SCREENING OF ADVANCED EXOTIC LINES OF WHEAT (*TRITICUM AESTIVUM* L.) TO IDENTIFY HIGH-YIELDING GENOTYPES UNDER LASBELA CLIMATIC CONDITION

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خلاصہ

اس مطالعہ کا مقصد بلوچستان کے متنوع موسمی حالات میں پیداوار اور متعلقہ خصوصیات کے لیے جدید CIMMYT گندم کے جراثیم کی کارکردگی کا جائزہ لینا تھا۔ایگریکلچر ریسرچ ویارو فارم، لسبیلہ میں ربیع کے سیزن 2022-23 کے دوران کئے گئے فیلڈ ٹرائل میں 14 منتخب گندم لائنوں کے ساتھ بے ترتیب مکمل بلاک ڈیزائن کا استعمال کیا گیا۔ جینوٹائپس G8 اور G14 نے نمایاں خصوصیات کی نمائش کی، جیسے بالترتیب زیادہ سے زیادہ جسمانی پختگی اور اسپائک انیشیشن۔ G13 اور G5 نے بالترتیب فصل کے اشاریہ، اناج کی پیداوار، پرچم کی پتی، اور اناج بھرنے کا دورانیہ، پودوں کی اونچائی کے لیے اعلیٰ اقدار کا مظاہرہ کیا۔اناج کی پیداوار، سپائیک انیشیشن، ہارویسٹ انڈیکس، حیاتیاتی پیداوار، اور پودے کی اونچائی کے درمیان مثبت ارتباط دیکھے گئے، جبکہ جسمانی پختگی، سپائیک شروع کرنے، اور اناج بھرنے کے دورانیے کے درمیان منفی ارتباط نوٹ کیے گئے۔ مطالعہ ایک بار بار انتخاب کے پروگرام میں زیادہ پیداوار دینے والی اور لمبی چوڑی لائنوں کو ضم کرنے کی تجویز کرتا ہے۔ بڑے جرمپلازم پولز میں ان جین ٹائپس کے بارے میں مزید تحقیقات کی سفارش کی جاتی ہے کہ ممکنہ نئی قسم کے ریلیز کے لیے امتزاج کی صلاحیت اور تناؤ کے خلاف مزاحمت کا جائزہ لیا جائے

Abstract

This study aimed to assess the performance of advanced CIMMYT wheat germplasms for yield and related traits in diverse climatic conditions of Baluchistan. The field trial, conducted during the Rabi season 2022-23 at Agriculture Research Wayaro Farm, Lasbela, employed a randomized complete block design with 14 selected wheat lines. Genotypes G8 and G14 exhibited notable characteristics, such as maximum physiological maturity and spike initiation, respectively. G13 and G5 demonstrated high values for harvest index, grain yield, flag leaf, and grain filling duration, plant height, respectively. Positive correlations were observed among grain yield, spike initiation, harvest index, biological yield, and plant height, while negative correlations were noted between physiological maturity, spike initiation, and grain filling duration. The study suggests integrating high-yielding and long-spiked lines into a recurrent selection program. Further investigations on these genotypes in larger germplasm pools are recommended to evaluate combining ability and stress resistance for potential new variety releases.

Key words: Harvest, Fertilizer, yield, characteristic, experiment

Introduction

Agricultural sector is indispensable to the country's economic growth, food security, employment generation and poverty alleviation particularly, at the rural level. It contributes 19.2 percent to the GDP and provides employment to around 38.5 percent of the labor force. Farming assumes a significant job in the economy of Pakistan and it is the most important source of living or income. The rapidly growing population demands for agricultural products especially food. Agriculture sector contributed around 22.04% to the GDP of Pakistan in 2019, whereas 18.34 % came from the industry (Plecher, 2020). Cereal crops provides complex carbohydrates including dietary fiber and proteins. They are typically low in fat, nutrient dense and in most cases fortified with many essential vitamins and minerals. They are not only convenient but also provide the much needed nourishment. Wheat, which is botanically known as (*Triticum aestivum L.)* and locally known as (Galla, Gandum) belongs to Gramineae / Poaceae family. Its ploidy level is hexaploid with the chromosome number (2n = 6x = 42). From food perspective, it is an essential cereal, and is considered as staple food which is used for consumption on daily routine life. It achieved a 2nd rank worldwide in terms of the overall production where, global volume of the production reached about 765.41 million metric tons during 2019/2020 (Shahbandeh, 2020).

Wheat grain yield is intricately influenced by a myriad of environmental factors, making it a complex and shifting outcome. Simultaneously, it constitutes a challenging, measurable genetic parameter, shaped by a multitude of elements that directly or indirectly impact grain production. The key avenue for enhancing grain yield lies in the genetic variability inherent in breeding resources (Bhutto *et al*., 2016). Notably, the selection of traits during breeding plays a pivotal role. The flag leaf area, for instance, emerges as a promising trait, facilitating the translocation of photosynthates towards grain formation. Therefore, prioritizing this trait in breeding efforts can contribute to achieving higher yields (Zeuli and Qualset, 1990). Additionally, positive correlations between spike length and grain yield, as elucidated by Ijaz and Kashif (2013), underscore the importance of parameters like spike length, grains per spike, and spikelets per spike in the breeding process. This multifaceted approach underscores the significance of genetic and trait-focused strategies in optimizing wheat grain yield.

For plant breeding against yield-contributing components, several morphological and physiological traits have been identified. Different processes including morphological as well as physiological, which affects each other and happen on multiple growth stages, are responsible for better results of grain yield. Moreover, from sowing to harvest, many yield components affect grain yield significantly at different growing periods. Previous research experiments in durum wheat reported the primary components of grain yield were thousand grain weight, No. of grains and grain weight spike^{-1} and plant height (Slafer and Andrade, 1991; Simane *et al*., 1993)

Through an exploration of the vast genetic variability within a diverse gene pool, we have successfully identified germplasms exhibiting specific yield traits tailored to the agro-climatic conditions of Lasbela. Introducing high-yielding wheat genotypes is imperative for enhancing wheat production in this area. This research constitutes a significant stride towards advancing genetic gain and overall wheat crop performance in the Lasbela region. The analysis of various yield-contributing traits in the recently introduced inbred lines has provided clear insights into which genotypes are most suitable for the arid to semi-arid areas of Balochistan. The selected lines will play a pivotal role in the development of new wheat varieties specifically designed for this region, employing reciprocal crosses as a strategic approach. This initiative reflects a proactive commitment to harnessing genetic potential and contributing to the sustainable improvement of wheat productivity in the distinctive agro-climatic context of Lasbela. The study was based on following objectives:

- To identify high yielding genotypes from diverse CIMMYT germplasm.
- To evaluate an association between yield characteristics under agro-climatic region of Lasbela.
- To make reciprocal crosses among high yielding genotypes.

Materials and Methods

The site studied and soil description

The experiment was carried out by following randomized complete block design (RCBD) with three repeats at Agriculture Research Wayaro Farm, located in the middle of Uthal and Bela city, during Rabi season 2022-23.

Fourteen wheat lines from CIMMYT (Mexico) were selected as parental material on the based on previous screening experiments for yield characteristics which was conducted at Lasbela University Uthal during two growing seasons 2017-19. Individual plot was fertilized @ of 100, 140 and 150 kg ha^{-1}, P_2O_5 (DAP), K_2O (SOP) and N (urea) respectively. All the recommended practices i.e., roughing, weeding, thinning was performed consistently for the respective replications.

Soil sampling and processing

Composite soil samples were made by collecting soil (0-15cm depth) randomly before trial, stored in polyethylene bags, and shifted to the laboratory for further processing. Then, any unwanted materials i.e., gravels, stones, roots or plant parts were removed and these samples were kept in the room for air dry. Later on, samples were ground and passed via sieve having 2mm size followed by transferring of samples to malleable airtight jars and then to the soil & water testing laboratory at ARI Quetta.

Soil physio-chemical analysis

Soil physio-chemical properties were determined by slandered methods where pH and electrical conductivity (EC) were examined in 1 (soil) ratio 2 (water) extracts by means of pH meter with model name “WTWpH720” and EC meter with model “HI8033” (McKeague, 1978; McLean, 1982). Similarly, soil organic matter availability was also measured from the well-known method “Oxidization” (Walkley, 1947; Black, 1973) whereas, Bouyoucos hydrometer was applied to determine soil texture (Bouyoucos, 1962). Readings from hydrometer were exploited to calculate the amount of clay, sand as well as silt in percentages, and the textural was identified by USDA textural triangle. Spectrophotometer model “ANA 75” was utilized to quantify the phosphorus (P) content in soil samples as followed by an approach for creation of blue color. Similarly, potassium (K) availability was also measured by using a flame photometer and emission spectroscopy (JENWAY PFP 7) (Soltanpour and Schwab, 1977).

Plant Material

Present trial included 14 CIMMYT lines of wheat crop and seeds of the respective genotypes were collected from Department of Plant Breeding and Genetics, Lasbela University of Agriculture Water & Marine Sciences.

Research layout

No. of plants per row = 10
No. of rows per genotype = 2
Row to R distance = 10cm
Plant to P distance = 10cm
Genotype to G distance = 30cm

REPLICATION 1	REPLICATION 2	REPLICATION 3
G-1 G-2 G-3 G-4	G-14 G-13 G-12	G-4 G-8 G-12
G-5 G-6 G-7 G-8	G-11 G-10 G-9	G-3 G-7 G-11
G-9 G-10 G-11	G-8 G-7 G-6 G-5	G-2 G-6 G-10 G-14
G-12 G-13 G-14	G-4 G-3 G-2 G-1	G-1 G-5 G-9 G-13

Observations to be recorded following observation will be recorder during the experiment
Germination % of seeds, Days to 75% Heading, Anthesis, Physiological maturity, Grain filling duration, Flag leaf area (cm2), Spike length (cm), Plant height (cm), Biological yield (g), Grain yield (g) and Harvest index.

Statistical Analysis

Research data for all recorded parameters were exposed to statistical analysis to elaborate the findings of the results. Analysis of variance (ANOVA) was assessed for proper and organized interpretation of obtained results from the experiment employing the software Statistix 8.1 (USA). Similarly, Fisher's ANOVA (99% and 95% significance level) was applied to examine the significant differences among genotypes (Steel *et al*., 1997) whereas, the correlation coefficient (Pearson) was applied to examine a relationship within studied characteristics. The genetic variance will be calculated by the following method (Kown & Torrie, 1964), given below

$$\delta^2 g = \frac{MSg - MSe}{r}$$

Similarly, Heritability $^{(BS)}$ will be assessed according to Hanson *et al*. (1956) which is given below:
Heritability (h^2_{bs}) = (δ^2_g / δ^2_p) x 100

Results and Discussion

Germination%

From table 1 it is clearly indicated that significant differences were observed within genotypes at (p<0.01). The coefficient of variance was estimated about 8.92%.Heritability was assessed germination with value of 0.81(table 1). Data for germination% ranged between 51.66% to 89% with mean value of 69.45% where minimum germination% was recorded in genotype G11 having 51.66% followed by G12 and G7 with average value 55.66% and 58.33% respectively, whereas maximum germination% was recorded in genotype G1 with 89% tailed by G2&G5 with results of 87.33% & 82.66% correspondingly

Spike length (cm)

Spike length is a trait of chief significance to influencing the grain yield and it has been noted that different genotypes vary in spike length capacity. It is believed that dense spike with high length contains max spikelet which gradually increases No. of grains spike^{-1} that leads to greater grain yield and this is considered an important factor in in wheat breeding programs. From table 1 it is apparently indicated that the impact of genotypes on spike length exposed significant differences at (p<0.05). Coefficient of variance was estimated about 9.12%. Heritability was assessed for spike length with value of 0.01.

Data for spike length ranged between 6.91cm to 8.33cm with mean value of 7.66cm where minimum spike length was recorded in genotype G2 having 6.91cm followed by G10 and G1 with average value 7.13cm and 7.22cm respectively, whereas maximum spike length was recorded in genotype G8 with 8.33cm which followed genotype G14 & G12 with results of 8.26cm and 8.11cm respectively (Table 2). Baloch *et al*. (2014a) and Baloch *et al.* (2014 b) also quoted the significant difference at (p<0.05) in his research findings

Flag leaf area (cm2)

The vegetative parameter “flag leaf area” contributes significantly in grain formation of plant (wheat) at the stage of spike expansion, as it supports and encourages photosynthates to produce improved grain yield (Ahmed *et al*., 2013). From table 1 it is evidenced that there was a significant difference observed among wheat genotypes ($p<0.01$). Coefficient of variance was estimated about 21.8%. Heritability was assessed for flag leaf area with value of 0.07.

Data for flag leaf area ranged between 11.24cm^2 to 18.72cm^2 with mean value of 15.33cm^2 where minimum flag leaf area was recorded in genotype G2 having 11.24cm^2 followed by G1 and G4 with average value 12.15cm^2 and 13.61cm^2 respectively, whereas maximum flag leaf area was recorded in genotype G13 with 18.72cm^2 which tailed genotype G7 & G5 with results of 17.91cm^2 & 17.38cm^2 respectively (Table 2).

Plant height

Plant tallness character “plant height”, is entirely crucial morphological parameter that tells weather any genotypes is susceptible to lodging or not. Similarly, short stature plants are more responsive to fertilizers. However, from table 1 it is clearly showed that the impact of genotypes on plant height indicated significant impact ($p<0.05$). Coefficient of variance was estimated about 5.51%. Heritability was assessed for plant height with value of 0.84.

From mean performances, plant height ranged from 69.96cm to 79.43cm with mean value of 75.34cm where minimum plant height was measured for genotype G14 having 69.96cm which is less than genotypes G4 (71.17cm) & G11 (73.4cm), whereas maximum plant height was measured in genotype G5 having 79.43.4cm which is more than G13 having 77.6cm & G3 having results of 76.76cm (Table 2).

Days to 75% Spike initiation

In production of any crop, days to spike initiation known as a crucial mark of early maturity. It is the period in which grains of a spike are developed that contributes to overall mass of the plant (Safi *et al*., 2017). From this table 1 it is clearly expressed that significant difference was noted amongst wheat genotypes ($p<0.01$). Coefficient of variance was observed about 4.17%. Heritability was assessed for days to spike initiation with value of 0.61.

From mean performances, days to spike initiation ranged from 54.66 to 65.33 with mean value of 58.57 where minimum days to spike initiation was measured for genotype G6 having 54.66 followed by G5 and G8 with an average value of 55.33 for both genotypes, whereas maximum days to spike initiation was measured in genotype G14 having 65.33 followed by G13 and G10 with an average value of 62.66 and 62.33 respectively (Table 2).

Days to 75% Anthesis

Anthesis refers to maturation of anthers (when slightly yellow anthers come out). ANOVA results proved that significant difference was observed amongst wheat genotypes ($p<0.01$). Coefficient of variance was estimated about 3.06% (as shown in table 1). Heritability was assessed for days to anthesis with value of 0.31.

From mean performances, results of an-thesis period were ranged between 62.33 & 73 days where an average day were 66.81 where minimum days to anthesis was measured for genotype G5 having 62.33 which is less than genotype G6 (63.33 days) & G7 (63.66 days), whereas maximum days to anthesis was measured in genotype G14 having 73 which is more than genotype G13 & G11 with results of 72.66 & 69.33 separately (Table 2).

Days to 75% Physiological maturity

Physiological maturity can be defined as appearance of yellowish peduncle indicating grains have completed their hard dough stage and fully matured. From table 1 it is apparently indicated that physiological maturity does remain same and showed non-significant impact within genotypes. Coefficient of variance was estimated about 2.47%. Heritability was assessed for days to physiological maturity with value of 0.

From mean performances, the plant character “days to reach physiological maturity” was in range of 90.66 & 94.66 days where overall value for mean was 93.33 days. Similarly, minimum days to physiological maturity was measured for genotype G11 having 90.66 which is less than genotype G13 (having 91.33 days) & G7 (having 92.33 days), whereas maximum days to physiological maturity was measured in genotype G8 having 94.66 which is more than genotype G4 & G12 (94.66 & 94.33) as shown in table 2.

Grain filling duration

It is a duration between anthesis to physiological maturity when photosynthates transferred towards grain filling. It covers soft dough as well as hard dough stage. From table 1 it is apparently indicated that significant difference observed within wheat genotypes ($p<0.01$). Coefficient of variance was estimated about 10.91%. Heritability was assessed for days to grain filling with value of 0.09.

From mean performances, days to grain filling ranged from 19.66 to 31 with mean value of 26.81 where minimum days to grain filling was measured for genotype G13 having 19.66 which is less than G14 (19.66) &

G11 (having 21.66), whereas maximum grain filling duration was measured in genotype G5 having 31 which is more than genotype G1 & G2 (30.33 & 30) as presented in table 2.

Grain yield

Grain yield is a trait of chief significance that motivates farmers to produce wheat crop in a large scale. It is totally dependent on yield contributing parameters i.e., spike length, spike weight and spike spikelet^{-1}. From table 1 it is clearly exposed that significant-differences were observed within studied wheat germplasms ($p<0.01$). Coefficient of variance was assessed about 15.52%. Heritability was assessed for grain

From mean performances, grain yield ranged from 5.12g to 8.85g with mean value of 7.54g where minimum grain yield was measured for genotype G1 having 5.12g which is less than genotype G10 & G11 (having 6.04g & 6.57g), whereas maximum grain yield was measured in genotype G13 having 8.85g which is more than genotype G2 (8.57g) & G8 (8.5g) as shown in table 2.

Biological yield

Genotypes with enlarged height are normally considered as higher yield that represents overall biomass, which is favoured by local growers or farmers as they don't only require its seeds or grains, but huge straw yield (locally known as bhoosa) to feed the cattle. From table 1 it is clearly indicated that significant differences were detected within genotypes ($p<0.05$). Coefficient of variance was estimated about 15.47%. Heritability was assessed for biological yield with value of 0.80.

From mean performances, biological yield ranged from 20.72g to 29.41g with mean value of 24.5g where minimum biological yield was measured for genotype G4 having 20.72g which is less than genotype G3 & G14 having 22.13g & 22.16g respectively (Table 2), whereas maximum biological yield was measured in genotype G2 having 29.41g which is more than genotype G7 (having 27.75g) & G9 having 27.75g.

Harvest index

The parameter harvest-index is the percentage of grain from the biomass-yield produced from a unit area. Harvest index is a crucial parameter that has straight effect on grain yield of wheat crop. From table 1 it is presented that a significant variation was noted among genotypes ($p<0.05$). Coefficient of variance was estimated about 17.5%. Heritability was assessed for harvest index with value of 0.84.

From mean performances, results of the harvest index were in range between 22.37% & 38.97% where value 31.32% was reported as overall average. However, minimum harvest index was measured for genotype G1 having 22.37% which is less than G10 & G5 having results of 25.58% & 26.2%, whereas maximum harvest index was measured in genotype G13 having 38.97% which is more than genotype G8 (having 38.02%) & G12 (35.73%) (Table 2).

Correlation

Based on the results drawn from correlation coefficient, it was noted that days to spike initiation was positively correlated ($P<0.01$) with days to anthesis ($r^2 = 0.593$) whereas negatively associated ($P<0.01$) with grain filing duration ($r^2 = -0.603$) and biological yield ($r^2 = -0.375$). Moreover, plant height is significantly associated with biological yield ($r^2 = 0.309$) and grain filing duration ($r^2 = 0.31$) at 95% level of confidence. Similarly, grain filing duration was positively correlated with days to physiological maturity ($r^2 = 0.51$) whereas, negatively associated with days to anthesis ($r^2 = 0.802$) at 99% interval. On the other hand, correlation results for parameter harvest index indicated positive association for grain yield ($r^2 = 0.689$) whereas negatively correlated with biological yield ($r^2 = -0.54$) at 99% level of significance (Table 3).

Table 1. Analysis of variance of the studied parameters of wheat

Parameters	Overall mean	(h^2BS)	CV	F value
Germination (%)	69.45	0.81	8.92	10.47^{**}
Spike length (cm)	7.66	0.01	9.12	1.16^{*}
Flag leaf area (cm^2)	15.33	0.07	21.8	1.16^{**}
Plant height (cm)	75.34	0.84	5.51	1.19^{*}
Days to spike initiation	58.57	0.61	4.17	4.91^{**}
Days to anthesis	66.81	0.31	3.06	7.15^{**}
Physiological maturity	93.33	0.00	2.47	0.86^{NS}
Grain filling	26.81	0.09	10.91	5.27^{**}
Grain yield (g)	7.54	0.79	15.52	1.99^{*}
Biological yield (g)	24.5	0.80	15.47	1.26^{*}
Harvest index (%)	31.32	0.84	17.5	2.41^{*}

Table 2. Mean performance of fourteen wheat lines for various growth traits and yield

Parameters	Germination (%)	Spike length (cm)	Flag leaf area (cm^2)	Plant height (cm)	Days to spike initiation	Days to anthesis
G1	89±5.57 a	7.22±0.65 abc	12.16±0.84bc	74.17±4.63abc	58.67±0.33bcdef	65±0.58def
G2	87.33±6.36ab	6.91±0.01 c	11.243±0.29c	78.3±1.22a	56.67±1.2def	66.33±0.67cde
G3	75±1.73cde	7.45±0.53 abc	14.927±0.72abc	76.77±1.4abc	60.33±0.88bcd	66.67±1.2cde
G4	78.33±0.88 bcd	7.38±0.12abc	13.617±1.55abc	71.17±1.91bc	58.33±0.33cdef	66.67±0.67cde
G5	82.67±3.53abc	7.95±0.15abc	17.383±5ab.08ab	79.43±4.53a	55.33±0.33ef	62.33±1.45f
G6	62±3.06fghi	7.85±0.44abc	15.2±0.16abc	75.53±0.67abc	54.67±2.6f	63.33±1.33ef
G7	58.33±2.03ghi	7.9±0.65abc	17.907±0.3a	77.4±0.45ab	56.33±1.45def	63.67±2.19ef
G8	70±2.65def	8.33±0.37a	16.12±0.79abc	74.83±3.98abc	55.33±0.33ef	67.67±0.33cd
G9	64.67±3.71efgh	7.73±0.17abc	18.727±0.92a	75.17±1.17abc	59±0bcde	65.33±0.88def
G10	68±3.06defg	7.13±0.56bc	15.193±1.1abc	75.57±1.27abc	62.33±1.67abc	65.67±0.67def
G11	51.67±8.21i	7.79±0.39abc	14.8±2.08abc	73.4±1.65abc	57.33±1.86def	69.33±0.33bc
G12	55.67±3.48hi	8.11±0.3ab	15.427±0.86abc	75.4±1.3abc	57.67±2.33def	67.67±0.67cd
G13	65.33±0.67efgh	7.36±0.09abc	16.42±2.29abc	77.67±2.16ab	62.67±1.45ab	72.67±1.45ab
G14	64.33±3.28fgh	8.26±0.39ab	15.483±2.1abc	69.97±1.66c	65.33±1.2a	73±2.08a

Table 3: Correlation coefficient results drawn for morphological parameters among fourteen advanced wheat lines.

Traits	ANT	BLY	FLA	GFL	GRY	HRI	PHM	PHT	SI
BLY	-0.236NS								
FLA	0.128NS	0.0107NS							
GFL	-0.8022**	0.2759NS	-0.1745NS						
GRY	0.0972NS	0.2266NS	0.2587NS	-0.0438NS					
HRI	0.2802NS	-0.5397**	0.2215NS	-0.2603NS	0.6887**				
PHM	-0.1039NS	-0.0391NS	-0.1094NS	0.5114**	-0.0345NS	-0.0238NS			
PHT	-0.2352NS	0.3092*	0.229NS	0.31*	0.1936NS	-0.0834NS	0.1208NS		
SI	0.5926**	-0.3748*	-0.0301NS	-0.6029**	-0.0334NS	0.2379NS	-0.1686NS	-0.2381NS	
SPL	0.1933NS	0.06NS	0.269NS	-0.0863NS	0.2186NS	0.1304NS	0.2054NS	-0.0754NS	-0.1869NS

*** = Significance (P<0.05), ** = Non-Significance (P<0.01), NS = Non-Significance (P>0.05).**

Abbreviations: Harvest index (HRI), Grain yield (GRY), Biological yield (BLY), Anthesis (ANT), Flag leaf area (FLA), Grain filling duration (GFL), Physiological maturity (PHM), Plant height (PHT), Spike initiation (SI), Spike length (SPL).

Present research findings revealed a substantial existence of genetic variability in yield contributing characteristics for studied genotypes. Our results differed highly significantly for concerned plant traits including harvest index, plant height, biological yield, area for flag leaf, and maturity days along with grain yield as well as spike length. Bhattarai *et al.* (2014) reported that the significant variable to improve grain yield in wheat was spike weight per plant whereas, studied genotypes in current experiment and grain weight per spike are significantly different in terms of the performance of given genotypes. Moreover, our findings have similar resemblance with the results of (Baloch *et al*., 2010) where they noted that different genotypes performed significantly different for various morphological parameters. It is studied that a single gene does not control grain yield directly, instead it is the consequential results of component characters in any plant. Therefore, gradual improvement in those plant components might direct to the resulting enhancement in grain yield successfully. Hence, in order to achieve balanced progress in yield and yield contributing components, the knowledge of correlation mechanism is essential as it supports the basis for expressing desirable measures in plant development programs (Degewione *et al.*, 2013).

Similarly, related results are also found for plant height by (Raza *et al*., 2018) where they reported that height of plant performed significantly different for various genotypes. Ijaz and co-authors (2015) found a positive association for grain yield with spike length, plant height as well as with harvest index in terms of both genotype and phenotype which confirmed our findings. Similarly, plant height considered as the significant phenotypic character among cereals (particularly in wheat) due to its effective role in improving grain yield and in its architecture (Bellucci *et al*., 2015; Hassan *et al*., 2019). Similar outcome for spike length results were found out with the results of (Ijaz *et al*., 2015). In addition to this, results of biological yield are in-line with the findings of (Burjus & co-authors, 2020) where they showed significant results which confirmed our findings. Grain yield showed high variation among genotypes for different wheat lines which are similar with the results of (Singh and Upadhyay, 2013). It is believed that selection is possible only if genetic stock comprises desired genotypic variability for grain yield per plant. Our outcomes for correlation between yield and physiological maturity are truly supported by Bhutto *et al.* (2016) where it was observed that days to reach maturity stage was positively associated with grain yield ($p<0.01$) at genotypic level. Alemu *et al.* (2020) reported that grain filling rate, biomass and harvest index are positively correlated with grain yield ($p<0.01$).

Conclusion

The obtained results confirmed the genetic variations among wheat genotypes and their response to agro-climatic conditions of district Lasbela. Present experiment unveiled the existence of genotypic variability for morphological plant characters in these genotypes. This genetic variability which was noted for yield related characteristics within studied genotypes is an efficient evident from vast gene pool of wheat cultivars. This study addressed our objectives by identifying the degree of potential genetic variability for the morphological traits as well as by determining its correlation with shoot traits of CIMMYT wheat lines. Conclusion of these results showed that Genotype G8 with maximum results for physiological maturity and spike length whereas, G14 for anthesis and spike initiation were reported, while Genotype G13 with maximum results for harvest index, grain yield and flag leaf and G5 with maximum results for grain filling duration and plant height were noted. Correlation coefficient results indicated positive association among grain yield, spike initiation, harvest index, biological yield and plant height. However, negative correlation was noted among physiological maturity, spike initiation, grain filling duration. In order to break this negative association, outperforming lines with higher yield and spike length can be included in a recurrent selection program.

This study suggests that these genotypes should be studied for further investigations in larger germplasm pool to assess the combining ability of different yield contributing parameters and resistance against stresses

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