PHYSIOLOGICAL PROPERTIES OF INDIAN HEXAPLOID WHEAT(*TRITICUM AESTIVUM*) CULTIVARS

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ABSTRACT

The present study was investigation for selected five wheat genotypes representing different agro climatic zones. The material was grown in four different test environments in randomized block design with five replications to identify the stable genotypes under different environments. The genotypes PBW 343, UP 2338, HD 2687, HI 1077 and RAJ 3989 were promising for grain yield. A major portion was accounted by non-linear component for days to heading, days to maturity and biological yield per plant. However, the linear portion was higher for number of grains per spike, effective tillers per plant and protein (%). The South India, increasing the profitability of farmer's in rice, wheat system and training the farmer's on RCTs and seed production. The results was revealed that based on the findings of base line survey, wheat crop evaluation by farmer's before and at maturity, and survey of 100 farmers in the project area. The project successfully achieved higher varietal replacement. Area under PBW 343 declined and other varieties of similar potential were being adopted. The correlation between ranking of varieties was highly significant which supported the farmer's perception that the performance of the varieties was consistent over the years. Mean score of PBW 343, UP 2338, HD 2687, HI 1077 and RAJ 3989 showed superiority over other varieties. The farmer's preferred PBW 343 for dense Spike, bold grain and more tillering. The farmer's appreciated the concept of demonstration of all the improved varieties at one site.

Key words: Wheat, Physical Properties, Genotypes

No: of Tables: 8 **No: of References: 16**

INTRODUCTION

Wheat (*Triticum aestivum*L. em. Thell.; 2n=42), a self-pollinated crop of the *Graminae* family (Sub-family *Poaceae*) and genus *Triticsum*, is the world's largest famous energy rich cereal crop (Kumar *et al*., 2014).

Wheat is one of the most important and widely cultivated crops in the world, used mainly for human consumption and support nearly 35% of the world population(Mohammadi-joo *et al.*, 2015) and providing 20per cent of the total food calories (Anonymous, 2014). It is the most widely cultivated food crop of the world. It is known for its remarkable adoption to a wide range of environments and its role in world economy. India accounts an area, production and productivity of 31.34 million ha, 95.91 million metric tonnes and 3061 kg/ha, respectively (Anonymous, 2013). In Gujarat, wheat is grown during 2013-14 in about 13.51 lac ha with total production of 36.50 lac metric tonnes and productivity of 2074 kg/ha(Anonymous, 2013).

India is Current estimates indicate that wheat crop grown on around 13.5 mha in India is affected by heat stress (Sareen *et al*, 2012). It is also reported that the cool period for wheat crop in India is shrinking; while the threat of terminal heat stress is expanding (Joshi *et al*, 2007). However, during the last few years, there is stagnation in wheat productivity and environmental issues are still posing challenge to the researchers and extension agencies. There is a need to diversify the area under different wheat varieties.

Altitudinal climatic variation and farmer's needs are probably the major attributers for high wheat diversity. Diversity study among quantitative traits and their genetic parameters estimates are prerequisite in wheat breeding program (Desheva and Kyosev 2015, Farshadfar and Estehghari 2014, Farshadfar et al 2013).

The magnitude of environmental variance was relatively lower than the genotypic variation. It indicated that there was not considerable effect of environment on the genotypic coefficient of variability (GCV). Highest magnitude of genotypic coefficient of variation was observed for vigour index followed by 1000-seedweight, day to maturity and plant height while high value of Phenotypic Coefficient of Variability (PCV) was estimated for vigour index followed by 1000-seed weight, day to maturity and plant height (Dhanda *et al.,*2004, Wani *et al*., 2011 Mehta *et al.,*2013 and Kumar *et al*., 2014). The large area occupied by PBW 343(Anonymous, 2005-06) is a major concern and other varieties need to be popularized for better production and profitability.

MATERIALS AND METHOD

The metrological observations at weekly intervals during experimental period were recorded and depicted. Each entry was accommodated in a single row of 3-meter length with spacing of 30 cm between row to row and 10 cm between plant to plant in each environment (Panse and Sukhatme, 1967). Heat stability index (HSI) was calculated for each genotype (Fisher and Maurer 1978).

Five wheat varieties viz. PBW 343, UP2338, HD2687, HI1077 and RAJ3989 were sown at farmer's fields. Additionally, four varieties under different tillage options like zero tillage, raised bed, rotary and conventional tillage were seeded with recommended package of practices at farmers. Those farmers who had sufficient experience in agriculture, exposure to mass media and/or having contacts with experts were encouraged to attend the field days so that they can judiciously rank the varieties. The farmer's were briefed by the social scientist about the coded varieties to facilitate ranking. Firstly, they were advised to have a look at all the wheat varieties grown and then to rank them as per their criteria and supporting reasons. The illiterate farmers were assisted by the team in doing this job. The baseline survey which is one of the time tested tools in differentiating the pre and post changes was used to study the impact of Participatory Varietal Selection on varietal diversification.

RESULTS AND DISCUSSION

a) Profile of the farmers: Most of the farmers were middle aged (67%) followed by young (18%) and old (15%) age. The findings show that 93 percent of the farmers were literate; however, in-depth analysis has indicated that about three-fourths of them were educated up to metric. From researcher's point of view, the literacy level was satisfactory and the farmers could follow the semi-technical language, therefore, the print material could be used to make the farmers aware of the latest technologies. All the farmers had agriculture as their main occupation. There were a few who had dairy (4%) and other subsidiary occupations. A trend was observed that those who had comparatively smallholdings were having other subsidiary occupations to support their family. Majority (83%) of the farmers were having more than ten years experience in agriculture. Only 17 percent of them had up to 10years experience in agriculture. Most of the farmers (42%) had 6-10 members in their family followed by up to 5 (38%) and more than 10 (20%). State agriculture officers, scientists from the research institutes and television were the main sources of information for new developments in agriculture. About half of the farmers were getting information from radio and newspapers. About one-fourth read magazines/pamphlets to get the information on recent developments in agriculture, including wheat cultivation technologies.

b) Participatory Varietal Selection (PVS): Under the participatory varietal selection, nine promising and newly released varieties were sown at farmers' field to provide an opportunity to the farmers to compare all the varieties at one site and select the desired varieties by farmers for their production conditions. Though, all these varieties were sown under timely sown conditions; whereas UP 2338 was recommended for both timely and late sown conditions. The varieties were evaluated by the farmers before and after maturity.

c) Economic importance of parameters: During farmer's days, they were asked to evaluate the varieties. First of all, the economic importance of various parameters was assessed on a three point continuum viz very important, some what important and not important by the farmers in Farmers group Discussion mode. The parameters used for

evaluation were germination, number of effective tillers, days to maturity, plant height, lodging resistance, insect and disease resistance, ear head length, grains per ear head, grain yield, straw yield, grain type, etc. (Table1).

***d)* Evaluation of wheat varieties:** All the varieties were evaluated by individual farmers in the field before and at maturity for various parameters on a three point continuum viz; very good, good and not good. The varieties were ranked on the basis of economic importance of a parameter and its evaluation score (Table 2). On the basis of composite score of first followed by PBW343, UP2338, HD2687, HI1077 and RAJ3989 (Table 3).

e) Mean performance and heat tolerance: Considering the mean performance of genotypes for different characters studied under timely sown and late sown environments in each of two locations, genotypes PBW343 for effective tillers per plant; HD2687, UP2338 and PBW343 number of grains per spike, PBW343 and UP2338 for 1000 grain weight PBW343 for biological yield per plant HD2687, UP2338, PBW343, HI1077 and RAJ3989 for grain yield per plant in all environments were found promising.

f) Effect of Varieties: The data were subjected to one-way analysis of variance (5 varieties against 12 parameters) to know the effect of varieties on different parameters and then the mean score was evaluated (Table 4). The results indicated that the mean score of highest followed by PBW 343 and this showed superiority over others.

g) Impact on varietal diversification: The project succeeded in convincing the farmers that cultivation of outdated varieties was no longer profitable and it was always better to grow more than one variety. After experimentation of the reduction in area under PBW343 was noticed (Table 5). Many of the farmers felt to discontinue PBW 343 because of the attack of powdery mildew and possibility of yellow rust. Never the less, PBW 343 was still better than many other existing varieties. UP2338 could not get approval of the farmers due to low yield in case of former and rust diseases susceptibility in the latter. Moreover, wheat was grown under timely sown conditions in this area; therefore, there was little scope for late sown varieties.

The parameters was found highly significant at 5% level which supported the farmer's perception that the performance of the varieties was consistent over the years (Table 6). One-way Analysis of Variance (ANOVA) with Tukey's estimate of power to which observations must be raised to achieve additivity = 3.033 (Table 7).

The estimates of parameters was findings of the surveys conducted before and after the experimentation have indicated that the area under PBW 343 and UP2338 declined. HD2687 occupied about 30.52 percent area and the newly released wheat variety PBW343 was expected to occupy more area as reported by the farmers (Table 8).

CONCLUSION

It may be concluded that the genotypes viz. PBW343, UP2338, HD2687, HI1077 and RAJ3989 exhibited the least reduction under terminal heat stress condition, as well as low (< 0.5) HSI values.

Moreover, the genotype PBW343, UP2338, HD2687, HI1077 and RAJ3989 was found stable and high yielder along with the resistance against terminal heat stress. It may be cultivated under terminal heat stress conditions. However, above all the genotypes may be utilized in breeding program to develop high yielding heat tolerant/resistance cultivars.

Evaluation of varieties by the farmers proved to bean effective tool in convincing them about potential of recently released varieties. Group approach utilizing key resource farmers may be utilized while doing farmer participatory varietal selection. The project has successfully achieved higher varietal replacement. Area under PBW 343 and UP 2338 has declined and other varieties of similar potential were being adopted. The farmers recommended the concept of participatory assessment of all the improved varieties at one site.

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Table 1. Economic importance score of parameters (N=100)

Genotype	Parameter Score
1. Germination	3.00
2. Number of effective tillers	2.96
3. Days to flowering	1.88
4. Days to maturity	1.87
5. Plant height	2.72
6. Lodging resistance	2.84
7. Disease resistance	2.88
8. Insect resistance	2.31
9. Thresh ability	2.02
10. Grain colour	2.24
11. 1000 kernel weight	2.73
12. Cooking quality	2.07
13. Chapati quality	2.35
14. Earhead length	2.51
15. Grains / earhead	3.00
16. Grain type	2.95
17 Grain yield	2.96
18 Straw yield	2.47

Table 2. Evaluation score of wheat varieties

Parameter	PBW343	UP2338	HD2687	HI 1077	RAJ 3989
Germination	2.78	2.69	2.72	2.68	2.65
Number of effective tillers	2.83	2.51	2.56	2.81	2.63
Days to maturity	2.58	2.48	2.36	2.61	2.45
Plant height	2.82	2.64	2.67	2.79	2.65
Lodging resistance	2.71	2.32	2.45	2.71	2.32
Disease resistance	2.48	2.35	2.29	2.48	2.32
Insect resistance	2.92	2.92	2.93	2.91	2.92
Spike length	2.62	2.64	2.66	2.59	2.63
Grains/ spike	2.53	2.61	2.64	2.52	2.61
Grain type	2.89	2.32	2.73	2.91	2.31
Grain yield	2.19	2.16	2.19	2.18	2.18
Straw yield	2.78	2.73	2.90	2.73	2.86
Total score	29.35	30.37	31.10	31.92	30.53

Thereafter the scores of all the parameters were summed up for a variety to get a composite score.;Parameter Score = M × E

M = Mean Economic Importance Score

E = Evaluation score of the same parameter

Composite Score of a Variety = Sum of the scores of all parameters for a variety

Table 3. Wheat varieties on the basis of evaluation score and economic importance score of parameters

Parameter	Wheat Varieties				
	PBW343	**UP2338**	**HD2687**	**HI 1077**	**RAJ 3989**
Germination	8.34	8.07	8.16	8.04	7.95
Number of effective tillers	8.37	7.42	7.57	8.31	7.78
Days to maturity	4.82	4.63	4.41	4.88	4.58
Plant height	7.67	7.18	7.26	7.58	7.20
Lodging resistance	7.69	6.58	6.95	7.69	6.58
Disease resistance	7.14	6.76	6.59	7.14	6.68
Insect resistance	6.74	6.76	6.76	6.72	6.74
Spike length	6.57	6.62	6.67	6.50	6.60
Grains/ spike	7.59	7.83	7.92	7.56	7.83
Grain type	8.52	6.77	2.05	8.58	6.81
Grain yield	6.48	6.39	6.48	6.45	6.45
Straw yield	6.86	6.74	7.16	6.74	7.06
Total score	86.79	81.75	77.98	86.19	82.26

Figures in parenthesis are the composite score

Table 4: Effect of varieties on parameters

	PBW343	UP2338	HD2687	HI1077	RAJ3989
Mean	7.2325	6.8125	6.4983	7.1825	6.8550
Std. Error of Mean	.30053	.24873	.48779	.29172	.25662
Sum	86.79	81.75	77.98	86.19	82.26
Range	3.70	3.44	6.11	3.70	3.37
Std. Deviation	1.04106	.86162	1.68976	1.01054	.88895
Variance	1.084	.742	2.855	1.021	.790
Kurtosis	1.398	3.530	4.165	1.222	3.515
Std. Error of Kurtosis	1.232	1.232	1.232	1.232	1.232
Skewness	-.942	-1.224	-1.980	-.852	-1.367
Std. Error of Skewness	.637	.637	.637	.637	.637
Harmonic Mean	7.0708	6.6922	5.6585	7.0318	6.7251
Geometric Mean	7.1562	6.7563	6.1755	7.1109	6.7947

a. Limited to first 100 cases.

Table 5: Change in area under different varieties and their preferred characters by formers

Varieties	% Area		Status	Preferred Characters
	Pre	Post		
PBW 343	71.61	63.15	Decline	bold grain, more tillering
HD 2687	25.42	30.52	Increasing	Spike length, more tillering, Good yield
UP 2338	2.67	2.01	Decline	Good yield
HI 1077	0.72	1.68	Increasing	Good yield
RAJ 3989	0.00	0.75	Increasing	Good yield

Table 6: Tests of Between-Subjects Effects

Dependent Variable of parameters

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	71.536[a]	5	14.307	1.201	.408	.500	6.006	.210
Intercept	1.492	1	1.492	.125	.736	.020	.125	.060
PBW343	15.712	1	15.712	1.319	.294	.180	1.319	.164
UP2338	1.597	1	1.597	.134	.727	.022	.134	.061
HD2687	33.457	1	33.457	2.809	.145	.319	2.809	.293
HI1077	8.679	1	8.679	.729	.426	.108	.729	.112
RAJ3989	23.116	1	23.116	1.941	.213	.244	1.941	.218
Error	71.464	6	11.911					
Total	650.000	12						
Corrected Total	143.000	11						

a. R Squared = .500 (Adjusted R Squared = .084)

Computed using alpha = .05

Table 7: ANOVA with Tukey's Test for Nonadditivity

			Sum of Squares	df	Mean Square	F	Sig
Between People			132.823	35	3.795		
Within People	Between Items		13.115	4	3.279	5.689	.000
	Residual	Nonadditivity	.837[a]	1	.837	1.457	.229
		Balance	79.852	139	.574		
		Total	80.689	140	.576		
	Total		93.805	144	.651		
Total			226.628	179	1.266		

Grand Mean = 6.9144

a. Tukey's estimate of power to which observations must be raised to achieve additivity = 3.033.

Table 8: Parameter Estimates

Dependent Variable of Parameters

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval		Partial Eta Squared	Noncent. Parameter	Observed Power[a]
					Lower Bound	Upper Bound			
Intercept	3.753	10.605	.354	.736	-22.197	29.703	.020	.354	.060
PBW343	-18.956	16.505	-1.149	.294	-59.341	21.429	.180	1.149	.164
UP2338	-2.768	7.560	-.366	.727	-21.267	15.730	.022	.366	.061
HD2687	-1.902	1.135	-1.676	.145	-4.678	.875	.319	1.676	.293
HI1077	13.740	16.096	.854	.426	-25.646	53.125	.108	.854	.112
RAJ3989	10.559	7.579	1.393	.213	-7.987	29.105	.244	1.393	.218

a. Computed using alpha = .05

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