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**Evaluation of different durum wheat varieties under stress conditions  
(Brackish water & coarse textured soil)**

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**KEYWORDS**

Durum wheat, stress conditions, quantity and quality

**A B S T R A C T**

To evaluate the performance of different durum wheat varieties along with one bread wheat as a check, a field experiment was conducted at Institute of Plant Introduction (IPI), Saleh Mohammad village, Malir Karachi Pakistan, located at 24° 52.11' N 67° 14.89' E during the winter season 2012, under stress condition i.e; brackish water ( 3558 ppm) and coarse textured soil (Hilly sand) having 0.40 EC ( Sm-1) with average pH value of 7.8.by using randomized complete block design with three replications. The results shows diverse trend regarding plant height (cm), number of tillers m<sup>2</sup>, spike length (cm), number of grains spike<sup>-1</sup>, grain yield (g m<sup>2</sup> ) and biological yield ( kg m<sup>2</sup> ).The quality parameters studied were wet and dry gluten percentage, gluten index and falling number. The maximum grain yield, 1000 grains mass weight ,wet and dry gluten percentage, gluten index and falling number 294 g m<sup>2</sup>,29.4 ,46.9 15.8,40 and 406, respectively was recorded from the Durum-2 followed by bread check TD1 (229 g m<sup>2</sup> ) grain yield while, the durum -1 and Rebel varieties were at par by producing grain yield of 222, 223 g m<sup>2</sup>, respectively..

**Introduction**

Wheat is the most important winter crop of Pakistan and primarily used as a staple food providing more protein than any other cereal crop. The most important modern wheat species now are the hexaploid bread wheat (*Triticumaestivum*spp) and the tetraploid durum wheat (*Triticumturgidum durum*), which are distinctive based on their genomic number, grain composition and food end-use quality attributes[1].Durum wheat belongs to

family Poaceae tribe Hordeae. It is consumed in many forms like bread, Pasta, cakes, biscuits, bakery products, and many confectionery products. Now a day there is increasing demand of durum wheat varieties used in bakery purpose, but the farmers are unaware about the durum wheat and its importance. Hence the cultivation of durum wheat in Pakistan is negligible.

Durum in Latin means hard wheat, it is a minor crop, grown on only 8 to 10% of all the wheat cultivated area. The remaining area is cultivated with hexaploid bread wheat [2,3,4,5]. It is cultivated in the semiarid regions of the world. However, durum wheat is a crop adapted to marginal lands. The cultivated area of durum wheat in the world is 13.7 million ha with production averaging about 30 million tons annually. Durum wheat has the hardest grain of all wheat and is used to make semolina. With its strong gluten properties and superior cooking characteristics, semolina is used in pasta products such as macaroni, and spaghetti [6, 7, 8].

The kernel size, hardness, golden amber color along with its protein content and gluten strength, make it suitable for manufacturing a unique and diverse range of food products. Pasta is the most common product of the durum wheat which is considered as one of the most important food staples in most part of the world. Semolina, durum granular, and durum flour milled from durum wheat are used to manufacture paste and non-paste food products. In spite of its low acreage, durum wheat is an economically important crop because of its unique characteristics and end products.

The differences between common wheat and durum wheat can be attributed largely to their gluten protein properties, with durum wheat normally having weaker gluten than bread wheat. However, the development of strong gluten durum cultivars has improved the cooking quality of pasta products and improved the bread baking quality [9]. The trend worldwide is to increase the consumption of durum wheat products. Pasta, bread, and all other food from grains are a major group of healthy, balanced, and nutritious foods. Research on increasing the

yield, production, and disease resistance of durum wheat should continue to be essential.

Historically durum wheat has received insufficient attention from breeders and farmers. Even in areas with low rainfall, farmers prefer to cultivate bread wheat, which relegates durum wheat cultivation to more marginal areas. It can be due to insufficient suitable durum wheat seeds compared to bread wheat for planting in different environmental conditions. One of the best options for crop production, yield improvement, and yield stability is to develop and cultivate new high yielding durum varieties [10, 11, 12].

Research on increasing the yield, production, and disease resistant durum wheat should continue to be essential. Generally wheat crop requires ideal conditions for its growth and yield like: presence of loamy soil and availability of sweet water. The farmers belong to areas of marginal soil along with brackish water fail to cultivate the wheat crop. Keeping the view a pilot project was initiated at the Plant introduction center, Saleh Mohammad village, Malir Karachi to evaluate the different durum Wheat varieties along with bread wheat (check) under stress conditions (brackish water & coarse textured soil).

### **Materials and Methods**

During the winter season 2012-1013 at the experimental field of Institute of Plant Introduction (IPI), Saleh Mohammad village, Malir Karachi Pakistan, located at 24<sup>o</sup> 52.11 N 67<sup>o</sup> 14.89 E. consist of coarse textured soil (Hilly sand) having 0.40 EC (Sm<sup>-1</sup>) with average pH value of 7.8 as source of irrigation water is dug well having 3558 ppm total soluble salts, an experiment was conducted for the evaluation of 3

Durum wheat varieties i.e. Rabel, Durum-1 and Durum -2 along with one check (TD-1) bread wheat variety. Land preparation was done accordingly and all the durum wheat varieties were planted on 5-12-2012 through hand drill under randomized complete block design with three replications; the distance between rows was 20.0 cm. Each plot size was 16x26 ft. Wheat varieties were fertilized according to recommended dose i.e. 120-90-60 NPK kg ha<sup>-1</sup>. All the Phosphorus, Potash and one third of nitrogenous fertilizer were applied at the time of sowing and remaining nitrogen fertilizer were applied in two equal splits 1<sup>st</sup> split during tillering stage and 2<sup>nd</sup> during the dough stage. The total 20 acre inches water was applied in eight irrigation intervals. The amount of each irrigation was 2.5 acre inches measured by cutthroat flume (4" x3' dimensions). Irrigation was also assured during the critical stages like: tillering, anthesis, milky, spike emergence and dough stages. For the control of mites and aphids Spray of Talent (Thaiochlopyrid 48%) was done two times. All the agronomic practices were carried out as per the crop need. While; the wheat crop was supplemented by Gibberex 10% at the time of grain formation which helps to increase the size and vigor of the seed.

The crop was harvested on 19-3-2013. Agronomic data regarding plant height (cm), number of tillers m<sup>2</sup>, spike length (cm), number of grains spike<sup>-1</sup> and grains yield m<sup>2</sup>(g) was recorded at the time of harvesting, 1000 grain was recorded through electrical balance and finally the data was statistically analyzed through the American Statistical program Statix 8.1.

## **Parameters observed during the study**

### **1. Final plant height (cm) at maturity**

Ten tillers were selected randomly from each plot at 3 different locations, their

heights were measured in cm and means were taken.

### **2. Spike length (cm) and grains per spike (No.)**

Ten spikes were randomly selected from each unit area in each plot. Each spike was measured with scale from the base to the apex to record the spike length in cm. To record the grains per spike, each spike was threshed separately and grains of each spike were counted and averaged.

### **3. 1000-grain weight (g)**

Thousand grains were counted at random from each plot and their weights were taken with a spring balance.

### **4. Biological yield (t/ha) and grain yield (t/ha)**

Whole plots were harvested and tied into bundles. Biological yield was recorded by weighing the bundles of each plot with spring balance.

The bundles were first sun-dried and then threshed by a thresher. The grain weight was recorded in kg and then subsequently converted into t/ha.

### **5. Grain protein content (%)**

Grain protein contents were determined by Micro-kjeldahl method by taking sample of 500 seeds from each plot and grinding them. The digestion was done by Gunning and Hibberds H<sub>2</sub>SO<sub>4</sub> method [13] and distillation was done by Micro-kjeldahl apparatus to determine seed nitrogen contents [14].

Thereafter, protein content was calculated by multiplying nitrogen contents in seed with a constant factor of 5.71 [15]. Data recorded were analyzed using ANOVA technique [16].

## Results and Discussion

**Plant Height (cm):** The maximum plant height 88.33(cm) were recorded from the Durum-1 followed by 87.16 (cm) from the Durum-2 which were non significant with each other ,while the minimum plant height 62.44(cm) were noted from the bread wheat variety TD-1. These results are in agreements with the findings reported by *Imtiaizet al.*2003, who observed non significant response. (Table-1).

**Number of Tillers m<sup>-2</sup>:** Wheat variety TD 1 shows significant results by providing the maximum number of 883.67 tillers m<sup>2</sup> ,followed by 485.0 and 400.33, respectively from the Rabel and Durum -2, while the minimum 359.333 tillers m<sup>2</sup> ,were recorded from the wheat variety durum-1 which were statistically non significant with rest of the varieties. The distinct trend was noted during the study and collection of agronomic data .The wheat variety which showed maximum plant height produced minimum tillers per meter while, the highest tillers were obtained from the variety which showed the minimum height ,this is due to the genetic makeup of the varieties (Table-1).

**Spike Length (cm):** The maximum spike length 7.60 (cm) were obtained from the wheat variety TD-1, followed by spike length of 7.08, 7.05 and 6.49 from the Durum-2 ,Rabel and durum-1 respectively. Statistically all the wheat varieties exhibited non significant difference with each other (Table-1).

**Number of Grains Spike<sup>-1</sup>:** The maximum number of grains spike<sup>-1</sup>(111.67) were recorded from the variety Durum-2 followed by 97.0 and 73 .67 grains spike<sup>-1</sup> from the Durum-1 and Rabel, respectively. While, the check wheat variety TD-1 produced the minimum grains spike<sup>-1</sup> 22.33 (Table-1).

**Biological Yield (g) m<sup>-2</sup>:** The maximum biological yield 1150 kg m<sup>-2</sup> was noted from the Durum -2 followed by Durum-1 which exhibited 1103.3 kg m<sup>-2</sup>. While, the check wheat variety TD-1 produced minimum biological yield 743.3 kg m<sup>-2</sup> that is considered as the best character for a high yielding variety, because the varieties which produces high volume of biological yield always recorded lower grain yield (Table-1).

**Grain Yield gm<sup>-2</sup>:** The maximum grain yield 294.0 gm<sup>-2</sup> was obtained from the Durum-2 followed by the check wheat variety TD-1 which exhibited grain yield of 229.0 (g) m<sup>-2</sup>. While, the Durum wheat Rabel and Durum-1 were at par by producing 223.33 and 222.33 grain yield (g) m<sup>-2</sup> respectively (Table-1).

**1000 Grain mass (g):** The maximum 1000 grain mass (39.4) was recorded from the check wheat variety TD-1, while the Durum wheat varieties Durum-1 and Durum -2 were at par by showing 30.1 and 29.4 grams of grain mass. Whereas the minimum grain mass (25.4) was noted from the Durum wheat Rabel (Table-2).

**Falling numbers:** It indicates the Sprout damage in wheat sample. Generally, a falling number value of 350 seconds or longer indicates low enzyme activity and it is known as very sound wheat. As the amount of enzyme activity increases, the falling number decreases. In this study the maximum falling number (406) was recorded in Durum-2 followed by Durum-1 (373), while the minimum falling number (304) was noted from the bread wheat (check) which was above the standard value according to the Sally *et al.*, 2005 the values below 200 seconds indicate high levels of enzyme activity.

**Table.1** Mean values of different Durum Wheat Varieties planted at IPI, SARC, Karachi during 2012

Variety	Plant height (cm)	Tillers m <sup>-2</sup>	Spike length (cm)	No of grains spike <sup>-1</sup>	Biological yield (g m <sup>-2</sup> )	Grain yield (g m <sup>-2</sup> )
TD-1	62.44	883.67	7.60	22.33	743.3	229.00
Rabell	74.88	485.00	7.05	73.67	1020.0	223.33
Durum-1	88.33	359.33	6.49	97.00	1103.3	222.33
Durum-2	87.16	400.33	7.08	111.67	1150.0	294.00
C.V %	5.17	20.81	15.93	10.78	10.04	18.81

**Table.2** Quality Characteristics of Durum Wheat varieties planted at IPI, SARC, Karachi during 2012

Variety	1000 grains mass (g)	Falling numbers	Wet gluten (%)	Dry gluten (%)	Gluten index
TD-1	39.4	304	31.3	10.5	27
Rabell	25.4	315	44.7	14.9	28
Durum-1	30.1	373	46.3	15.2	38
Durum-2	29.4	406	46.9	15.8	40

**Table.3** Physical properties of Soil at IPI, SARC, Karachi

S.No.	Parameters	Characteristics
1.	Texture	Sandy loam
2.	Dry bulk density	1.59 gm/cm <sup>3</sup>
3.	Infiltration rate	1.56 cm/hr
4.	Field capacity	14.8%
5.	Wilting point	06.2%
6.	Available moisture	08.6%

**Table.4** Chemical properties of Soil at IPI, SARC, Karachi

Sampling depth (m)	Parameters		
	ECe (dS/m)	pH	SAR
0 – 15	2.9	7.0	3.9
15 – 30	3.0	7.1	3.9
30 – 60	3.2	7.3	4.8

The falling number test does not directly measure amylase enzyme activity, but measures changes in the physical properties of the starch portion of the wheat kernel caused by these enzymes during the test (Table-2).

**Wet gluten (%):** Protein is very important for durum wheat to produce good pasta quality with 12.5%. High protein wheat is used for making high gluten bread flour and for blending with lower protein wheat to improve its baking quality. In the present study the maximum (46.9 %) wet gluten was obtained from the durum -2 followed by Durum-1 which recorded (46.3%) while, both the Durum varieties were non significant with each other. The minimum wet gluten (31.3%) was noted from the bread wheat TD-1 planted as check (Table-2).

**Dry gluten (%):**The maximum dry gluten (15.8%) was exhibited by the Durum-2 followed by the Durum-1 which recorded 15.2% dry gluten .Where as the bread wheat variety TD-1 planted as (check ) produces minimum dry gluten (10.5 %).

**Gluten index:** The percentage of wet gluten remaining on the sieve after centrifugation is defined as the gluten index. The Gluten Index is a measure of the gluten strength, which indicates whether the gluten is inadequate, sufficient, average or excellent.

In this study the maximum gluten index (40) was recorded from the Durum-2 followed by Durum-1 which recorded 38 gluten indexes, while the bread wheat TD-1 stood at lowest by showing 27 gluten index. Results indicates that sufficient gluten index were present in all the tested wheat cultivars (Table-2).

## Conclusions

The result of this study indicates that it is difficult to find a wheat variety that is simultaneously stable for quality characteristics and at the same time provide high grain yield. It is therefore reasonable to select the leading variety in quality & quantity characteristics for a given environment. It is further concluded that the durum wheat can be cultivated successfully on marginal lands with brackish water which ultimate increase the farmer's income.

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