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Genetic variability in different maize (*Zea mays* L.) genotypes for comparative yield performance under local conditions of Rawalakot, Azad Jammu and Kashmir

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Abstract

The investigational material consisted of fourteen genotypes of maize collected from Crop Science Institute, National Agriculture Research Center Islamabad. The study was conducted to investigate the genetic variability in different maize (*Zea mays* L.) genotypes for grain yield performance under local conditions of Rawalakot, Azad Jammu and Kashmir. The data was collected for some morpho-physiological traits like days to tasselling, days to silking, number of leaves plant[-1], number of cobs plant[-1], tassel branching, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows ear[-1], number of kernels row[-1], 100-grain weight (g) and grain yield (kg ha^{-1}). Statistically significant differences were found among all the maize genotypes for the characters under observation. Azam showed maximum number of cobs/plant, 100-grain weight, ear girth, kernel rows/ear and maximum grain yield. Genotype E-77 was a high yielding variety followed by Habib-1, Islamabad Gold and Margalla. These genotypes could be exploited in further breeding activities for the development of high yielding lines.

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Introduction

Maize is among the most significant dietary crop worldwide. Millions of people in the developing world derive their protein and calories requirement from it (Yadav and Indra, 2010). In addition to providing raw product to animal feed, it also contributes a substantial quantity of raw product to several industries, hence gains an important position in global economy and trade (Bello *et al.,* 2010).

The world average yield of maize was three times higher in 2011 (5185 kg ha-1) than 1961 (1942 kg ha-1) (FAO, 2013). The world maize growing area also increased from 106 million hectares to 170 million hectares between 1961 and 2011 (FAO, 2013).

In Pakistan, maize is the 3rd most significant food crop. Maize contributes 2.2% to the value added in agriculture and 0.5% to gross domestic production. In Pakistan during 2012-13 cropping season maize was grown on an area of 1.085 million hectare. A total production of 4.631 million tones with an average yields of 4268 kg/ha was also reported during the same cropping season (Anonymous, 2013). However, there is still a considerable gap between the yield potential of the improved varieties and national average yield. Development of high yielding varieties is the most fundamental goal of any maize breeder to increase yield. Grain yield is the collective product of inherited and environmental factors. Genetic variability in maize genotypes plays a vital role in grain yield variation (Tahir *et al.,* 2008). Significant variation found in the germplasm of maize for ear height, ear length, plant height, 100-grain weight and ear girth (Hussain *et al.,* 2005). Maize production could be increase through development of improved genotypes capable of producing enhanced yield under different agro climatic conditions.

The objective of the present study was therefore, designed to compare the genetic variability for production potential of different available maize genotypes and to select a suitable one for maximum yield potential under the local condition of Rawalakot, Azad Jammu and Kashmir.

Materials and methods

The present study was conducted in the experimental area of the Department of Plant Breeding and Molecular Genetics, Faculty of Agriculture, The University of Poonch, Rawalakot, Azad Jammu and Kashmir. The investigational material consisted of fourteen genotypes of maize including, Soan-3, E-77, 1097, Islamabad Gold, MTM- 1, Margalla, Jalal, MTM-2, Islamabad White, 7004, Habib-1, Rakaposhi, Azam and Habib-2. The material was collected from Crop Science Institute, National Agriculture Research Center Islamabad.

This investigational material was sown in randomized complete block design (RCBD) having three replications and fourteen maize genotypes as treatments. Each experimental unit comprised of five meter length of three rows keeping plant-to-plant and row-to-row distances of at 25 cm and 75 cm. Two seeds per hill were sown and thinned to one seedling after few days of germination. Recommended dose of fertilizers (Urea and DAP) were applied during seed bed preparation. Urea was applied in three doses. First dose was applied at the time of sowing. The remaining fertilizer (Urea) was applied when the crop attained fifty centimeter height but the last and third doses of fertilizer was given before the anthesis. Normal agronomic and cultural practices were applied to experiment throughout the growing season.

The data was collected for some morpho-physiological traits like days to tasselling, days to silking, number of leaves plant-1, number of cobs plant-1, tassel branching, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows ear-1, number of kernels row-1, 100-grain weight (g) and grain yield (kg ha-1). Statistical method (ANOVA) of Steel *et al.* (1997) was adopted to ascertain the difference among maize varieties for various traits. The mean for each character was calculated.

Results and discussion

Analysis of variance showed that there were highly significant differences among maize genotypes for days to 50% tasselling.

The maximum number of days was shown by E- 77 (70.7 days) followed by Habib-1 (70.3 days) while MTM -2 took minimum days (62.3days) to tasselling. These results are also in line with those of Kafeel *et al.* (2004) who also found significant difference among maize varieties for days to pollen shedding. The result also confirms genetic variability in the test genotypes.

Table 1. Analysis of variance (mean squares) for thirteen characters of maize genotypes.

Source of variance	d. f.	DT	DS	PH (cm)	EH (cm)	C/P	L/P	TB/P	EG	EL (cm)	KR/E	K/R	HGW (g)	GY/ha (Kg)
Replications	2	0.88	0.29	123.65	28.32	0.024	1.188	10.501	0.005	0.027	1.510	46.984	1.723	8684.000
Genotypes	13	24.7**	22.3**	949.1**	120.3**	0.99*	2.21**	21.36**	0.03**	2.28**	3.81**	74.28**	6.80**	1992.0**
Error	26	0.99	0.88	36.04	19.29	0.357	0.565	10.458	0.003	0.044	0.392	32.572	1.256	1810.000

*, ** Significant at 5% and 1% probability levels respectively.

The variation among the genotypes was also highly significant for days to 50% silking. The coefficient of variance value for days to 50% silking was 1.34. Variety MTM-2 was the earliest one and took 65 days to silking whereas E-77 took the maximum days (73.3 days) for 50% silking. In the present study, days to 50% silking ranged between 65.0 to 73.3 days among varieties. These results were supported by Hussain *et al.* (2005) reported genetic variation among different maize population for days to 50% silking. They viewed that the differences in maturity among genotypes was due to genetic basis and reflection of weather pattern i.e. temperature, available soil moisture. However, Hussain *et al.* (2011) also claimed that maize genotypes at different locations showed an inconsistent behavior of female for days to 50% silking.

Genotype effect on plant height was highly significant the coefficient of variance for plant height was 3.34. The maize genotypes were significantly different from each other. Mean values indicated that the maximum plant height was observed in maize variety Islamabad Gold (203.6 cm.) fallowed by Azam (200.7 cm.) whereas the minimum plant height was showed by variety E-77 (135.27 cm.). These findings are also in line with those of Tahir *et al.* (2008) who reported that plant height is a genetically as well as environmentally controlled trait. The effect of genotype was highly significantly differences on ear height and the coefficient of variance value for ear height was 7.45. The difference among maize genotypes was significant and continues.

The variety Islamabad Gold showed maximum ear height (72.8cm.) followed by Margalla (72.7 cm.) while the minimum ear height was showed by variety MTM-2 (49.3), Jalal (51.9 cm) and Habib-2 (52 cm). These results are also in line with the previous studies of Ihsan *et al.* (2005) and Ullah *et al.* (2005).

Number of cobs plant[-1] showed significant differences among the maize genotypes. The coefficient of variance for number of cobs plant[-1] was 3.34. Mean values indicated that maximum number of cobs plant[-1] was observed in maize variety Jalal (2.0), Azam (2.0), and many other varieties except 1097 while minimum number of cobs plant[-1] was produced by variety 1097 (1.8). Nizam-ud-din *et al.* (2010) also reported a highly significant effect of genotypes on plant height. Analysis of variance for number of leaves plant[-1] was showed highly significant difference among the genotypes of maize and coefficient of variance value for number of leaves per plant was 5.9. The maximum number of leaves per plant was produced by variety Islamabad Gold (14.2) followed by E-77 (14.1) whereas the minimum number of leaves per plant (11.33) was showed by MTM-2. The findings were also in line with the study of Mehdi and Ahsan (2001). They also found significant effect of genotypes on number of leaves per plant. The effect of genotypes on number of tassels branches plant[-1] was highly significant. The difference among maize genotypes was significant for tassel branching per plant. The number of tassel branches per plant was ranging from 22.58 to 13.7.

The variety Soan-3 had the greatest tassel branches per plant (22.6) while the variety MTM-2 had the lowest number of tassel branches per plant. These results were supported by Yadav and Indra (2010). Ear girth showed highly significant differences among maize genotypes. Coefficient of variance value for ear girth was found 2.56. The varieties Azam and Jalal showed the maximum ear girth (2.0 cm²) while the variety Islamabad White showed minimum ear girth (1.7 cm²). In this study the ear girth ranged from 2.0 to 1.7 cm². Similar results were also obtained by Manuwar et al. (2013).As ear girth increases, kernels ear⁻¹ also increases which in turn increase the hundred grain weight. Therefore, selection for one or more of these characters would help the breeder to increase grain yield in maize. The main effect of genotype on ear length was found highly significant.

Table 2. Mean values for thirteen characters of maize genotypes.

Genotypes	DT	DS	PH	EH	C/P	L/P	TB/P	EG	EL	KR/E	K/R	HGW	GY/ha
E-77	70.7a	73.3a	203.7a	72.9a	2.0a	14.2a	22.6a	2.0a	18.3a	16.8a	40.5a	33.6a	7590.8a
Habib-1	70.3ab	73.0a	200.6a	72.0a	2.0a	14.1a	22.0a	2.0a	17.6b	16.3a	40.0ab	31.7b	7534.2a
1097	70.2b	72.7a	194.2abc	63.7bc	2.0a	13.8ab	21.1ab	1.9b	17.5b	14.4b	33.4bc	31.2bc	7530.8a
Soan-3	70.0ab	72.3ab	191.2bcd	63.5bc	2.0a	13.5abc	21.1ab	1.9b	17.3b	14.9b	33.1bc	31.4bc	7526.7ab
Islamabad Gold	69.0bc	71.0bc	187.6cd	63.4bc	2.0a	12.9abcd	21.1ab	1.8bc	17.6b	14.4b	38.3bc	31.0bcd	7457.5b
Margalla	67.7cd	70.3cd	185.3cde	59.7cd	2.0a	12.8bcd	19.7ab	1.8bc	17.4b	14.6b	35.4bc	30.8bcde	7308.3c
Habib-2	67.3d	70.3cd	182.3def	59.3cd	2.0a	12.8bcd	19.4abc	1.8bc	16.7c	14.8b	36.2bc	30.2bcde	7291.7c
7004	66.3de	69.0de	182.2defg	58.9cd	2.0a	12.7bcd	18.9abcd	1.8bcd	16.6cd	14.2bc	32.2bc	29.8cdef	7295.0c
Azam	66.3de	68.7e	177.3efgh	58.5cd	2.0a	12.5cdf	18.8abcd	1.8cde	16.5cd	14.1bcd	38.4bc	29.7cdef	7200.0d
Jalal	65.0ef	68.0ef	175.1fgh	57.1cd	2.0a	12.5cdf	18.7abcd	1.8cde	16.0de	14.1bcd	32.6bc	29.3def	7121.7e
Islamabad White	64.7f	67.7ef	172.1gh	53.7de	2.0a	12.1de	18.7abcd	1.8cde	16.0ef	13.2cde	35.3bc	29.0ef	6975.0f
Rakaposhi	63.7fg	67.0fg	167.9hi	52.0de	2.0a	12.0de	16.4bcd	1.7de	15.9fg	13.1de	34.3bc	28.5f	6931.7fg
MTM-2	62.9g	65.7gh	158.4i	51.9de	2.0a	11.9de	14.0cd	1.7de	15.6gh	12.6ef	30.6c	28.5f	6867.5gh
MTM-1	62.7g	65.0h	135.3j	49.3e	1.8b	11.3e	13.7d	1.7e	15.4h	11.9f	29.7c	28.4f	6849.2h
LSD	1.7	1.6	10.1	7.4	0.1	1.3	5.4	0.1	0.3	1.1	9.8	1.9	71.4

Note: DS: Days to 50% tasselling, DS: Days to 50% silking, PH: plant height, EH: ear height, C/P: no of cobs per plant, L/P: no of leaves per plant, TB/P: no tassel branches per plant, EG: ear girth, EL: ear length, KR/E: kernel rows per ear, K/R: kernels per row, HGW: 100-grain weight and GY/ha: grain yield per hectare.

The genotype 7004showed maximum ear length (18.3 cm) followed by Islamabad Gold (17.6cm) whereas Habib-2 showed the minimum ear length (15.4 cm). Our results are in conformity to the earlier findings of Ihsan et al. (2005) how claimed significant variation for ear length among maize hybrids. Kernel rows per ear showed that there were highly significant differences and coefficient of variance of kernel rows ear⁻¹ was 4.4. Azam (16.8) possessed the maximum number of kernel rows ear⁻¹ while the minimum number of kernel rows ear⁻¹was found in variety Habib-2 (11.9). These results were in line with Munawar et al. (2013) who claimed that number of kernel rows ear⁻¹ is a genetically controlled factor but environmental and nutritional level may also influence the number of kernel rows ear⁻¹. The more number of kernel rows per ear results in more grain yield. Analysis of variance reveled that there were highly significant differences among the genotypes of maize regarding number of grains per row. The coefficient of variance value for number of grains per row was 16.00. Maximum number of grains per row (40.5) was found in 7004 which differed significantly from all other genotypes except the genotype Soan-3. Minimum number of grains per row (29.7) was found in Habib-2.

The number of grains per row is polygenic characteristics and is influenced by environmental factors. Grain yield is directly related to number of grains per row.

The more number of grains per row results in more grain yield. Difference among the genotypes for 100-grain weight was highly significant.

Coefficient of variance value for 100-grain weight was 3.71. 100-grain weight is an important factor directly contributing to final grain yield of crop. Means values indicated highly significant results. There was a prominent effect of different genotypes on 100-grain weight. Maximum 100-grain weight (33.6 g) was recorded in Azam which differed significantly from all other genotypes. Minimum 100-grain weight (28.4 g) was found in Islamabad Gold. These results are also in accordance with those of Shahwani *et al.* (2001) who claimed that 100-grain weight is genetically controlled characteristics.

The data was statistically analyzed and highly significant difference was found among the maize genotypes for grain yield. Coefficient of variance value for grain yield was 0.59. Grain yield of a crop is the ultimate objective of all the research of grain crops. It is a factor which is related with many other factors such as number of cob per plant, number of row per cob, number of grains per row and 100-grain weight etc.

Hence an increase or decrease in any of the above factors may influence the crop yield Hussain *et al.* (2011). The LSD indicated that maize genotypes varied significantly for grain yield. Azam (7590.8 kg ha⁻¹), 7004 (7534.2 kg ha⁻¹), Habib-1 (7530.8 kg ha⁻¹) and Soan-3 (5227 kg ha⁻¹) were at par and produced the maximum grain yield. The minimum grain yield (6849.2 kg ha⁻¹) was obtained from MTM-1. More grain yield in Azam might be due to more number of cobs per plant and greater 100-grain weight.

These results are supported by the findings of Aziz *et al.* (1992), who reported significant differences among maize cultivars for grain yield. They also viewed that final grain yield is a join function of yield components.

Conclusions

Keeping in view the above discussion it is concluded that: Highly significant genetic variability among the test maize genotypes was observed for the characters studied.

Because of the presence of desirable genetic variability in the tested genotypes it is recommended to use in breeding program to develop new high yielding synthetic/hybrid varieties.

The maize genotype Azam produced highest grain yield under rainfed conditions Rawalakot and it is recommended for general cultivation under rainfed conditions of Rawalakot, Azad Jammu and Kashmir. Selection should be practiced for kernel rows/ear, ear girth, 100-grain weight and kernels/row to increase yield potential in maize varieties.

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