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EVALUATION OF DIFFERENT MAIZE VARIETIES FOR YIELD AND YIELD CONTRIBUTING TRAITS

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Abstract

In Pakistan, maize is one of the most important crops for food and feed. It is used in numerous products that are linked to human nutrition.But currently, due to the unavailability of high yielding maize varieties and choice of unsuitable varieties under a given environment reduce the final yield. This experiment was carried out at the Agriculture Research Farm of Abdul Wali Khan University Mardan, Khyber Pakhtunkhwa, Pakistan during the first week of March 2018. Seven different maize varieties (Pscv-1219, Pscv-1306, Pscv-1311, Pscv-0309, Pscv-0401, Pscv-8003 and local check Azam were collected from Cereal Crops Research Institute (CCRI) Pirsabak Nowshera, Pakistan. The experiment was carried out bya Randomized Complete Block Design (RCBD) with three replications. Analysis of data showed significant variations for almost all studied traits ($p< 0.05$). In terms of grain yield, variety Azam was found the best as it produced maximum grains(8972.13kg ha^{-1}) followed by Pscv-1306 (7431.05 kg grains ha^{-1}), Pscv-1311 (7114.29 kg grains ha^{-1}) and Pscv-1219 (6979.67 kg grains ha^{-1}) which were statistically non-significant. Similarly, the minimum grain yield was noted for variety Pscv-0309 (5319.78 kg grains ha^{-1}) which was similar to variety Pscv-0401 (6335.92 kg grains ha^{-1}) and Pscv-8003 (5539.20 kg grains ha^{-1}). It seems logical to conclude from the findings of this trial that among the newly introduced varieties Pscv-1306, Pscv-1311 and Pscv-1219 also exhibited the best performance which was similarto that of the check (Azam). Therefore,further trails are thus imperative to evaluate these varieties under slightly different environmental conditions and cultural practices which may potentially suit these more than the one used in this trial.

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Introduction

Maize (*Zea mays* L.) is a short duration, annual and cross-pollinated crop belongs to family Phocaea. it is a fast-growing crop and has the capability to bring forth high grain yield per unit area (Akbar*, et al.*, 2008). It is one of the major cereal crop cultivated in Pakistan. Maize is a dual-purpose crop, It is known for food and feed across the world. Besides, it has multifaceted uses such as, bread making, corn flakes, corn syrup, paper making and food industries (Khan*, et al.*, 2013). Corn oil is suited for human intake because of the presence of a relatively high amount of unsaturated fatty acids (Tariq and Iqbal, 2010). In Pakistan maize are cultivated in 1.12 million hectares with a total production of 4.53 million tons (Shah*, et al.*)with compere to other countries like China, America, and Brazil the average maize yield of Pakistan is very low (Shafiullah*, et al.*, 2018).

There are many factors that affect the grain yieldof maize like inappropriate fertilizer application, weeds management, poor supply of water and attack of different types of pest and diseases. Furthermore, the most important factor is the selection of inappropriate varieties under given environment (Tahir*, et al.*, 2008). For commercial crop production, the environmental condition cannot be changed but a genetic make-up of a variety can be modified by using different techniques of biotechnology and hybridization (Khan*, et al.*, 2013). Moreover, the screening of different varieties are also a systematic approach to evaluate the stability and yield performance in different environmental condition. Different maize varieties production are different at various sites (Olakojo and Iken, 2001).

Therefore, It is very important to screen various maize varieties in different ago-ecological zones for their adaptation, yield potential and to release the most suitable varieties for cultivation (Hussain, 2011). Based on such a phenomenon, the experiment was conducted in the Agriculture Research Farm of Abdul Wali Khan University Mardan, Khyber Pakhtunkhwa, Pakistan to determine the most stable and high yielding varieties for the local environment.

Research methodology

Experimental site

The experiment was conducted at Agriculture Research Farm Abdul Wali Khan University Mardan, Khyber Pakhtunkhwa, Pakistan. The latitude and longitude of Mardan, Pakistan are 34.206123 and 72.029800respectively.

The GPS coordinates of Mardan is 34° 12' 22.0428" N and 72° 1' 47.2800" E. The average rainfallrate is 559 mm. The soil in Mardan ranges from sandy loam to clay.

Treatments and experimental design

Seven different varieties were used like Pscv-1219, Pscv-1306, Pscv-1311, Pscv-0309, Pscv-0401, Pscv-8003 and local check Azam. Varieties were collected from Cereal Crops Research Institute (CCRI) Pirsabak Nowshera, Pakistan.

The experiment was led out according to Randomized Complete Block Design (RCBD) with three replications. The size of each experimental unit was 5×1m, which consisted of two rows. Distance between row-to-row and plant to plant was 75cm and 25cm respectively.

Land preparation

The land was prepared by plowing the soil with a cultivator followed by a rotovator for a uniform seedbed. The field was cleared from any weeds residues. Total of 21 experimental units were made.

Three to four-centimeter-deep, holes were made by the simple pointed stick in all experimental units for seed sowing.

Planting

The maize was grownin the first week of March 2018. Phosphorus was applied as starter dose at the rate of 115 kg ha^{-1}.DAP was used as a source of Phosphorus.

Two seeds per hole were inseminated and then covered by light soil. In order to maintain the optimal plant density, thinning was done after 10 to 15 days.

Nitrogen fertilization

The optimal fertilizer dose of nitrogen 180 kg ha^{-1} as Urea was applied in three split doses at different stages i.e. after germination, grand growth stage and before tasseling. Each application was followed by irrigation.

Weed control

First, weeding was done after three weeks of emergence by hand hoe, the second weeding was done after five weeks of emergence.

Pesticide application

Due to a little attack of stem borer at tasseling stage on stem and tassels. The furadon in the granular form at the rate of 20kgha^{-1} was applied. Six to seven grains were applied in the upper whorl of the plant.

Harvesting

Harvesting was done when the cob sheath dried completely. All the cobs were removed from the standing crop and were collected in small polythene bags.

Data measurement

Data were recorded for the following parameters i.e. Days to 50% pollen shedding (no.), Plant height (cm), ear height (cm), Ear population ha^{-1}, Fresh ear weight (gm), Moisture percentage of grains, Number of rows $ear^{-1,}$ Number of grains row^{-1}, Number of gains ear^{-1}, 1000-grain weight (gm), Grain yield kg ha^{-1}. All the data were recorded according to their standard methods.

Statistical analysis

The data were analyzed by using statistic 8.1 software ($p< 0.05$). LSD test was performed to check the variation in different traits among different varieties.

Results and discussion

Days to 50% pollen shedding

Days to 50% pollen shedding as affected by different varieties are shown in Fig-**1.** Analysis of the data revealed that this trait was significantly different for the tested varieties ($P < 0.05$).

Maximum days to 50% pollen shedding were taken by variety Pscv-8003 (77.33 days) followed by Pscv-1306 (74.667 days) which were statistically at par with varieties Pscv-1219 (74.333 days), Pscv-0309 (74 days), Pscv-0401 (74 days) and Azam (73 days). Likewise, the lowest number of days (71) to 50% pollen shedding was noted for variety Pscv-1311.

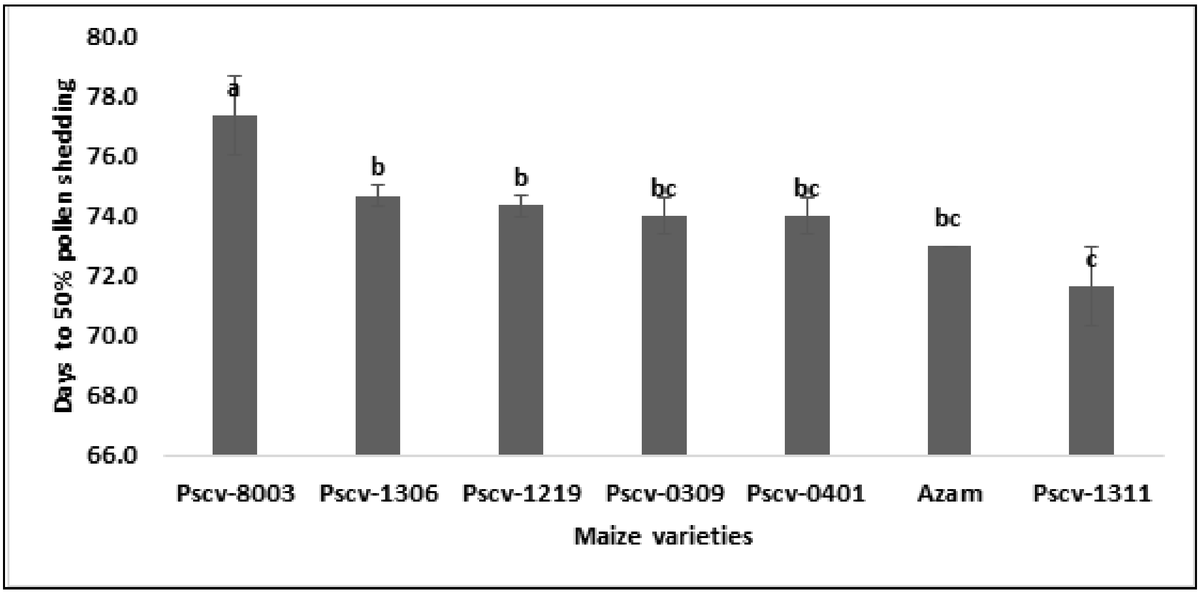

Fig. 1. Days to 50% pollen shedding of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

The two main environmental signals that affect the growth and development of maize are temperature and photoperiod(Inamullah, *et al.*, 2011). Wiebold (2002) reported that some maize genotypes show a different level of responses to photoperiod and temperature. When genotypes are said to vary in calendar "days to maturity" they are actually different in the "growing degree days" or the thermal units they consume. Based on photoperiod the plants are classified into two main classes i.e. short duration and long duration plants (Capristo, *et al.*, 2007). All the above factors might be the possible reasons for differences in days to pollen shedding. The result was also similar to the result of Hussain (2011) in which days to 50% pollen shedding was significantly different.

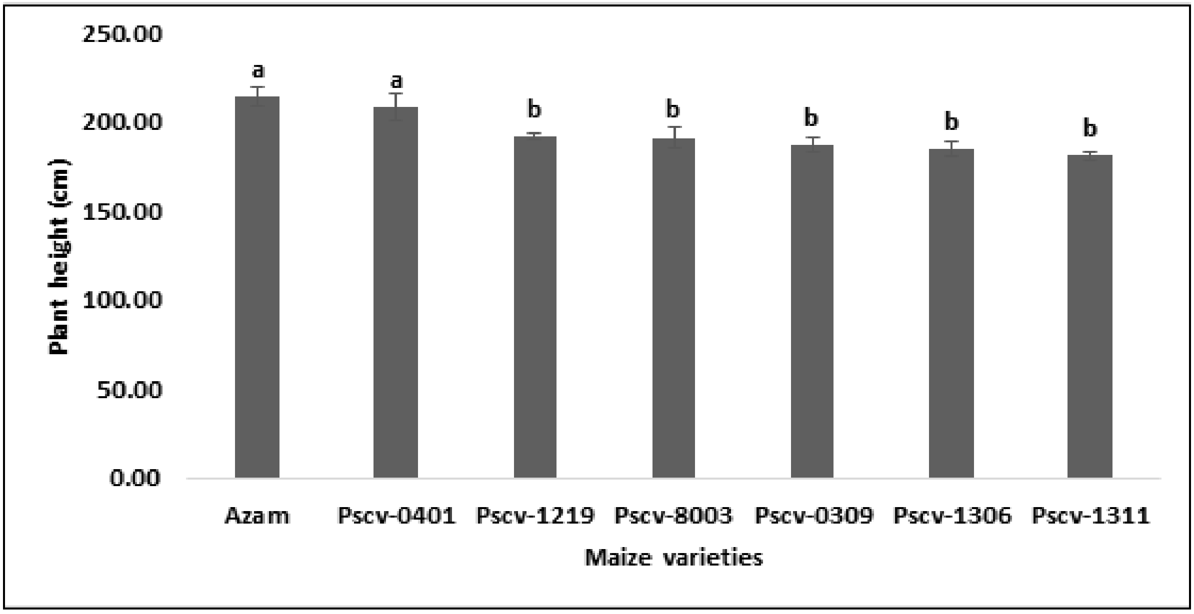

Fig. 2. Plant height (cm) of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

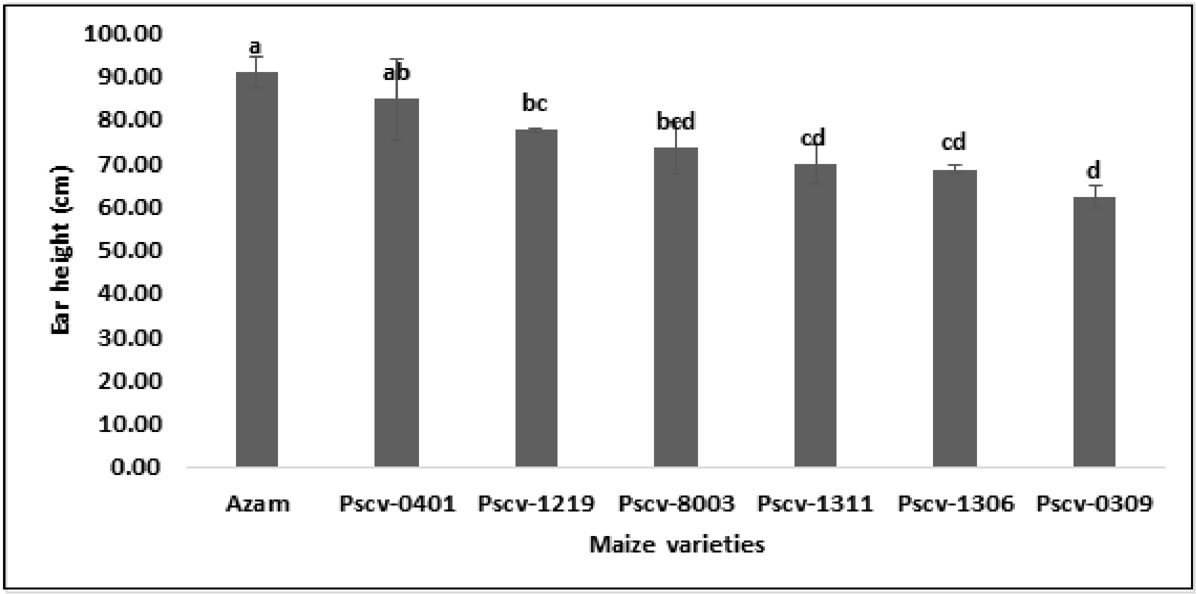

Fig. 3. Ear height (cm) of various maize varieties**.** Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

Plant height (cm)

Pant height is a very important trait for developing of new varieties as well as for grin yield.Data regarding plant height are represented in Fig-2. Which is affected by different maize varieties. Statistical analysis of data shows significant differences in maize plant height ($P < 0.05$). Tallest plants were noted in variety Azam (214.33cm) which was statistically at par with Pscv-0401 (208.67cm) while smallest plants were found in variety Pscv-1311 (181.33cm) which was statistically in line with Pscv-1219 (192cm), Pscv-8003 (191.33cm), Pscv-0309 (187.33cm) and Pscv-1306 (185cm).

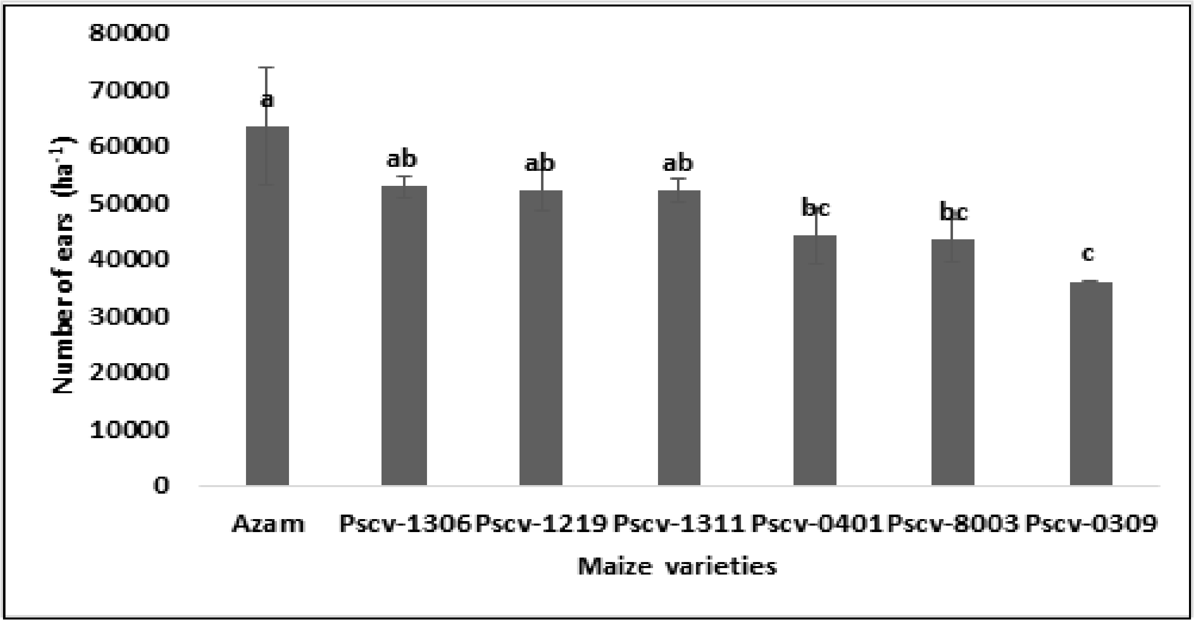

Fig. 4. Ear population (ha^{-1}) of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

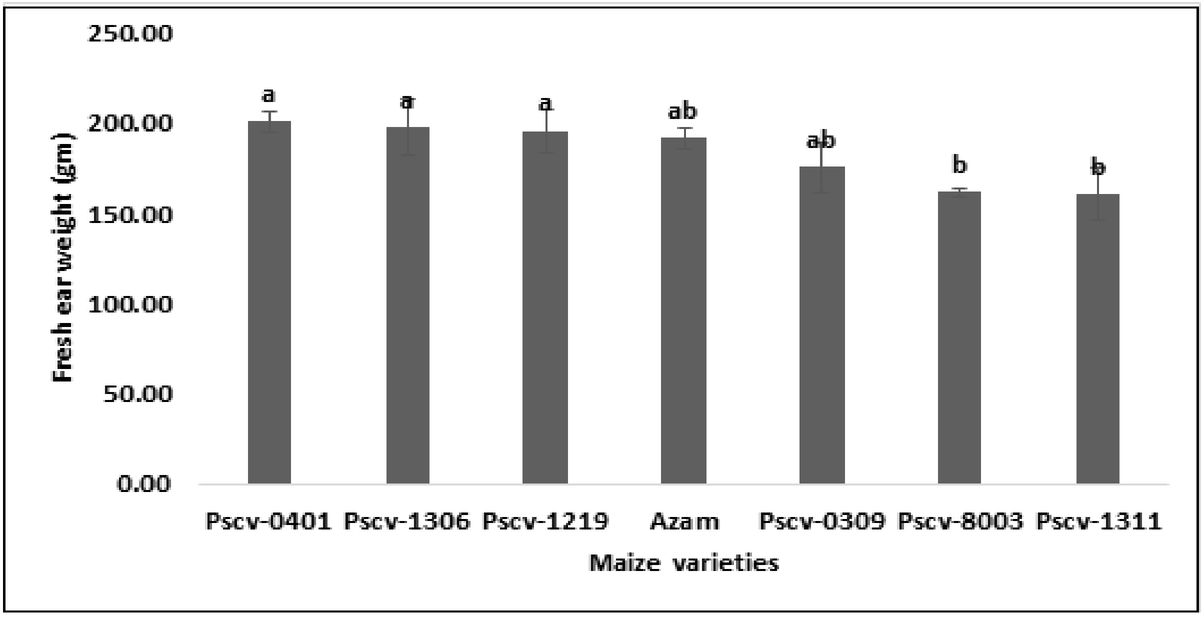

Fig. 5. Fresh ear weight (gm) of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

Plant height is a genetic factor therefore change in the genotype of different maize varieties were resulted in different plant height. Similarly, environmental factors are also closely linked with the change in plant height (Tahir, *et al.*, 2008). Plant height was also genetically linked with the reproductive stage whenever the plant is shifted to the reproductive stage it stops their internode formation.

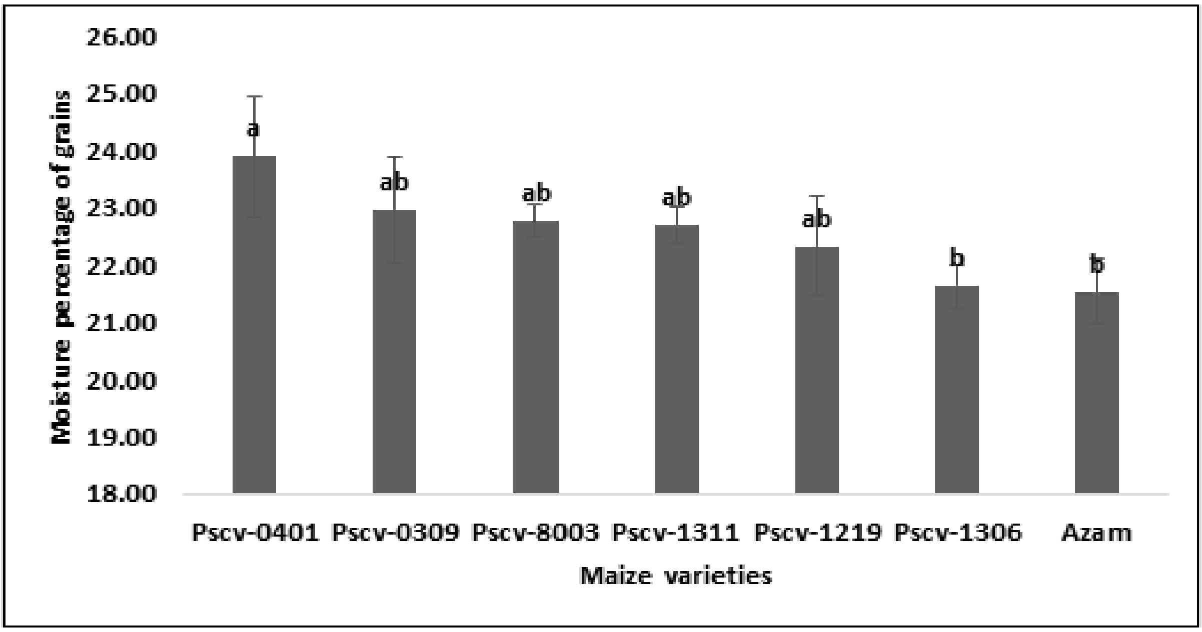

Fig. 6. Moisture percentage of grains of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05.Vertical bars indicate standard error of means for three replicates.

This fact indicated that maize variety, which is early in their maturity, would have shorter plant height (Troyer and Larkins, 1985). Competition for light and nutrients might be also possible reasons for variation in plant height.

Ear height (cm)

Data concerning ear height are shown in Fig-3. Analysis of the data specified that the ear height of different maize genotypes was significantly affected by different varieties ($P < 0.05$). Higher ear height (91.66cm) was documented for Azam, which was statistically at par with genotype Pscv-0401 (84.667cm) followed by Pscv-1219 (77.667cm), Pscv-8003 (73.6cm), Pscv-1311 (69.8cm) and Pscv-1306 (68.533cm).

The lowest ear height (62.2cm) was recorded for genotype Pscv-0309. The possible reason for differences in ear height among different tested genotypes might be the change in their genetic makeup (Olakojo and Olaoye, 2005, Salami, *et al.*, 2007, Muhammad, *et al.*, 2010).

Ear population (ha^{-1})

Ear population data are shown in Fig-4. Which shows significant changes in the number of ears ha^{-1} for different tested varieties ($P < 0.05$).

Maximum number of ears were recorded for Azam (63334 ha^{-1}) while Pscv-1306 (52666 ha^{-1}) was at par with Pscv-1219 (52000 ha^{-1}) and Pscv-1311 (52000 ha^{-1}) followed by Pscv-0401 (44000 ha^{-1}) and Pscv-8003 (43334 ha^{-1}).

The lowest number of ears ha^{-1} was recorded for variety Pscv-0309 which was (36000 ears ha^{-1}).

The dissimilarity in the number of ear ha^{-1} could be because of the genetic as well as due to environmental factors. The ear population data are linked with germination m^{-1} and plant population.

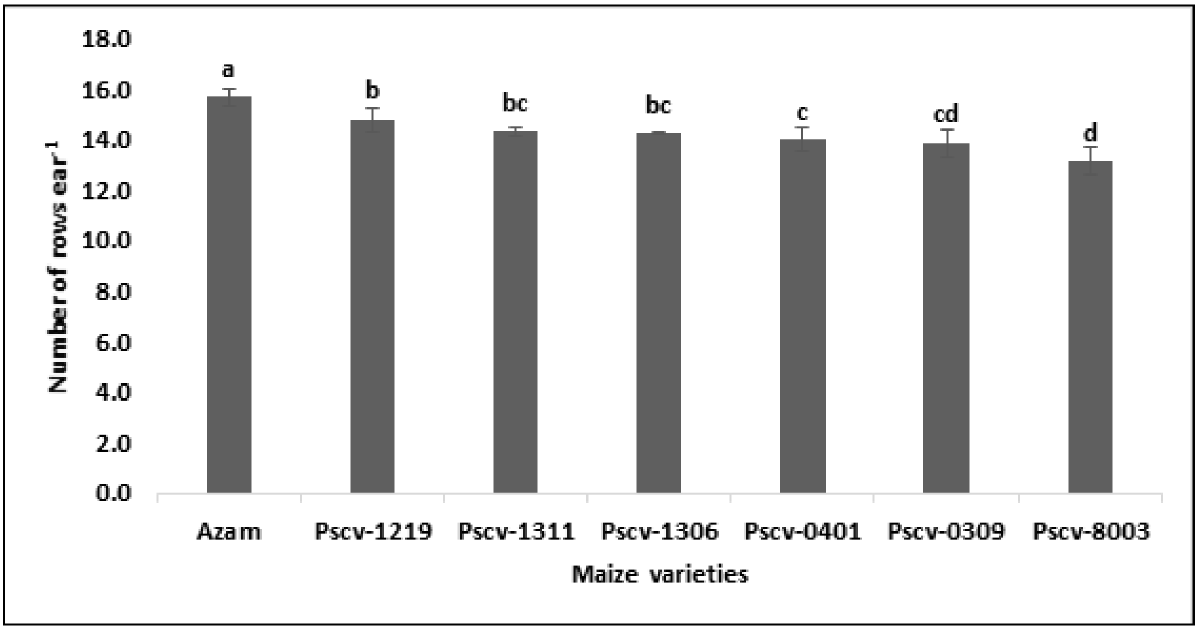

Fig. 7. Number rows ear^{-1}of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05.Vertical bars indicate standard error of means for three replicates.

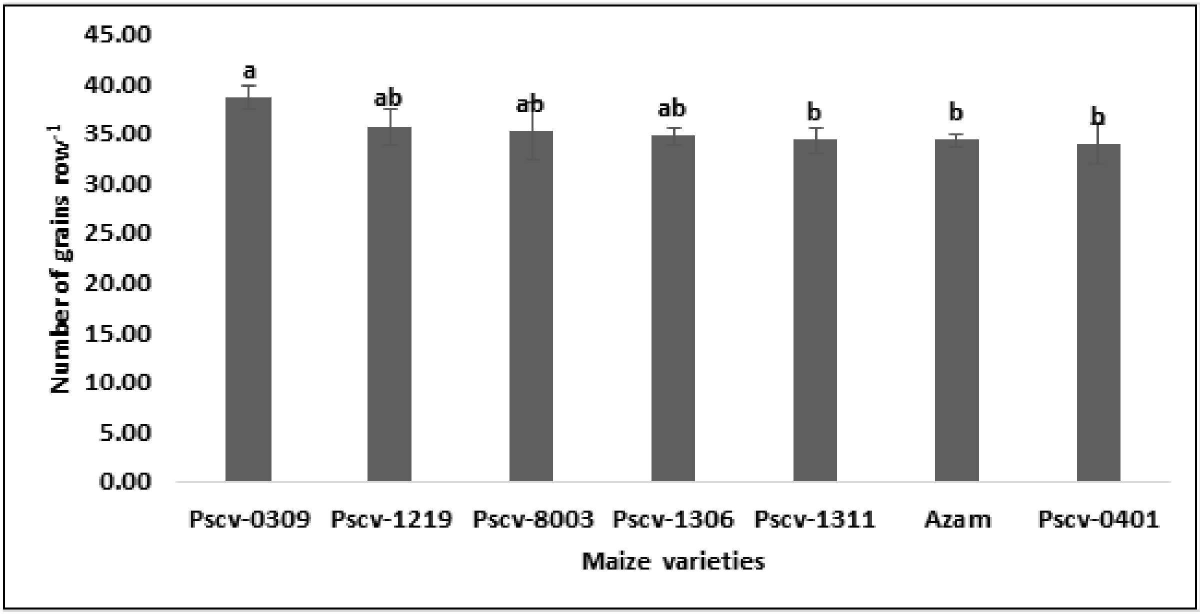

Fig. 8. Number of grains row-1 of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

Fresh ear weight (gm)

The ear weight was shown in Fig-5. Which shows statistically significant variance for different maize varieties ($P < 0.05$). Variety Pscv-0401 recorded maximum (201.01gm) ear weight followed by Pscv-1306 (197.4gm) both varieties means for fresh ear weight are statistically at par with Pscv-1219 (195gm) and between one another. Similarly, variation in fresh ear weight for variety Azam and Pscv-0309 was found non-significant with one another their ear weight was 191.8 and 175.6gm respectively. Lowest ear weight was recorded for variety Pscv-1311 (160.7gm) which was at par with Pscv-8003 (161.7gm).

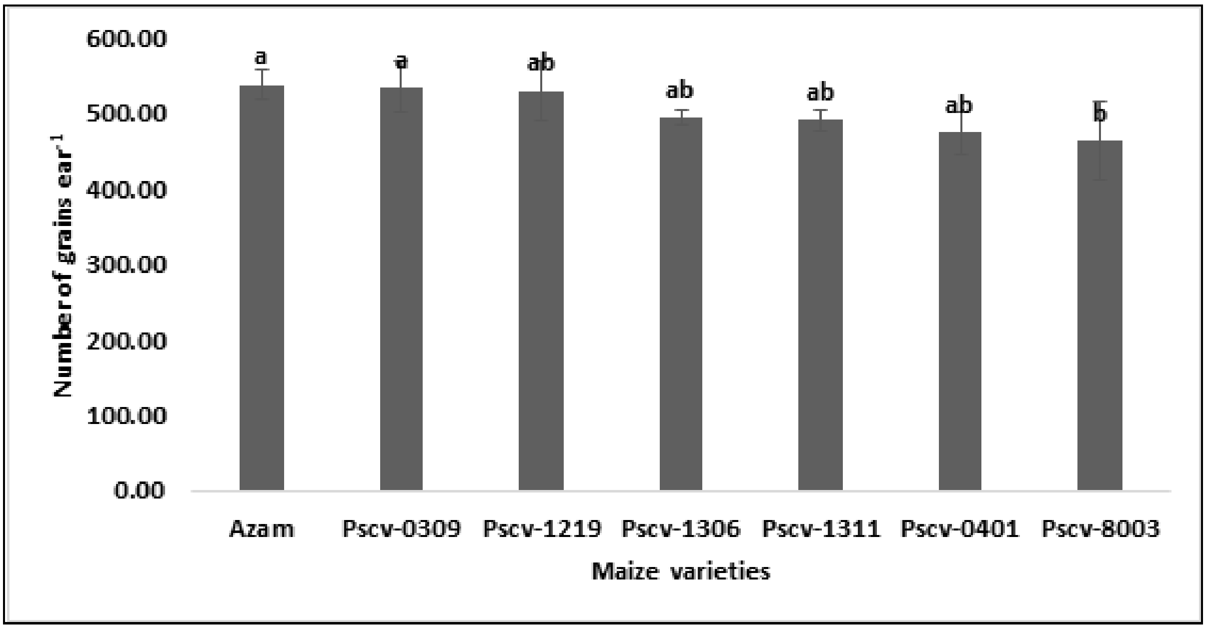

Fig. 9. Number of grains ear^{-1} of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

The variation in the genetic capacity of varieties to produce higher assimilate and translocation capacity towards ear could be a possible reason for differences in fresh ear weight (Shafiullah, *et al*., 2018). Similar results were also reported by (Hussain (2011)).

Moisture percentage of grains

Data regarding moisture percentage as affected by different maize genotypes are shown in Fig-6. According to statistical analysis, the moisture percentage was significantly different in tested varieties ($P < 0.05$). Maximum moisture (23.9%) was shown by variety Pscv-0401 followed by Pscv-0309 (22.96%), which was statistically similar with Pscv-8003 (22.76%), Pscv-1311 (22.7%) and Pscv-1219 (22.33%). Varieties Pscv-1306 and Azam showed 21.633% and 21.53% moisture. It was estimated that variety, which was early in their maturity, contains lower moisture in their grains while late-maturing varieties show higher moisture content in their grains (Hidayat-ur-Rahman, *et al*., 2009).

Number of rows ear^{-1}

Data regarding the number of rows ear^{-1} are shown in the Fig-7. As affected by different maize genotypes. Statistical analysis of data revealed significant variation for the number of rows ear^{-1} ($P < 0.05$). More number of rows per ear (15.7) were noted for variety Azam followed by Pscv-1219 (14.8 rows ear^{-1}) which was statistically similar with Pscv-1311 (14.3 rows ear^{-1}) and maize variety Pscv-1306 (14.3 rows ear^{-1}). Likewise, the number of rows per ears in variety Pscv-0401 and Pscv-0309 were 14.0 and 13.9 severally. The minimum number (13.1 rows ear^{-1}) was found in variety Pscv-8003 which was at par with Pscv-0309. Similarly, the findings of Ullah, *et al.* (2016) and Hidayat-ur-Rahman, *et al.* (2009) also revealed significant variations in the number of row ear^{-1} for different maize genotypes.

Number of grains row^{-1}

Fig-8 shows the number of grains per row as affected by different maize genotypes. Statistical analysis of data shows significant variation for the number of grains per row ($P < 0.05$). Maximum number (38.53) grains per row were produced by variety Pscv-0309 followed by variety Pscv-1219, Pscv-8003 and Pscv-1306, which produced 35.73, 35.20 and 34.73 grains row $^{-1}$ respectively. Similarly, variety Pscv-0401 produced the lowest number of grains row^{1} and was found a non-significant variation with Pscv-1311 (34.33 grains rows $^{-1}$) and Azam (34.33 grains rows -

^{1}). The result was in line with Ghimire and Timsina (2015) who also found significant variation in grain row^{-1} for different tested genotypes.

Number of grains ear^{-1}

The grains ear^{-1} as affected by different maize varieties are shown in Fig-**9**. The data were significant ($P < 0.05$). According to statistical analysis, maximum grains ear^{-1} were recorded for Azam (538.27) followed by variety Pscv-0309 (535.16), Pscv-1219 (530.13), Pscv-1306 (495.45), Pscv-1311 (491.77) and Pscv-0401 (475.57), they were as par with each other.

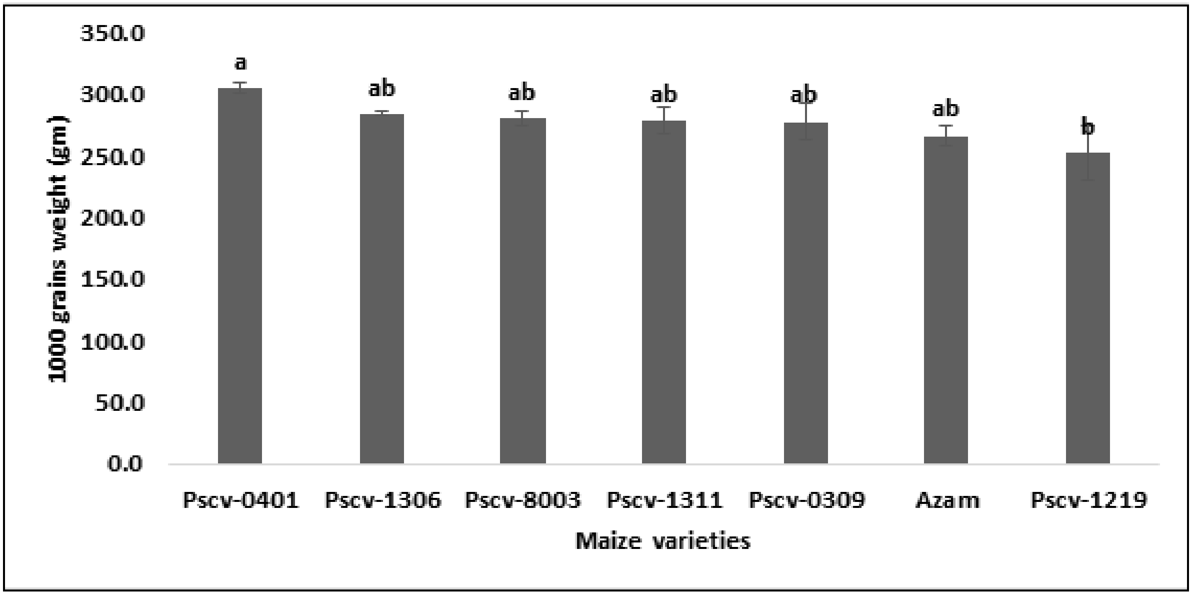

Fig. 10. 1000 grains weight (gm) of various maize varieties. Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

The lower number of grains ear^{-1} was found in genotype Pscv-8003 (464.33). The possible reason for dissimilarity in the number of grains per ear is the genotypic properties of tested varieties.

1000-grains weight (gm)

Thousand-grain weight is an important yield component which significantly contributes towards final grain yield of maize crop. Data regarding 1000-grain weight as affected by different varieties are shown in Fig-10. According to statistical analysis, the 1000grains weight varied significantly among the tested varieties ($P < 0.05$). The maximum grains weight was noted for variety Pscv-0401 (305.4gm) followed by Pscv-1306 (284.2gm), Pscv-8003 (280.6gm), Pscv-1311 (278.6gm), Pscv-0309 (277.9gm) and Azam (266.5gm). Similarly, the lowest 1000-grains weight was recorded for Pscv-1219 (252.1gm). The fluctuation in 1000 grains' weight among different varieties might be due to change in the size of grains (Ali, 2014). This might be also due to the change in the time period of the grain filling stage, which alter the final grain weight of maize genotypes (Shafiullah, *et al.*, 2018). The change in the genetic capability of different genotypes for nutrient uptake might be also one of the reasons for a change in 1000-grains weight. Ali (1994) also found significant changes regarding 1000 grains weight in different tested genotypes of maize.

Grain yield (kg ha^{-1})

Data regarding grain yield Fig-11. Reveal that significant differences exist among the tested varieties. Maximum grain yield i.e. 8972.13 (kg grains ha^{-1}) was recorded for Azam, followed by Pscv-1306 (7431.05 kg grains ha^{-1}), Pscv-1311 (7114.29 kg grain ha^{-1}) and Pscv-1219 (6979.67 kg grains ha^{-1}) which were statistically non-significantly different.

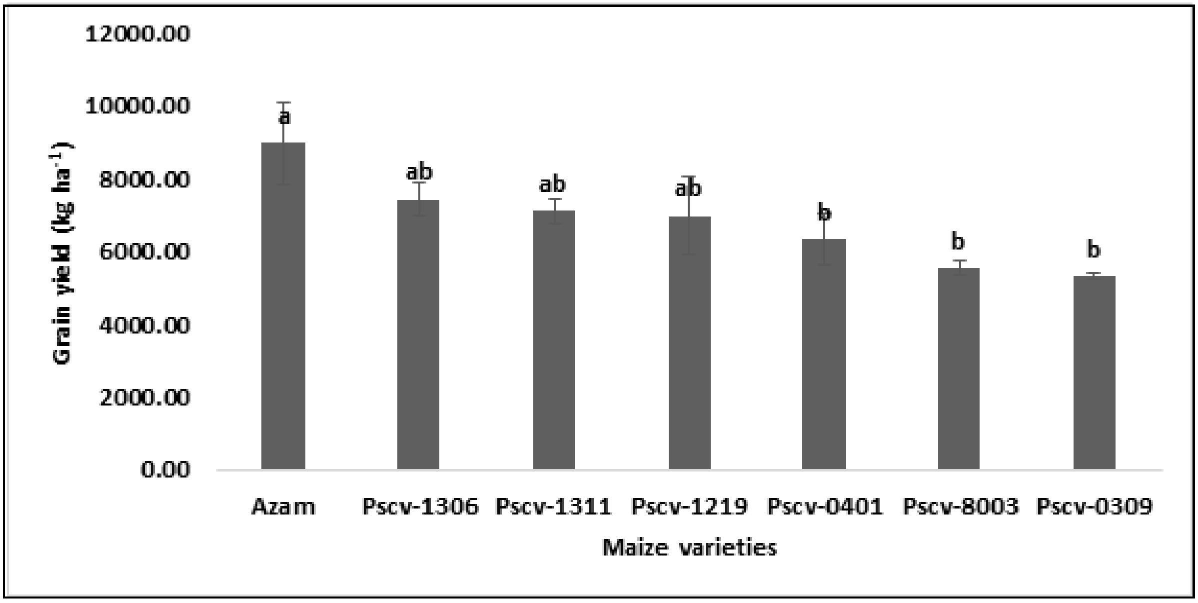

Fig. 11. Grain yield (kg ha^{-1}) of various maize varieties.Values followed by different alphabets are significantly different from one another at a probability value of 0.05. Vertical bars indicate standard error of means for three replicates.

Similarly, lower grain yield was noted for variety Pscv-0309 (5319.78 kg grains ha^{-1}) which was at par with variety Pscv-0401 (6335.92 kg grains ha^{-1}) and Pscv-8003 (5539.20 kg grains ha^{-1}). The variation might be due to the change in the genetic background of these varieties (Zulfiqar, *et al*., 2006, Qamar, *et al*., 2007, Ahmad, *et al*., 2011) and their response to environmental conditions (Khan, *et al*., 2013). The plant population, grains ear^{-1} and ear population might be also reasons for the change in grains yield. Similarly, the photosynthetic ability of different varieties to utilize maximum light energy, maximum assimilate production and its conversion to starch could alter the grain yield (Derby, *et al*., 2004).

Conclusion

It seems logical to conclude from the findings of this trial that variety Azam which was used as check performed well in terms of grain yield and other agronomic traits when compared with the rest of the tested genotypes. Similarly, among the newly introduced varieties Pscv-1306, Pscv-1311 and Pscv-1219 also exhibited the best performance which was found similar to that of the check (Azam). Further trials are thus imperative to evaluate these two varieties under slightly different environmental conditions and cultural practices which may potentially suit these more than the one used in this trial.

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