Identification of suitable bread wheat (*Triticum aestivum L.*) lines for rainfed situation in Karnataka

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Karnataka is one of the important wheat growing states in the peninsular India. Most of the area is under rainfed condition dominated by durum wheat cultivation. In the recent years, the area under bread wheat is increasing under rainfed condition. This necessitated the identification of suitable lines for this situation. The success of any breeding programme depends upon the successful selection of genetically variable material in hand. To make the heritable improvement in characters, estimation of genetic parameters and genetic advance is required. Heritability estimates provides information about the extent to which a particular character can be transmitted to the successive generations. Knowledge of heritability of a trait guides a plant breeder to predict behavior of succeeding generations and helps in making desirable selections. Correlation studies along with path analysis provide a better understanding of the association of different characters with grain yield. Path coefficient analysis separates the direct effects from the indirect effects through other related characters by portioning the correlation coefficients (Dixet and Dubey, 1984). The present study was carried out to evaluate the genetic variability and inheritance of yield of some diverse lines for the development of desirable wheat genotypes for the rainfed areas.

An experiment was conducted for evaluation of 32 bread wheat lines along with four checks viz., C-306, PBW-175, HW-2004 and NI-5439 which were planted in RCBD with 2 replications at ARS (University of Agricultural Sciences, Dharwad) Bailhongal during Rabi 2009-10. Each entry was sown in 4 rows with 23 cm spacing between the rows and necessary cultural practices were followed. At maturity ten plants from central rows were selected at random from each entry for recording data on five quantitative characters viz., days to maturity, days to heading, plant height (cm), 1000 grain weight (g) and grain yield (kg/ha). The mean data were subjected to analysis of variance to test the level of significance among the genotypes for different characters according to Steel and Torrie (1980). Genotypic and phenotypic coefficient of variability was calculated according to Johnson *et al.*, (1956). Estimation of broadsence heritability and genetic advance at 5% selection intensity were calculated using formula reproduced by Allard (1960) as follows

$$h^2_{(BS)}\ \% = [V(G)/V(P)]*100\ \&$$

$$GA = (K)*(\sqrt{P})*(h^2_{(BS)})$$

Where √P is standard deviation of phenotypic variance and K is selection differential with 2.06 @ 5% selection intensity. Genetic advance in terms of percentage of mean was calculated as GA (%) = [(100*GA)/X] described by Brim *et al.*, (1959) where X is the mean of the population for a particular trait. While correlation and path coefficient analysis were computed according to the method suggested by Dewey and Lu (1959).

Analysis of variance showed highly significant differences among the genotypes for all the characters under study (Table 1). Mean data of the different plant traits revealed a considerable amount of variability for all the traits studied (Table 2). Out of 36 entries, six entries viz., NIAW-1017 (839.5), MP-1184 (816.5), AKAW-3717 (801.5), UAS-295 (782.5), UAS-291 (762.5) and HI-1547 (743.5) were significantly superior in grain yield over check NI-5439 (722).Whereas six entries, MP-1184 (44.85), MACS-6215 (42.4), K-0443 (40.65), HD-2935 (40.4), MP-1182 (40.2) and MP-1183 (38.95) were significantly superior in 1000 grain weight over check PBW-175 (35.65). While, the five entries viz., UAS-290 (89.25), HI-1547 (86.45), HD-2934 (84.2), UAS-289 (83.75) and MP-1182 (83.25) were taller compared to the check PBW-175 (83.25). Though the genotype HI-1547 recorded higher grain yield and plant height but 1000 grain weight was very low.

Estimates of genotypic coefficient of variability (GCV), phenotypic coefficient of variability (PCV), broadsence heritability, genetic advance and genetic advance expressed as percentage of mean for five characters are presented in table 3. The estimates of GCV were high for grain yield (29.46) while the remaining traits recorded moderate to low GCV estimates. The PCV values were higher than GCV value for all the traits which reflect the influence of environment on the expression of traits. High heritability estimates were recorded for day to heading, days to maturity, plant height, 1000 grain weight and grain yield. Yousaf Ali *et al.* (2008) also reported high heritability estimates for plant height, number of spikelets per spike, spike length, number of grains per spike, 1000 grain weight and yield per plant which supported the present findings.

Heritability and genetic advance are the two parameters which are very important for selection. High genetic advance coupled with high heritability estimates offers the most effective condition for selection (Larik *et al.*, 2000). The utility of heritability therefore increases when it is used to calculate genetic advance, which indicates the degree of gain in a character obtained under a particular selection pressure. Thus, genetic advance is yet another important selection parameter that aids breeder in a selection program

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(Shukla *et al*., 2004). High heritability accompanied with high genetic advance in case of plant height and 1000 grain weight indicates that most likely the heritability is due to additive gene effect and selection may be effective in the early generation for these effects. Kalim Ullah *et al.* (2011) also recorded high heritability estimates for plant height, days to 50% flowering, 1000 grain weight days to heading, spikelets spike-1 and spike length. High heritability coupled with low genetic advance for days to heading and days to maturity indicated non-additive gene effects. Therefore, there is a limited scope for improvement of these traits.

The phenotypic and genotypic correlations for morphological traits are presented in Table 4. Grain yield had highly significant and positive genotypic correlation with plant height and negative genotypic correlation with days to heading and days to maturity. It seems logical for selection of early maturing long stature genotypes with high yield for rainfed situations. Plant height showed significant and positive genotypic correlation with 1000 grain weight. Path coefficient analysis provides an effective way of finding out direct and indirect source of correlation.

Table 1. Analysis of variance showing mean squares for different character in bread wheat under rainfed condition

Sources of variance	d.f.	Days to heading	Days to maturity	Plant height	1000 grain weight	Grain yield
Treatment	35	31.06**	38.79**	51.51**	30.2**	53617.54**
Replication	1	7.34	29.37	11.68	69.2	0.000
Error	35	3.97	3.56	7.01	1.27	4033.20

Table 2. Mean *per se* for some plant traits in bread wheat under rainfed condition

Genotypes	Days to heading	Days to maturity	Plant height	1000 grain weight	Grain yield
AKAW-3717	66	97	83.0	34.9	801.5
UAS-294	71	103	71.2	35.5	444.5
UAS-295	58	94	82.0	37.1	782.5
NW-3073	69	101	80.7	28.5	358.0
WH-1024	65	107	70.8	36.7	339.0
WH-1025	65	106	70.9	31.1	334.5
HD-2934	66	98	84.2	29.5	352.0
HD-2935	67	104	83.0	40.4	411.0
HD-2944	68	99	82.2	32.8	371.5
UAS-289	59	90	83.7	32.5	631.5
HI-1547	66	96	86.4	33.7	743.5
MP-3211	60	93	77.5	34.2	687.5
K-0441	65	96	80.7	38.6	661.0
K-0442	60	93	77.5	31.7	615.0
K-0443	79	104	82.0	40.6	467.0
K-0444	65	99	79.2	38.1	462.5
PBW-577	63	99	71.5	31.9	510.5
PBW-578	64	100	76.2	34.8	489.0
NIAW-1114	67	103	73.7	28.2	570.0
NIAW-1017	65	101	76.9	29.8	839.5
UP-2663	64	101	70.1	30.5	339.5
UP-2664	66	103	77.4	32.5	712.5
MP-1182	65	95	83.2	40.2	421.0
MP-1183	60	93	80.0	38.9	633.0
MP-1184	62	91	82.7	44.8	816.5

Cont.

MACS-6215	59	94	78.6	42.4	629.0
UAS-290	68	96	89.2	36.2	538.5
UAS-291	65	94	79.7	35.5	762.5
HUW-599	66	105	66.9	34.9	340.5
DT-160	66	97	74.2	32.7	367. 0
TL-2945	64	98	80.0	37.0	385.5
PBW-576	70	102	73.6	34.6	460.5
C-306 [C]	68	102	78.5	34.3	426.5
PBW-175 [C]	69	104	83.2	35.6	433.0
HW-2004 [C]	67	100	80.7	33.7	379.5
NI-5439[C]	66	97	77.7	31.7	722.0
Grand Mean	65	99	78.6	34.9	534.4
CV %	3.04	1.90	3.36	3.23	11.88
S.Em±	0.199	0.189	0.264	0.112	0.635

Table 3: Estimation of different genetic parameters for important quantitative traits in bread wheat under rainfed condition

Statistical parameter	Days to heading	Days to maturity	Plant height	1000 grain weight	Grain yield
Range	59-71	91-108	67 - 89	28.3 - 44.9	335-840
GCV %	5.61	4.24	6.00	10.91	29.46
PCV %	6.38	4.65	6.88	11.38	31.77
Heritability (%)	77.3	83.2	76.0	91.9	86.0
GA	6.67	7.89	8.47	7.52	300.81
*GA %	10.17	7.96	10.77	21.54	56.28
Discriminant function analysis	-5.24	-15.50	2.33	1.31	--

*as percent of mean

Table 4. Genotypic and phenotypic correlation among different quantitative characters in wheat

Characters	Correlation	Days to heading	Days to maturity	Plant height	1000 grain weight	Grain yield
Days to heading	G	1.000	0.673**	0.042	-0.087	-0.469**
	P	1.000	0.594**	-0.015	-0.073	-0.357*
Days to maturity	G		1.000	-0.547**	-0.282	-0.638**
	P		1.000	-0.489**	-0.213	-0.522**
Plant height (cm)	G			1.000	0.340*	0.359*
	P			1.000	0.271	0.295
1000 grain weight (g)	G				1.000	0.170
	P				1.000	0.147
Grain yield (kg/ha)	G					1.000
	P					1.000

*-Significant at 0.05 and ** Significant at 0.01

Table 5. Genotypic path analysis showing direct (diagonal) and indirect effects for grain yield in bread wheat under rainfed condition

Characters	Days to heading	Days to maturity	Plant height	1000 grain weight	Grain yield
Days to heading	-0.146	-0.328	0.004	0.001	-0.469**
Days to maturity	-0.099	-0.488	-0.057	0.004	-0.638**
Plant height (cm)	-0.006	0.267	0.104	-0.005	0.359*
1000 grain weight (g)	0.013	0.138	0.035	-0.016	0.170

Residual = 0.5856. *-Significant at 0.05 and ** Significant at 0.01

The results were presented in Table 5 which revealed that plant height exhibited highest positive direct effect, while days to maturity, days to heading and 1000 grain weight exhibited negative direct effects with grain yield. Discriminate function analysis (Table 3) reveled that plant height contributed more to the yield followed by 1000 grain weight, days to heading and days to maturity.

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