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Comparative Assessment of Advanced and Chinese Hybrid Lines of Wheat Under the Agro-Ecological Context of Peshawar, Pakistan

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A B S T R A C T

The rate at which the world's population is expanding necessitates an annual increase in food production in order to feed the expanding population. As a result, during the Rabi season of 2021–2022, a field experiment was carried out at the Agronomy Research Farm, The University of Agriculture Peshawar. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Row-Row spacing was kept at 30 cm. The experimental field was twice ploughed The evaluation was conducted employing eleven parameters, all of which were strongly influenced by different wheat lines. After an examination of the results, it was determined that the most desirable wheat line among the advanced lines in terms of biological and grain yield were AL-32 and AL-60 (8049 and 3610 kg ha-1, respectively), while the best performing line among Chinese hybrid lines in terms of biological and grain yield was 15-CA73 (9094 and 3777 kg ha-1, respectively), while the Khaista variety among local check varieties produced the highest biological and grain yield (5766 and 2277 kg kg ha-1, respectively).

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INTRODUCTION

Wheat (Triticum aestivum L.) is an annual grass belonging to the poaceae family which is widely cultivated around the world for the grains it is cultivated for basic nutritious needs by mankind. Wheat is a Rabi season crop and it reaches up to a height between 49 cm's to 125 cm's with an elongated stem ending with tightly packed clusters of florets forming an inflorescence. Moreover, it is a monocot crop having fibrous root system and equipped with C3 photosynthetic system (Smith, 2010).

Wheat was very firstly domesticated and cultivated roughly around 10,000 years ago by the dwellers of the fertile crescent, today's Palestine, Iraq, Syria, Lebanon, Egypt, Jordan and the surrounding areas of Turkey and Iran, however the crop that we know today is very different from the crop that used to be cultivated primitively because of having small grains and by putting this under consideration, they selected particular plants with desired range of grains and plant height (Oyewole, 2016).

In Pakistan annually spring wheat is grown on an area of 9.04 million ha-1 that produces 23.86 million tons of wheat per year while in Khyber Pakhtunkhwa (KP), wheat is sown on about 0.78 million ha-1 which produces 1.2 million tons of wheat (MNFSR, 2019). Average yield of KP is about half of the national average yield because 67% area is rainfed in KP and due to altered precipitation patterns the yield of KP is half of the national yield. In the recent times due to climate change the sowing of wheat is delayed because the rainfall is delayed in the winter (Akmal et al., 2011).

Our population is growing at an exorbitant rate which demands in acceleration in food production every year to feed the growing population. To cope with this situation, we have to put concerted and hectic efforts in increasing the yield per hectare of wheat. But due to the poor agronomic practices, only 20-40% of the maximum genetic potential of best available commercial varieties is being achieved by farmers. Higher yield will come from the integration of improved farm practices of soil fertility, water management, land preparation, stand establishment, weed control and plant protection (CIMMYT, 1989).

Development of new wheat varieties have resulted in remarkable increase in the yield per unit area worldwide. Varieties with different morphological and economic character are now available as breading stock (Parihar and Singh, 2017). Multi-environmental trails are important in plant breeding and agronomy for studying yield stability and predicting yield performance of varieties and agronomic treatments across environments (Vaughan and Judd, 2003). The differential response of varieties to environmental changes is a variety x environmental interaction. Like the effects of variety, the effects of agronomic treatments or any other management practices can change differentially in relation to environmental changes, producing environmental effects on wheat production (Smith, 2015). Agronomists use trials to compare combination of agricultural production alternatives and make recommendations to farmers about the superior varieties and their stability across environments (Crossaet et al., 2018).

The agronomic performance of crop varieties and advanced lines could be evaluated by multi-environment trials. Evaluating performance of wheat genotypes under different environments and using different inputs, yield and its components analysis (Piepho, 2015). The performance of wheat genotypes is mainly associated with the soil and climatic conditions, applications of inputs and other management conditions (Piepho et al., 2004). The evaluation of elite wheat varieties and advanced lines is essential for further improvement of wheat. Most previous studies were carried out by using a single method and usually described the validity of methods and performance of trials, whereas the performances of genotypes in given environments were seldom reported. The performance of a genotype in a given environment is more important for wheat cultivation and improvement (Vaughan and Judd, 2003). Keeping in view of the above discussion concluded that evaluation of new varieties needed for the increasing production.

Genotype by environment interaction plays a vital role in the performance of different genotypes. Extensive testing of wheat genotypes under different environments has been in practice for developing relatively stable cultivars (Gebeyuhu, 1987).

Therefore, the aim of this research was to evaluate the performance of different advanced and Chinese hybrid lines of wheat in comparison to local check varieties and to select lines that showed best performance and well adopted under the agro ecological conditions of Peshawar.

LITERATURE REVIEW

Kakabouki et al. (2022) conducted an experiment to check the performance of fourteen genotypes of durum wheat under Eastern Mediterranean conditions. The experiment included two experimental lines and twelve commercial wheat (Triticum durum) varieties from diverse backgrounds were cultivated to compare their crop properties, yield and protein content in terms of growing degree days (GDDs). For all varieties, GDDs to head emergence was affected by factor year, whereas GDDs from head emergence to harvest were influenced by both varieties and year.

Taheri et al. (2021) carried out an experiment in order to investigate the quantitative and qualitative performance of bread wheat genotypes under different climatic conditions. The research conducted for a span of six years between the growing seasons of 2011-2017 to check the effect of various environments on quality and quantity of bread wheat. The experiment was laid out in randomized complete block design having three replications. The experiment included eight wheat varieties (Pishgam, Sirvan, Parsi, Bahar, Pishtaz, Sepahan, Sivand and Arg) that were selected for examination. The results revealed that the maximum grain yield was recorded for the variety Parsi while maximum protein content and Zeleny sedimentation value was attained by the variety Sivand and Sirvan respectively.

Hazari et al. (2019) conducted an experiment to check the performance of wheat genotypes under different irrigational approaches in the Terai agro ecological condition. The experiment was conducted at an experimental field of

Uttar Banga Krishi Viswavidyalaya during the Rabi season of 2016. The experiment included six different wheat genotypes under two irrigation management practices i.e. irrigated and restricted irrigated condition. The results revealed that highest economic yield was produced by HD 2967 under both irrigated and restricted condition. Significant variances were found in all growth and yield attributing characters in two irrigational conditions.

Basir et al. (2015) conducted an experiment to check the potential of wheat (Triticum aestivum L.) advanced lines for yield and yield attributes under different planting dates in Peshawar valley. The experiment was conducted at cereal crops research institute (CCRI), Pirsabak, Nowshera, Pakistan during 2013-2014 to evaluate 6 wheat advanced lines (PR-105, PR-103, PR-106, PR-107, PR-108 and PR-109) under six different planting dates. The sowing dates as well as the genotypes significantly affected yield and yield components.

Rasheed et al. (2015) carried out an experiment to check the performance of exotic wheat genotypes under the agro climatic conditions of Mansehra, Khyber Pakhtunkhwa. The research was performed at Agricultural Research Station Baffa, Mansehra during the year 2012-2013. The experiment included twelve advanced lined of wheat along with two check varieties namely (Siran and Atta-Habib). The genotypes were sown on 9th November, 2012. The data was recorded for the parameters mentioned ahead, Grain yield, biological yield, plant height, number of tillers, thousand grain weight, spike length, spikelets per spike, grain per spike, harvest index, flag leaf area (cm), peduncle length (cm), disease infection, days to germination and 50% to heading were recorded during the experiment.

Alam et al. (2013) carried out an experiment to analyze the performance of different genotypes of wheat (Triticum aestivum L.) in heat stress conditions. The experiment was conducted in the research field of wheat research center (WRC), Bangladesh agriculture research institute (BARI), Nashipur, Dinajpur, Bangladesh in the rabi season from November, 2012 to April, 2013), 2012-13 to observe the effect of heat stress delayed irrigated sowing conditions (ILS) on the yield and yield components of different wheat genotypes and thereby to search heat tolerant genotypes. The treatments included four days of sowing viz. 30 Nov (D1), 15 Dec (D2), 30 Dec (D3) and 14 Jan (D4) and 4 genotypes viz. BARI Gom 26(V1), BAW1051(V2), BAW1120(V3) and BAW 1141(V4) were taken as test genotypes and V1 as check. In ILS conditions, all genotypes faced high temperature in different stages which hampered the growth of the yield contributing attributes resulting the extreme yield reduction of all except V4. But, all yield contributing characters of V4 performed the best in heat stress condition.

Ahmad et al. (2010) conducted an experiment to check the performance of various wheat genotypes by planting on different dates under the agro climatic conditions of Peshawar valley. The experiment was performed at cereal crops research institute (CCRI), Pirsabak, Nowshera, Pakistan during the year 2007-08. The experiment included six wheat genotypes to select best planting dates and judge their performance under the central agro-ecological zone of

NWFP, Pakistan. Six planting dates were used from October 25th to December 15th with 10 days interval in a randomized complete block design with split-plot arrangement having three replications. The experiment showed that that late sowing decreased values of all the parameters studied in the experiment.

Hossain et al. (2009) conducted a research to check the performance of various wheat genotypes under different tillage options. The study was carried out at the regional wheat research center, Shyampur, Rajshahi during Rabi season of 2001-2002 and 2002-2003 to observe the performance of wheat genotypes among the different tillage options. The experiment was laid out in strip split plot design in which two tillage systems were tested which were 1: manually prepared permanent bed (PB- as this is in reference to two other crops besides wheat per season sown on the same beds) and conventionally tilled on the flat (CTF). Within each tillage system, ten wheat genotypes were tested. From the results, it was observed that significant different between bed planting and conventional method of sowing was detected for plant population m^{-2}, grain yield, spike m^{-2}, spikelets per spike, grains per spike and harvest index but found non-significant for biomass, plant height and thousand grain weight.

METHODOLOGY

The experiment was conducted at Agronomy Research Farm, The University of Agriculture Peshawar during Rabi season, 2021-2022. The experiment was laid out in randomized complete block design (RCBD) having three replications. The comparative evaluation of thirty five wheat lines, which included twenty two advanced lines, nine Chinese hybrid lines and four local check varieties, was conducted in order to select the lines that were well suited for Peshawar region. The experimental field was ploughed twice up to the depth of 30 cm with the help of disc harrow followed by rotavator. The seeds were sown using line sowing method with the help of seed drill machine and previously the seed bed was prepared at proper moisture conditions Sowing was done at the seed rate of 100 kg ha^{-1}. The R-R distance was maintained at 30 cm. Irrigation was carried out as per crop's requirement and a basal dose of fertilizers were applied to the field and all other necessary agronomic practices were carried out.

The data was recorded on the following parameters:

1. Tillers (m-2)
2. Grains spike-1
3. Thousand grain weight (g)
4. Biological yield (kg ha-1)
5. Grain yield (kg ha-1)

Methodology for data Recording:

Tillers m^{-2}

Data on tillers (m-2) was recorded by counting the number of tillers in three random rows within a length of one meter from each plot and then number of tillers in each row from each plot was counted and then converted to number of tillers (m-2) by following formula.

$$\text{Tillers } (m^{-2}) = \frac{\text{No. of tillers in three central rows}}{\text{R-R distance} \times \text{No. of rows} \times \text{Row length}}$$

Spike Grains $^{-1}$

For recording grains spike-1, three randomly selected spikes from each plot were manually threshed and grains were counted using electronic grain counting machine and then average was calculated.

Thousand grain weight (g)

A sample of thousand grain were counted using an electronic grain counting machine and separated for each plot. The grains were then weighed the help of a sensitive electronic balance and thousand grains weight was recorded.

Biological yield (kg ha^{-1})

Three central rows were harvested in each experimental plot, sun dried, weighed and then converted in to biological yield kg ha-1 by the given formula.

$$\text{Biological yield (kg ha}^{-1}) = \frac{\text{Biological yield of three central rows (kg)}}{\text{No. of rows} \times \text{row length (m)} \times \text{R-R distance (m)}} \times 10{,}000\ m^2$$

Grain yield (kg ha^{-1})

Three central rows from each plot were harvested, sun dried, threshed and then converted to kg ha^{-1} by the following formula.

$$\text{Grain yield (kg ha}^{-1}) = \frac{\text{Grain yield of three central rows (kg)}}{\text{No. of rows} \times \text{row length (m)} \times \text{R-R distance (m)}} \times 10{,}000\ m^2$$

Statistical Analysis

Data was statistically examined by using analysis of variance techniques recommended for the randomized complete block design. Upon significant F-test results, means was compared using least significance difference test (Steel and Torrie, 1984).

RESEARCH RESULT AND DISCUSSION

Tillers m-2

Data regarding tillers m-2 of wheat is shown in Table 1. Statistical analysis of the data showed that different wheat lines significantly affected tillers (m-2) of wheat. Advanced line AL-122 produced maximum number of tillers (m-2) (230%) followed by MY-1501, GM-1215 and AL-118, respectively as compared to Chinese hybrid line MY-409 which produced lowest tillers (m-2). The significant different might be due to varied genetic response of wheat lines to environmental conditions. The results are in agreement with Zubair et al. (1987), Borghi and Perenzin (1994), Ali and Khan (1998) who reported significant differences in number of tillers plant-1 in different genotypes.

Grains Spike^{-1}

Data concerning grains spike-1 of wheat is shown in Table 1. Statistical analysis of the data showed that different wheat lines significantly affected grains spike-1 of wheat. Advanced line AL-186 gained maximum number of grains spike-1 (192%) followed by AL-12, GM-1683, AL-41 and AL-44, respectively as compared to advanced line AL-60 which produced lowest number of grains spike-1. Agro-climatic conditions during fertilization process might also be responsible for producing varied number of grains spike-1 in different varieties tested. These results are in line with the finding of Humara et al. (2004) who reported different grain spike-1 for wheat genotypes.

Table 1. Tillers M^{-2} and Grains Spike-1 as Affected by Different Wheat Lines.

Lines	Tillers m^{-2}	Grains spike^{-1}
AL 12	392 op	70 b
AL 16	635 efg	41 s
AL 34	357 p	47 k
AL 41	489 kl	62 c
AL 44	668 de	61 d
AL 60	656 def	26 z
AL 118	728 b	46 m
AL 122	830 a	53 g
AL 146	683 cd	37 v
AL 178	605 gh	47 l
AL 186	570 hi	77 a
GM 1683	492 kl	70 b
15-CA73	438 n	53 h
GM 1215	819 a	35 w
MY 409	251 q	28 y
MY 902	413 no	44 p
MY 2914	260 q	31 x
MY 1501	828 a	49 i
AKBAR	534 ij	46 n

LSD (0.05) for tillers m-2 = 37.56
LSD (0.05) for grains spike-1 = 0.48

Thousand Grain Weight (g)

Data regarding thousand grain weight is represented in Table 2. Statistical analysis of the data showed that different wheat lines significantly affected thousand grain weight of wheat. Wheat lines AL-34 gained maximum thousand grain weight (60%) followed by AKBAR, MY-902, 15-CA73 and MY-2914, respectively as compared to advanced line AL-178 which gained lowest thousand grain weight. These significantly differences might be due to inherent genetic potential and existing climatic condition especially during seed filling stage, which may play a very decisive role for a variety to attain heavier or light grain. These results are in agreement with the findings of Larik et al. (1999) and Akbar et al. (2000) who reported similar results in different wheat cultivars/ varieties.

Biological yield (kg ha^{-1})

Data concerning biological yield in given in table 2. Statistical analysis of the data showed that different wheat lines significantly affected biological yield of wheat. Chinese hybrid line 15-CA73 gained maximum biological yield (194%) followed by AL-32, AL-60, AL-42 and AL-41, respectively as compared to advanced line AL-146 which gained lowest biological yield. The significant differences might be due to the genetic response of the trialed varieties to the climatic condition and the subsequent varied plant height and tillers production. These results are in accordance with the results obtained by Khan et al. (1990).

Grain yield (kg ha^{-1})

Data regarding grain yield of wheat in shown in Table 2. Statistical analysis of the data showed that different wheat lines significantly affected grain yield of wheat. Chinese hybrid line 15-CA73 gained maximum grain yield (240%) followed by AL-60, AL-34, AL-16 and AL-12, respectively as compared to advanced line AL-146 which gained lowest grain yield. These significant differences might be due the compatibility of higher grain yield producing varieties to the climatic condition and the genetic potential of varieties (Ciha, 1982) or might be due to subsequent more spike m-2 (Tammam at el., 2000) and grains per spike. Our results are in accordance with the finding of Khan et al. (2001) who reported different grain yield production potential in wheat varieties/cultivars.

Table 2. Thousand Grain Weight (g), Grain Yield (kg ha^{-1}) and Biological Yield (kg ha^{-1}) as Affected by Different Wheat Lines.

Lines	TGW (g)	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
AL 12	40 N	7344 d	3044 bc
AL 16	41 I	7310 d	3171 b
AL 34	53 A	6383 e	3194 b
AL 41	42 F	7494 cd	3027 bc
AL 44	38 X	4705 jk	1777 l
AL 60	39 T	7905 bc	3610 a
AL 118	38 Y	5327 hi	1777 l
AL 122	41 H	4011 mn	1360 mn
AL 146	38 a	3088 o	1110 o
AL 178	33 g	3688 n	1194 no
AL 186	37 D	5533 ghi	2194 hij
GM 1683	35 e	6272 e	2527 def
15-CA73	46 D	9094 a	3777 a

GM 1215	41 H	4094 mn	1860 kl
MY 409	40 N	4032 mn	1444 m
MY 902	47 C	5110 ij	1860 kl
MY 2914	44 E	5766 fgh	2194 hij
MY 1501	40 K	6300 e	2610 de
AKBAR	50 B	4433 klm	2194 hij

CONCLUSIONS AND RECOMMENDATIONS

Under the experiment various wheat lines including advanced, hybrid and local check varieties were studied. Throughout the examination various parameters were studied and were carefully compared. Eventually, comparing all the yield components on which these lines excelled variably it was concluded that the best performing wheat line for desirable yield traits for the agro ecological conditions of Peshawar is the Chinese hybrid line 15-CA73 which outperformed all other lines in terms of grain yield.

As for recommendation, the Chinese hybrid line 15-CA73 showed desirable yield traits in comparison with others advanced, hybrid and local check varieties. Therefore, 15-CA73 is recommended for the agro ecological conditions of Peshawar, Pakistan.

ADVANCED RESEARCH

This research still has limitations so it is necessary to carry out further research related to the topic "Comparative Assessment of Advanced and Chinese Hybrid Lines of Wheat Under the Agro-Ecological Context of Peshawar, Pakistan" to perfect this research, as well as increase insight for readers

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