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Characterization and Evaluation of Morphological Traits in Wheat Species Grown in Humid South Eastern Plain Zone of Rajasthan

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ABSTRACT

Wheat is an annual plant belonging to the family Poaceae. It is used by human being in the form of flour for making different types of product like Chapatti, Bread, Biscuit, Cookies, noodles, maida, pasta etc. The objective of this study was to assess the morphological characteristics of germplasm bread and durum wheat. During two consecutive years (rabi 2015-16 and 2016-17) ten varieties of wheat species (Triticum aestivum L. and Triticum durum Desf.) were planted under field conditions and observe their morphological characters i.e. Days to heading, Days to maturity, Plant height, No. of ear head/m^2, Ear length, No. of Grain ear^{-1}, Weight of seed ear^{-1}, 1000 grain weight, Grain yield, Hectoliter weight and Texture. Results shows that among wheat species genotypes GW 366, HI 1544, Raj 4037, HD 4728, HI 8737 and HI 8498 showed superiority for yield and yield attributes, therefore these genotypes could be utilized in various breeding programmes in future. Result was prepared by ANOVA method to analysis the genotypes for morphological variability. Desired traits can also be used for further improvement of morphological parameters through ideal breeding programme.

Key words: *Wheat, morphology, trait, characterize, Anova*

INTRODUCTION

Wheat *(Triticum)* is locally known as Gehun/Kanak, it belongs to the family Poaceae (Graminee). It is the second most important food crop of India after rice, Among the world, India ranks 3rd position in wheat production. It is one of the important and widely cultivated crops of the world (Figure-1). Wheat is grown about 29 million hectare acreage of across the country[6] used mainly for human consumption and support nearly 35% of the world population[7] and providing 20 per cent of the total food calories[2]. Wheat is counted among the "Big three" cereals crops, with over 600 million tones being harvested annually. Wheat is used as a stable food grain for urban and rural community and as well a major source of fodder for animal feeding.

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Wheat is nature's unique gift to the humanity as it supply major source of nutrition in terms of proteins, carbohydrate and minerals. Worlds mostly nutrition consumption depends on wheat and wheat products viz. Chapati, biscuit, pasta, macroni, noodles and fermented products, all over the world people consume wheat products in one of these forms[1].

Rajasthan is the largest state of India consisting 10.4 per cent of total geographical area and 5.67 per cent of total population of Country. There are a large number of wheat cultivars which adopted to different climatic conditions and that is why wheat is being cultivated in nearly all over the world[4,8]. Wheat yield is under influence of various factors such as climate, cultivar, pests, agronomic practices, diseases and weed infestation. Over two dozen individual species have been characterized as part of genus *Triticum*. Of these, only two or three are widely cultivated in India. Wheat is a monocotyledon member of Poaceae family. It is herbaceous plant. Probably, it is the first crop plant which is domesticated and cultivated by human. Common wheat or bread wheat varieties have soft or hard endosperm, red or white bran color, winter or spring habit. Common wheat are haxaploids (AABBDD; 2n=6x=42), it is called as *Triticum aestivum L.*, Durum or macroni wheat have tetraploids (AABB; 2n=4x=28), it is called as *Triticum turgidum*, traditionally known as *Triticum durum Desf.*, another one species *Triticum dicoccum* are also grown in some parts of India. It is called as Emmer wheat and having tetraploid (AABB; 2n= 4x=28).

A balance diet containing enough calories, proteins and micronutrients is essential for the proper growth and development of human beings. Around three billion people all over the world encounter problem of malnutrition due to micronutrient deficiency. So, emphasis is being given to improve wheat grain nutrition quality to meet the challenge of world malnutrition. According to United nations 'DESA' report, World population is expected to increase from around 7 billion now to around 8.5 billion by 2030. In South Asia and Africa, two out of five children will remain malnourished, despite distinct improvement in per caput food availability. Thus, food grain and nutritional quality will continue to remain major challenge for developing countries all over the world. Accordingly plan to study the present investigation.

MATERIAL AND METHODS

The present study was designed to work out morphological aspect among 10 wheat varieties during Rabi season 2015-16 and 2016-17. The investigation was carried out in the field experiment at a farmer's field, Dhakarkheri village, Kaithoon road, Kota (Rajasthan). Kota is situated in between 25^0 11' N latitude and 75^0 54' E longitudes at 273 m altitude from mean sea level. The study area Humid South Eastern Plain Zone is also called as Zone V of Rajasthan. It covers the geographical area of about 2.7 m. ha. spread over Kota, Jhalawar, Bundi, Baran and parts of Sawai Madhopur districts out of which about 1.8 m. ha is under cultivation. The soil of Zone V is clay loam type and ground water is saline. Experimental materials of studies comprised of 10 wheat varieties received from Agricultural Research Station, Ummedganj, Kota (Agriculture University, Kota) viz. 5 genotypes of *Triticum aestivum L.* (Raj 4037, Raj 4238, GW 322, GW 366, HI 1544) and 5 genotypes of *Triticum durum desf.* (Raj 6560, MPO 1215, HI 8498, HI 8737, HD 4728) was sown in Randomized Block Design with three replications kept 6 m X 1.20 m gross plot area, six row each and 23 cm distance between row to row.

The observation were recorded on eleven different morphological traits viz. Days to heading, Days to maturity, Plant height, No. of ear head/m^2, Ear length, No. of grain ear^{-1}, Weight of seed ear^{-1}, 1000 grain weight, Grain yield, Hectoliter weight and Texture. Observations were recorded on five randomly selected competitive plants in each entry of each replication for all the characters except for days to 75% heading and days to maturity, which were recorded on plot basis. Analysis of

variance was done, procedure given by Panse and Sukhatme[10].

Morphological Methods

Five competitive plants will be randomly selected from each replication in genotypes for recording observations. The selected plants will be tagged and data on individual plant will be recorded for the following characters:

1. **Days to heading**: It is calculated as days taken from sowing to emergence of 75% of ears in a plot. Observation on off-type plants should not be considered.
2. **Days to maturity**: Total days taken from sowing to maturity when all plants in a plot show natural senescence and the grains become hard and fit for harvesting.
3. **Plant height (cm)**: Measured at the time of maturity in centimeters from the ground level upto the terminal ear. Care should be taken to record the measurement from the most commonly representative plants in the plot.
4. **No. of ear head/m^2**: Total ear's in one sq.m. area.
5. **Ear length (cm)**: Length of ears of five representative ear heads from base of ear to top of ears awns from each plot were measured and averaged to record mean length of ear in c.m.
6. **No. of grain ear^{-1}:** Five representative ear heads selected from sample rows of each plot were threshed, winnowed and their grain number counted and averaged to record mean number of grain per ear.
7. **Weight of seed ear^{-1} (gm):** Representative ear head selected from sample rows of each plot were threshed, winnowed and their grain weighed in grams and recorded as weight of seed per ear**.**
8. **1000 grain weight (gm)**: A small seed sample was taken from the produce of each plot harvested and 1000 seeds were counted, weighed in grams and recorded as test weight (TKW).
9. **Grain Yield (Kg/plot)**: The sun dried bundles from each plot were threshed and winnowed and the grain so obtained was weighed with physical balance to record seed yield kg per plot.
10. **Hectoliter weight (Kg/hL)**: Hectoliter weight usually determines the plumpness of the grain. Flour yield increase and flour ash decrease with the increase in hectoliter weight. Grain size and shape are the most important features which influences the overall hectoliter weight of the grain.
11. **Texture (So, SH, H)**: Hardness of matured seed (Soft, Semi Hard and Hard).

RESULTS AND DISCUSSION

Morphological characterization and analysis of variation (ANOVA)

Morphological characterization is the beginning step in description and classification of crop germplasm because breeding programme mainly depends upon magnitude of genetic variability[12]. Morphological markers are those neat traits that are evident to human naked eyes. These markers are selected based on the experience of the breeder to correlate a phenotype trait with a trait of interest[3]. Molecular marker is differing among species, genus and varieties of plants. It is quickest and easiest way to find out the presence of a morphological marker with a trait for improvement. Diversity, based on the morphological characters, is essential in plant breeding as it show important traits to plant breeders; however, the phenotypes are highly influenced by many environmental factors.

In the present investigation, 10 important morphological characters have been studied to assess the pattern and limitation of genetic variability and relatedness among 10 genotypes of *Triticum sp.* The results acquired are depicted under the following headings:

ANOVA for Individual Environment:

Successful breeding evaluation largely depends on the limit of genetic variability present in the material. The average mean of squares from the ANOVA for different morphological characters depicted in (Table 2) revealed that the mean squares due to genotypes were highly significant for all the characters. This indicates the presence of significant genetic variability in the material.

Bhattarai *et al*. studied on different morpho-physiological and yield attributing traits i.e.,

days to heading, maturity, plant height, spike length, number of grains per spike, thousand kernel weight, hectoliter weight, grain yield and biomass yield. Significant genotypic differences were observed for all the traits studied indicating considerable amount of variation among genotypes for each character. Khushboo *et al.*[5] studied on 250 F2 populations of cross WH1105 x WH711 to evaluate the correlation and path coefficient analysis. The correlation estimates showed positive and significant correlation of grain yield with number of tillers per plant, ear weight and 100 grain weight. Investigation was carried out by Nusrat Jan *et al.*[9]with 20 wheat genotypes to study the genetic advance, variability and heritability. Analysis of variance considerable variability among the genotypes for 13 quantitative characters. The study provides scope for selection and further regular utility of the genotypes in the plant improvement.

Performance of genotypes

Based on the pooled data of consecutive two years i.e. rabi 2015-16 and 2016-17 for various characters, minimum and maximum results taken from the average performance of 10 genotypes of *Triticum sp. (Triticum aestivum L. and Triticum durum desf.)* for the characters studied. Genotypes were grouped as group I *(Triticum aestivum L.)* and group II (*Triticum durum desf.)* based on their species. The data depicted in the (Table 3) reveals that accurate range of variation among genotypes for all the characters. Analysis of variance showed that all the genotypes show significance between the 10 genotypes.

Days to heading

The mean heading days for 10 wheat genotypes was 76 days (Table 3) with the range of 71-86 days. It was recorded early in group I variety Raj 4037 (71 days) and in group II variety HI 8498 and HI 8737 (71 days) each, while late heading in group I variety GW 322 (86 days) and for group II variety MPO 1215 and HD 4728 (79 days) each, respectively.

Days to maturity

The average number of days to maturity was 121 days (Table 3) of all the genotypes. Data for days to maturity, recorded early and late in group I variety Raj 4037 (111 days) and GW 322 (134 days), respectively. While in group II early and late maturity in variety HI 8737 (117 days) and Raj 6560 (125 days), respectively.

Plant height

Plant height was in the range of 91.7 cm to 105.3 cm. The average plant height was 98.1 cm (Table 3), tallness was found in group I genotype Raj 4037 (105.3 cm) and dwarfness in GW 366 (98.7) whereas in group II, entry HI 8737 (100.3) and HI 8498 (91.7) was performs, respectively. **No. of ear head/m^2**

The average number of ear head/m^2 was 297 with range of 257 to 348 ear head in one m^2 plot area (Table 3). Maximum nos. of ears head/m^2 was found in group I genotype GW 366 (348) and minimum nos. was in Raj 4238 (271) while in group II, genotype HD 4728 (347) and MPO 1215 (257) gave maximum and minimum nos. of ear head /m^2, respectively.

Ear length

The average ear length was 9.0 cm (Table 3) and varied from 7.1 cm to 11.4 cm. Ear length found tall in group I genotype HI 1544 (11.4) and dwarf in GW 366 (9.6) while in group II, genotype HI 8498 was tall (8.3) and genotypes Raj 6560 and MPO 1215 were equal (7.1) dwarf.

No. of grains /ear

The average number of grains/ear was 47 (Table 3) with the range of 41 to 57. Maximum and minimum number of grains/ear was found in group I genotype Raj 4037 (57) and Raj 4238 (41), respectively. While in group II, genotype Raj 6560 (50) and HD 4728 (44) was recorded respectively.

Weight of seed/ear

The average weight of seed in 10 genotypes was 2.44 g with range of 1.85 g to 2.80 g (Table 3). Weight of seed was found highest and lowest in group I genotype Raj 4037 (2.80) and GW 322 (1.85) and same trend was also observed in group II genotype HI 8737 (2.72) and MPO 1215 (2.35), respectively.

1000 grain weight

The average weight of 1000 grain was 47.56 g (Table 3) with range of 42.12 g to 55.27 g. Weight was higher in group I entry GW 366

(49.82) and lower in GW 322 (42.12) while in group II entry HD 4728 (55.27) and Raj 6560 (43.67), respectively.

Grain yield

The average grain yield of all the 10 genotypes was recorded with 46.47q/ha (Table 3) and grain yield varied from 43.07 to 50.63 q/ha. Group I genotype GW 366 gave maximum grain yield (49.25 q/ha) and minimum was given by Raj 4238 (43.13 q/ha). In group II genotypes HD 4728 gave highest grain yield (50.63 q/ha) while lowest was given by Raj 6560 (43.07 q/ha).

Hectoliter weight

The mean value of Hectoliter weight was recorded 79.920 Kg/hL (Table 3) with the range of Hectoliter weight was from 78.183 to 80.767 Kg/hL. The highest Hectoliter weight was in group I cultivar GW 366 (80.050) and lowest in cultivar Raj 4238 (78.183), while in group II cultivar HD 4728 (82.600) and Raj 6560 (79.617) also gave similar trend, respectively.

Mean value of various parameters indicate the normal distribution of genotypes in the present study and hence, representing the spectrum of variability. The coefficient of variation for traits studied being in the range of 1.72 to 13.92 indicate the ampleness of the material and characters studied for further estimation of genetic variability parameter in present investigation.

Based on performance, genotypes HD 4728, GW 366, HI 8498, Raj 4037, HI 8737 and HI 1544 have been identified as superior for most important morphological characters (Table 4). Therefore, these genotypes have been identified for profitable breeding and crop improvement programmes.

Table 1: List of genotypes with pedigree used in present investigation

S. No.	Name of Variety	Centre of Origin	Year of Release	Pedigree	Description of variety
1	Raj 4037	RAU, Durgapura (Rajasthan)	2003	DL788-2/RAJ3717	IR, TS
2	Raj 4238	RAU, Durgapura (Rajasthan)	2016	HW2021/RAJ3765	IR, LS
3	GW 322	JAU, Junagarh (Gujarat)	2002	GW173/GW196	IR, TS
4	GW 366	JAU, Junagarh (Gujarat)	2006	DL802-3/GW232	IR, TS
5	HI 1544	IARI, Indore (M.P.)	2008	HINDI62/BOBWHITE/CPAN2099	IR, TS
6	Raj 6560	RAU, Durgapura (Rajasthan)	2005	TOPDY6	IR, TS
7	MPO 1215	JNKVV, Powarkhera (M.P.)	2009	GW1113/GW1114//HI8381	IR, TS
8	HI 8498	IARI, Indore (M.P.)	1999	RAJ6070/RAJ911	IR, TS
9	HI 8737	IARI, Indore (M.P.)	2014	HI8177/HI8158//HI8498	IR, TS
10	HD 4728	IARI, New Delhi	2015	ALTAR84/STINT//SILVER_45/3/SOMAT_3.1/4/ GREEN_14//YAV_10/AUK	IR, TS

*IR- Irrigated, TS-Timely sown, LS-Late sown

Table 2: ANOVA for the 10 choosen characters in 10 genotypes of *Triticum sp.*

S. No.	Characters	Mean of square		
		Replications	Treatments	Error
	Degree of freedom (df)	**(2)**	**(9)**	**(36)**
1	Days to heading	20.47	127.82	24.18
2	Days to maturity	33.05	209.75	40.85
3	Plant height (cm)	1.02	88.96	19.59
4	No. of ear head/m^2	123.27	5710.72	257.35
5	Ear length (cm)	0.57	18.64	0.40
6	No. of grain/ear	2.72	129.40	8.37
7	Weight of seed/ear (g)	0.20	0.72	0.12
8	1000 grain weight (g)	2.39	126.60	6.29
9	Grain yield (q/ha)	0.43	48.27	7.79
10	Hectoliter weight (Kg/hL)	5.51	9.07	1.89

Table 3: Performance of different characters of various genotypes of *Triticum sp.* (Pooled data of 2 years)

Genotypes	Days to heading	Days to maturity	Plant Height (cm)	No. of ear head/m^2	Ear length (cm)	No. of Grain/ ear	Weight of Seed/ear (g)	1000 grain weight (g)	Grain Yield (q/ha)	Hectoliter weight (Kg/hL)	Texture (SO, SH,H)
Group I (Triticum aestivum L.)											
Raj 4037	71	111	105.3	296	11.0	57	2.80	43.80	45.47	78.750	H
Raj 4238	74	120	99.5	271	10.7	41	1.87	45.48	43.13	78.183	SH
GW 322	86	134	99.0	292	10.3	43	1.85	42.12	44.20	79.217	H
GW 366	78	123	98.7	348	9.6	50	2.73	49.82	49.25	80.050	H
HI 1544	74	117	99.8	311	11.4	50	2.33	43.73	46.68	79.350	H
Group II (Triticum durum desf.)											
Raj 6560	75	125	98.0	281	7.1	50	2.47	43.67	43.07	79.617	SH
MPO 1215	79	123	95.7	257	7.1	45	2.35	46.93	44.30	80.167	H
HI 8498	71	120	91.7	270	8.3	47	2.68	52.67	48.25	80.500	H
HI 8737	71	117	100.3	302	7.3	47	2.72	52.15	49.72	80.767	H
HD 4728	79	124	93.3	347	7.3	44	2.62	55.27	50.63	82.600	H
Mean	**76**	**121**	**98.1**	**297**	**9.0**	**47**	**2.44**	**47.56**	**46.47**	**79.920**	-
Range	71-86	111-134	91.7-105.3	257-348	7.1-11.4	41-57	1.85-2.80	42.12-55.27	43.07-50.63	78.183-80.767	-
SEm±	**2.01**	**2.61**	**1.81**	**6.55**	**0.26**	**1.18**	**0.14**	**1.02**	**1.14**	**0.56**	-
CD 5%	**5.76**	**7.48**	**5.18**	**18.78**	**0.74**	**3.39**	**0.40**	**2.94**	**3.27**	**1.61**	-
CV	**6.49**	**5.26**	**4.51**	**5.40**	**7.03**	**6.11**	**13.92**	**5.27**	**6.01**	**1.72**	-

Table 4: Genotypes classified as per their high *per se* performance in *Triticum sp.*

S. No.	Characters	Best Genotypes	Genotype showing uniform high *per se performance*
1.	Days to heading	Raj 4037, HI 8498, HI 8737	Raj 4238, HI 1544, Raj 6560
2.	Days to maturity	Raj 4037	HI 1544, HI 8737
3.	Plant height (cm)	HI 8498	HD 4728, MPO 1215
4.	No. of ear head/m^2	GW 366	HD 4728, HI 1544
5.	Ear length (cm)	HI 1544	Raj 4037, Raj 4238
6.	No. of grain/ear	Raj 4037	GW 366, Raj 6560
7	Weight of seed/ear	Raj 4037	GW 366, HI 8737
8	1000 grain weight (g)	HD 4728	HI 8498, HI 8737
9	Grain yield (q/ha)	HD 4728	HI 8737, GW 366
10.	Hectoliters weight (g)	HD 4728	HI 8737, HI 8498

Kingdom : Plantae
Sub Kingdom : Tracheobionta
Super Divison : Spermatophyta
Division : Mangoliophyta
Class : Liliopsida
Sub Class : Commelinidae
Order : Cyperales
Family : Poaceae (Graminee)
Genus : *Triticum*
Species : a*estivum and durum*

English name- Wheat, Hindi name- Ganhu, Sanskrit name-Godhum

Fig. 1: Taxonomic Position

CONCLUSION

ANOVA methods explain significant mean square values denoted substantial degree of genetic variability among the genotypes. The ANOVA of morphological characters data indicate that mean squares for all genotypes were significant for all the characters. The mean squares due to genotype interaction were also significant for all the characters.

On the basis of performance of genotypes *per se*, both *Triticum* sp. genotypes GW 366, HI 1544, Raj 4037, HD 4728, HI 8737 and HI 8498 showed superiority level for yield and yield attributes, therefore these cultivars could be gainfully utilized in various breeding programmes in future.

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