence of additive nature of genetic variability was indicated. It can be concluded that since these characters are highly responsible for selection. Superior genotypes evolved through selection on the basis of these characters. Most of the characters showed moderate to high heritability estimates, indicating chance for selection of better genotypes with respect to these characters. Spike length per plant and days to maturity showed discouraging result due to low heritability and genetic advance. Character exhibited high heritability indicated that these characters were least influenced by environment. This suggest that need of partitioning the overall variability into heritable and non heritable with the help of suitable heritable estimates and genetic advance. A heritability estimates alone is meaningless and along with genetic advance is more meaningful in predicting the ultimate effect of selection. The result are in conformity with the finding of Singh *et al*. (2006) and Ghawat and Sakher (2010).

Table 6. Estimation of heritability and genetic advance in percent of mean for 11 characters in wheat (*Triticum aestivum* L.)

S.No.	**Traits**	h^2 (Broad sense)	Genetic Advance 5%	Genetic Advance 1%	Genetic advance as % of mean 5%	Genetic advance as % of mean1%
1	Days to 50% flowering	87.22	5.96	7.64	7.14	9.15
2	Flag leaf area	96.20	6.69	8.58	19.92	25.53
3	Plant height(cm.)	95.30	7.83	10.03	8.78	11.25
4	Tillers per plant	93.70	5.28	6.77	49.29	63.17
5	Spike length per plant(cm.)	73.40	1.07	1.37	9.39	12.03
6	Number of seeds per spike	98.00	12.84	16.46	18.81	24.10
7	Days to maturity	83.80	4.37	5.60	3.81	4.89
8	Biological yield per plant	99.60	29.68	38.04	59.17	75.82
9	Harvest index(%)	98.90	16.10	20.64	45.91	58.84
10	1000grain weight per plant(g)	91.20	5.58	7.15	13.83	17.72
11	Grain yield per plant (g)	98.90	6.20	7.94	36.54	46.82

The genetic architecture of seed yield , in wheat as well other crops, is based on the effect produced by various yield components directly with one another . In this respect the correlation coefficient which provides symmetric measurement of degree of association between two variables or characters. In present investigation simple correlation coefficient (table-4) were computed for eleven characters. Grain yield per plant showed positive and highly significant association with tiller per plant and biological yield per plant it mean that increase in number of tillers are also increased grain yield. 1000 grain weight showed positive and significant correlation with flag leaf area and plant height. Increase flag leaf area heavier the grain weight and it will take into consideration. Harvest index showed positive and significant correlation with flag leaf area and spike length per plant .Flag leaf area indirectly affected harvest index and longer spike length and grain yield also increases. Biological yield per plant showed highly significant correlation with days to 50% flowering, tillers per plant and days to maturity but negative and significant for plant height. Days to maturity showed highly significant correlation with days to 50% flowering, it means increases number days of flowering increases days to maturity. Number of seed per spike found positive and highly significant correlation for flag leaf area, plant height and spike length. Spike length per plant showed positive and significant correlation with plant height and flag leaf area. Tiller per plant was non significant association for all the characters. Plant height showed negative and significant correlation with days to 50% flowering and positive highly significant for flag leaf area.

The above discussion revealed that all the highly significant estimates of correlation coefficient observed among the important yield component such as biological yield per plant and tillers per plant were highly significant positive correlation with grain yield. Thus selection practiced for improving these traits individually or simultaneously is likely to bring improvement in other due to correlated response. This suggests that selection would be quite efficient in improving yield component in wheat. The similar result have been reported by Narwal *et al*. 1999, Singh *et al*. 2003.

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