Research Article

Evaluation of Elite Candidate Maize Hybrids for Growth and Development Under the Agroclimatic Conditions of Peshawar Valley

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Abstract | In the present climatic scenario crop varietal/hybrid adaptation for a specific region is an eminent concern of agronomists. In this regard the current study aiming to evaluate different maize hybrids (PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917, 30K08 and CS-200) for higher grain yield was carried out at ARI-Tarnab, Peshawar during Kharif-2019. The study was conducted using randomized complete block design with three replications. The planting was done on ridges following recommended planting geometry of row to row distance of 75cm and plant to plant distance of 25 cm. Our findings revealed that plant height (cm), ear weight (g), grains ear^{-1}, 1000 grain weight (g) and grain yield (kg ha^{-1}) varied significantly (P≤0.05) among different hybrids while no significant variations were observed in terms of emergence m^{-2}, days to 50% emergence and ear length (cm). Our data revealed maximum plant height (245.00 cm), 1000 grain weight (363.00 g) and grain yield (5031.11 kg ha^{-1}) for PSHW-201916. 30K08 produced maximum ear weight of 229.33 g and grains ear^{-1} of 379.33. Our findings revealed maximum 1000-grain weight (g) and grain yield (kg ha^{-1}) for PSHW201916 when compared with other hybrids under traile. Similarly, maximum plant height was also noted for PSHW201916. Thus it is concluded that for higher grain yield PSHW-201916 is better options under the agro-ecological condition of Peshawar valley.

Received | November 29, 2021; **Accepted** | July 18, 2022; **Published** | March 06, 2023
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Citation | Sardar, S.H., Y. Jamal, Iltafullah, A. Basir, H. Ullah and M. Alam (2022). Evaluation of elite candidate maize hybrids for growth and development under the agroclimatic conditions of Peshawar valley. *Sarhad Journal of Agriculture*, 39(1): 236-241.
DOI | https://dx.doi.org/10.17582/journal.sja/2023/39.1.236.241
Keywords | Maize hybrids, 1000-grain weight, Grain yield, PSHW-201916, PSHW-201915

Introduction

Maize crop grows almost all over the world. It belongs to family poacea and ranks third after wheat and rice in terms of importance (Ali *et al*., 2020). Maize is a short day and highly cross-pollinated crop with monoecious nature. Maize crop is cultivated twice a year i.e. summer and spring (Khan *et al*., 2018). It can be grown at an altitude of 3300 meters above the sea level and its cultivation extends over a wide range of geographical and environmental conditions ranging from 58° N to 40° S (Ullah *et al*., 2017).

It is a multipurpose crop and adoptive to hot and subtropical places (Husain *et al*., 2016). Maize is a necessary food for a large number of peoples around the globe, and also used as feed for poultry and animals because it is considered as a good forage crop due to its nutritious stalks (Ali *et al*., 2020). In Pakistan, where rapid population growth exceeds our gain in cereal production, maize offers the opportunity to fulfill the gap. Increase in maize production can reduce the demand for wheat and hence can help to reduce the dependence on other cereals as well (Khan *et al*., 2018).

The maize per acre production of the country is very low when as compared to other countries of the globe. For enhancement of maize yield, it is important for breeders to focus on development of high yielding early maturity varieties, which have the potential of disease resistance, responsive to enhanced production practices and the presented cropping pattern and well adoptable to the current environmental conditions (Tahir*et al*., 2008).

In maize breeding the improvement in grain yield is a pilot objective, and the trait is controlled by yield contributing parameters. Increased production per unit area can be gained by raising superior varieties and hybrids. Normally for the improvement of a crop, genetic variability for various morphological and yield traits is important and can be exploited in the selection program. Partitioning and magnitude of genetic variance in maize are considered of great value for the breeder and act as a guide in choosing germplasm for population improvement (Ihsan *et al*., 2005).

Keeping in view the above statements, the current experiment was carried out to evaluate ten maize hybrids for various yield related parameters that could be of significant importance in future maize breeding programs for identification of new sources of improved characteristics and possible incorporation.

Materials and Methods

In order to evaluate different maize hybrids of white kernel type for growth and yield attributes the present research was carried out at Agriculture Research Institute Tarnab, Peshawar in kharif 2019. Ten maize hybrids PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917, 30K08 and CS-200 were assessed for relative growth and yield traits under the agro-climatic conditions of Peshawar region. Treatment distribution was accomplished using randomized complete block design (RCBD) with three replications. The planting was done on ridges with 75 cm row spacing and 25 cm plant spacing, having 20 plants per row and 40 per plot. Before sowing seed were treated with disinfectant Confider 70 WP to avoid soil borne pests. At sowing P_2O_5 and K_2O were applied @ 90 kh ha^{-1} and 60 kg ha^{-1} consistantly. In first irrigation cypermethrin was be applied to make the seed safe from pests. Nitrogen application was done in 3 splits i.e. at seedling stage, at knee height stage and at booting stage. Uniform agronomic practices were conducted during the growth period of the crop.

Data were collected on days to 50% emergence, emergence m^{-2}, plant height(cm), ear length (cm), ear weight (g), grains ear^{-1}, 1000-grain weight (g) and grain yield (kg ha^{-1}).

For days to 50% emergence, after seed sowing the number of days was noted till 50% emergence of the crop. The days were totaled in order to tabulate the data. In each sub plot 2 rows having length of 1 meter were considered at random and emerged plants were counted to finalize the data relating emergence m^{-2}. For plant height (cm) data, five randomly selected plants at physiological maturity were measured from base to the tips in each sub-plot and then their means were worked out. The data regarding ear length (cm) were recorded by measuring the ear lengths of five randomly selected ears in two rows and after that their means were found out. To undertake the data regarding ear weight (g), fiver random ears were selected in each row and after weighing these with electric balance their means were found out. After ear weight the grains of the five random cobs in each row were counted carefully and the numbers were divided by 5 to conclude the data for grains ear^{-1}. To finalize the data regarding1000-grain weight (g), in every plot 1000 grains were counted at random followed by weighing with electronic balance. For grain yield (kg ha^{-1}) data, harvesting of three central rows was done in subplots with sickle, and after sun drying were threshed and weighed with electronic balance. The data were then accomplished using the following formula:

$$\text{Grain yield (kg ha} - 1) = \frac{\text{Grain weight of three central rows}}{\text{Row length x R} - \text{R distance x No.of rows}} \times 10000$$

Statistical analysis

Statistical analysis of the data was performed through significant differences using statistical software Statistix 8.1 and in case of significant results the means of treatments were compared at probability level of p≤0.05 using LSD test (Jan *et al.*, 2009).

Results and Discussion

Emergence m^{-2}

Figure 1 presents emergence m^{-2} of various maize hybrids (PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917, 30K08 and CS-200). A non-significant influence of hybrids on emergence m^{-2} was clear from the data analysis. However, high emergence m^{-2} (13.57 plants) was confirmed for PSHW-201915 and lowest emergence m^{-2} (11.19 plants) was confirmed for CS200.

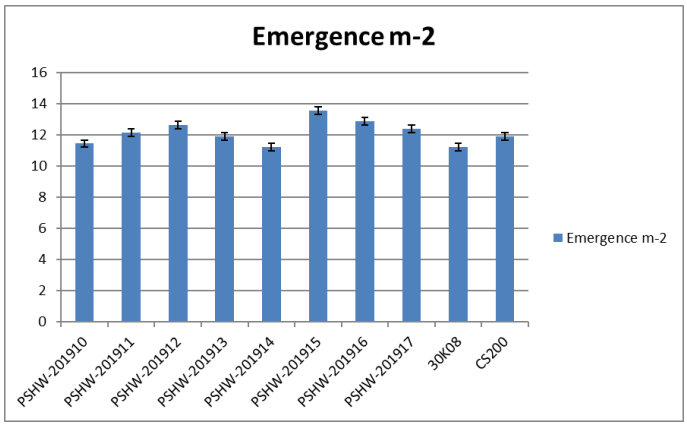

Figure 1: *(Grain yield kg ha^{-1}) of different maize hybrids.*

The possible reason for non-significant effect of various maize hybrids on emergence m^{-2} might be high stand and germination ability of hybrids. Faisal *et al.* (2015) summarized non-significant influence of various varieties regarding emergence m^{-2}.

Days to 50 % emergence

Days to 50% emergence of hybrids PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917,30K08 and CS-200 are demonstrated in Figure 2. From data analysis we confirmed non-significant influence of various hybrids on days to 50 % emergence. However, higher value of 7.67 was noted for PSHW-201911, PSHW-201911 and PSHW-201914 as compared to others.

The non-significant effect might be associated with the fact that seedlings mainly depend on food reserved in their endosperm during the stage of germination (Hafidi *et al.*, 2012). These results are similar with conclusions of Azeem *et al.* (2018) who revealed non-significant influence of maize varieties on days to emergence.

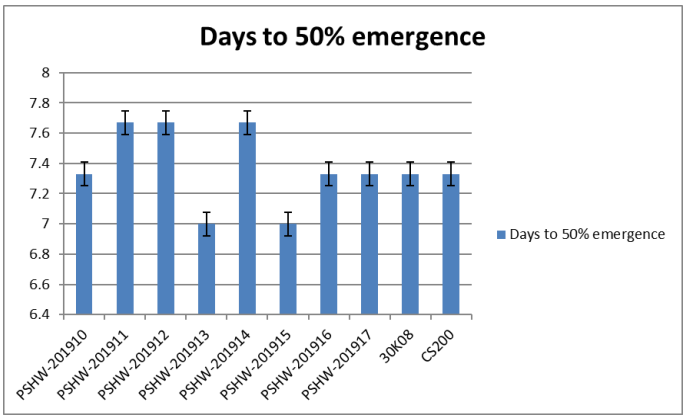

Figure 2: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Plant height (cm)

Mean values regarding plant height (cm) of maize hybrids are given in Figure 3. From data analysis we observed marked (p≤0.05) influence of maize hybrids on plant height (cm). Highest plant height (245.07 cm) was noted for PSHW-201916 that was statistically at par with 30K08 (243.67 cm). Shortest plant height (210.00 cm) was recorded for PSHW-201910.

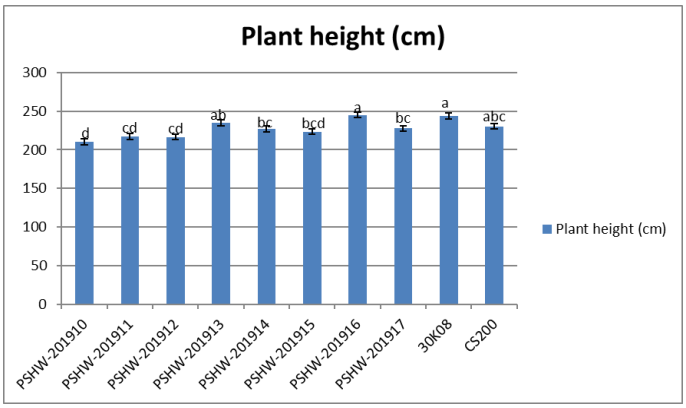

Figure 3: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Increased plant height (cm) by hybrid PSHW-201916 might be due to the genetic distinction of the hybrid. The findings are supported Tahir *et al.* (2008) who summarized that plant height (cm) was markedly influenced by maize hybrids. Khan *et al.* (2018) also concluded significant influence of various hybrids on that plant height of maize crop.

Ear length (cm)

Figure 4 shows data regarding ear length (cm) of

various maize hybrids. Analysis of variance of the values confirmed non-significant influence of hybrids on ear length (cm). However, maximum ear length of 16.50 cm was recorded for PSHW-201917 followed by CS200 with ear length of 16.47 cm. Similarly, minimum ear length of 14.90 cm was recorded for PSHW-201914.

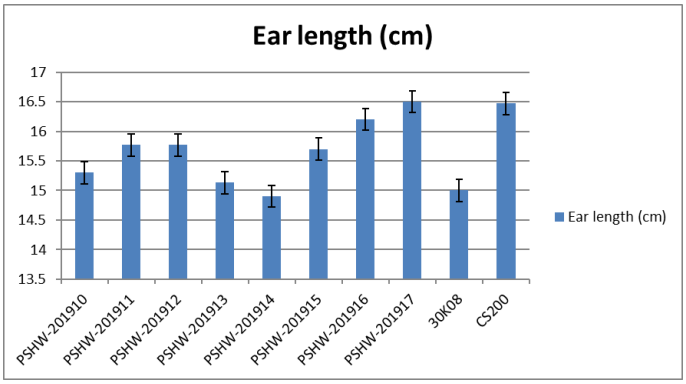

Figure 4: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Longer ears in case of hybrid 30K08 might be due to its genetic superiority. The findings are linear with results of Khan *et al.* (2018) who reported marked variations among hybrids for ear length. Izzam *et al.* (2017) also summerised marked differences among maize hybrids for cob length.

Ear weight (g)

Data on ear weight (g) are documented in Figure 5. Statistical analysis of the data showed significant ($p \leq 0.05$) effect of maize hybrids on ear weight(g). Maximum ear weight of 299.33 g was observed for 30K08 thatwas statistically at par with 298.67 g ear weight for PSHW-201917. Likely, the minimum ear weight of 294.00 g was found for PSHW-201914.

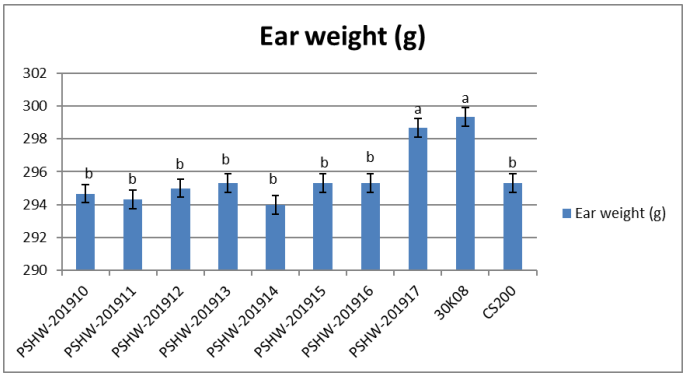

Figure 5: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Hybrid 30K08 produced heavier ears than the rest. Maruthi and Rani (2015) also found that different maize genotypes performed differently for yield and yield contributing traits.

Grains ear^{-1}

Data pertaining to grains ear^{-1} of hybrids PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917, 30K08 and CS-200 are shown in Figure 6. Significant ($p \leq 0.05$) influence of these hybrids was observed from statistical analysis of the data on the said trait. Our observations revealed maximum grains ear^{-1} (379.33) for 30K08 while the minimum grains ear^{-1} (292.00) were obtained from PSHW-201915.

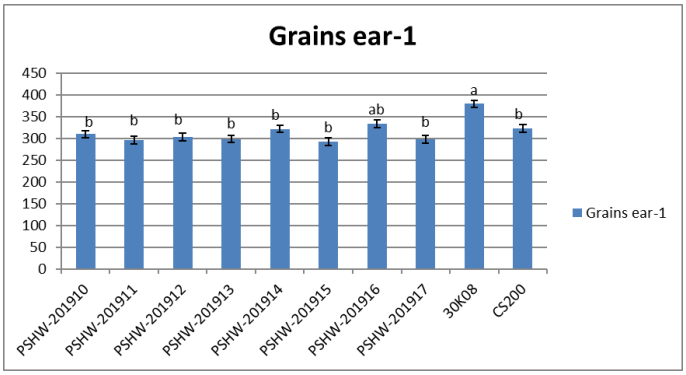

Figure 6: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Higher number of grains ear^{-1}by hybrid 30K08 might be due to the longest ears of the said hybrid. Our findings are supported by Sesay *et al.* (2018) who observed significant variations in different hybrids for grain ear^{-1}. Khan *et al.* (1999) also found that maize hybrids were significantly different for no of grain cob^{-1}.

1000-grain weight (g)

Data concerning 1000-grains weight (g) of maize hybrids are presented in Figure 7. Significant influence ($p \leq 0.05$) of maize hybrids on the said trait was evident from statistical analysis of the data. Our findings revealed maximum value (363.00 g) of the said parameter for PSHW-201916 as compared to minimum value of 281.00 g from PSHW-201912.

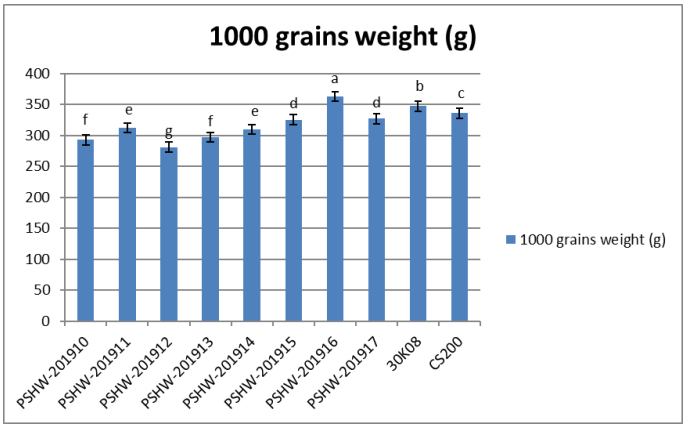

Figure 7: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Thousand grains weights (g) is the major yield determining factor. As thousand grains weight (g) is a genetic trait, hence was varied for different hybrids. The findings are in accordance with Tahir *et al.* (2008) who confirmed significant variations in hybrids for thousand grain weight (g). In maize hybrids evaluation trial Mkhabela *et al.* (1992) found that Pioneer hybrid had highest 1000 grain weight.

Grain yield (kg ha^{-1})

Statistical analysis of values revealed that grain yield (kg ha^{-1}) varied markedly ($p \leq 0.05$) among various maize hybrids (Figure 8). The data confirmed that PSHW-201916 produced maximum grain yield of 5031.11 (kg ha^{-1}) tailed by PSHW-201914 (4999.11 kg ha^{-1}) when compared with minimum lowest value of 4521.33 kg ha^{-1} from PSHW-201912.

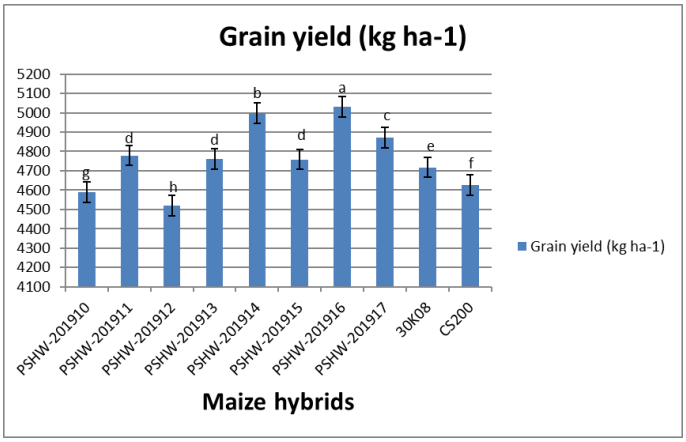

Figure 8: *(Grain yield kg ha^{-1}) of different maize hybrids.*

Grain yield is the ultimate goal of a researcher in cereal crops. In the current study, hybrid PSHW-201916 performed the best. This might be attributed to high grains cob^{-1}, and 1000-grain weight of the said hybrid. Jan *et al.* (2018) also summarized that yield of grain (kg ha^{-1}) was significantly influenced by different hybrids. Ali *et al.* (2020) also reported significant variations among hybrids for grain yield.

Conclusions and Recommendations

The hybrids PSHW-201910, PSHW-201911, PSHW-201912, PSHW-201913, PSHW-201914, PSHW-201915, PSHW-201916, PSHW-201917, 30K08 and CS-200 were screened on the basis of various growth and yield parameters. The results revieled high emergence m^2 for PSHW-201915. More days to 50% emergence were taken by PSHW-201911, PSHW-201911 and PSHW-201914. Similarly, maximum ear length and ear weight were noted for PSHW-201917 and 30K08 consistantly. While significantly maximum plant height (cm), 1000-grain weight (g) and grain yield (kg ha^{-1}), were noted for PSHW201916. So on the basis of best performance regarding economic yield, PSHW201916 is recommended for obtaining maximum grain yield (kg ha^{-1}) under the agro-ecological conditions of Peshawar valley.

Novelty Statement

Hybrids considered in the study are elite candidate and are never evaluated earlier for growth and development traits under the agroclimatic conditions of Peshawar valley.

Author's Contribution

Syed Hilal Sardar: Project execution and drafting
Yousaf Jamal: Checking of the draft and making necessary amendments
Iltaf Ullah: Project designing
Abdul Basir: Statistical analysis
Hidayat Ullah: Material arrangements and fertilizer management
Mukhtar Alam: Critical review of the draft with amendments
Ikramullah: Pests control and agronomic practices insurance

Conflict of interest

The authors have declared no conflict of interest.

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