

## Genetic Diversity Analysis for Yield and Other Parameters in Maize (*Zea mays* L.) Genotypes

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**Abstract:** The experiment was conducted to estimate the genetic diversity in 14 different maize genotypes at Agricultural Research Station Baffa, Mansehra Pakistan. The experiment was laid out in RCBD with three replications. The results of analysis revealed that all the characters like days to 50% pollen shedding, days to 50% silking, plant height, ear height, 100 grain weight, harvest index and grain yield were significantly affected due to various maize genotypes. The days to 50% pollen shedding ranged from 43.00 to 53.33 showed by genotypes 24K42 and 2236, days to 50% silking from 46.67 to 55.67 days by genotypes 24K42 and 2234, plant height from 139.00 to 230.70 cm by genotypes 25K56 and KT304, ear height from 68.33 to 104.33 cm by genotypes 25K56 and 2236, 100 grain weight from 26.67 to 35.33 g by genotypes 24K42 and ND6876, harvest index from 0.311 to 0.461 by genotypes CKD933 and 2235 and grain yield from 5.35 to 12.51 kg/plot by genotypes 24K42 and ND6876, respectively. Evaluation revealed genotype ND6876 and genotype 2235 to be the most promising ones and their adaptation to the agro ecological condition of this area can bring a substantial increase in a maize grain yield.

**Key words:** Genetic diversity, genetic variations, maize yield parameters, seed yield

### INTRODUCTION

Maize (*Zea mays* L.), with a remarkable productive potential among the cereals, is the third important grain crop after wheat and rice and accounts for 4.8% of the total cropped area and 3.5% of the value of the agricultural output. In the year 2005-06 world area under maize crop was 147562 thousand ha with a production of 701273 thousand metric tones and average yield of 4752 kg/ha while in Pakistan this crop occupies 1042 thousand hectares with 3109.6 thousand tones production and 2984 kg/ha yield (Anonymous, 2005-06). Maize is a short duration crop and has a top priority in hilly areas, especially in northern parts of the country. It is grown in temperate, tropical and sub tropical areas and is used as grain as well as fodder crop. It is staple food and also used in breed making, corn flexes, corn syrup, corn starch and in food and textile industry. Important by product of maize is corn oil which is most suitable for human consumption due to low level of unsaturated fatty acids (Khan, 1982).

Increased production per unit area is primary objective of maize breeding programmes. Of these, the grain yield is the most important and complex trait as it is quantitatively inherited and as a result of different vital processes of entire plant such as photosynthesis, transpiration and storage of food materials (Naushad *et al.*, 2007). The production and utilization potential of

maize in the recent years is not only attracting the attention of research scientist but also evolving major national and international thrust with a view to providing solution to various problems of maize which include low seed yield (Kim, 1994). Maize display an orderly sequence of development of yield components namely number of cobs/plant, number of kernel rows, number of kernel/rows and kernel weight (Viola *et al.*, 2003). Thus, indirect selection can be used through searching for improved yield components (Welsh, 1981). Grain yield is considered to have positive correlation with plant height, and 1000-grain weight (Ajmal *et al.*, 2000) similarly days to silking showed positive correlation with grain yield/plant (Afzal *et al.*, 1997).

Genetic improvement in traits of economic importance along with maintaining sufficient amount of variability is always the desired objective in maize breeding programs (Hallauer and Scobs, 1973). To improve genetic diversity of local germplasm, it is important to know the extent of already existing genetic variability in the material. Genetic variability, which is a heritable difference among cultivars, is required in an appreciable level within a population to facilitate and sustain an effective long term plant breeding programme. To widen the genetic base, exogenous materials which are introduced from other regions abroad and have specific genetic background may play a great role to maximize heterosis. The analysis of genetic diversity provides maize

Table 1: Mean performances for various plant trait of maize genotypes planted at ARS Baffa, Mansehra

Genotypes	Days to 50%		Plant height (cm)	Ear height (cm)	100 grain wt (g)	Harvest Index	Grain Yield (kg/plot)
	pollen shedding	% silking					
CKD932	51.33 AB	55.00 A	154.33 C	102.70 A	29.67 CD	0.347 DE	9.031 BCDE
CKD933	48.33 DE	51.33 C	163.70 C	79.00 CD	28.33 DE	0.311 E	6.716 DEF
24K42	43.00 G	46.67 CD	161.70 C	70.67 D	26.67 E	0.371 CD	5.359 G
39K71	50.00 BCD	53.33 B	178.70 BC	79.00 CD	30.00 CD	0.354 CDE	8.925 BCDE
48K95	50.67 BC	53.67 AB	173.30 BC	83.33 BCD	29.33 CD	0.345 DE	7.752 BCDEF
25K56	46.00 F	49.33 C	139.00 D	68.33 D	30.33 CD	0.398 BCD	7.618 DEF
KT303	48.00 DEF	54.33 AB	158.67 C	92.67 ABC	29.00 DE	0.374 CD	9.532 BCD
KT304	49.00 CDE	51.33 C	230.70 A	90.00 ABC	30.33 CD	0.375 CD	9.549 BCD
2234	52.00 AB	55.67 A	173.30 BC	98.67 AB	29.00 DE	0.367 CDE	7.152 EFG
2235	51.00 BC	51.33 C	225.33 A	100.67 AB	34.67 A	0.461 A	11.910 A
2236	53.33 A	54.67 AB	227.00 A	104.33 A	32.00 BC	0.354 DE	6.554 FG
ND6339	48.00 DEF	51.33 C	185.30 B	86.00 ABCD	33.00 AB	0.426 ABC	9.637 BC
ND6340	48.33 DE	51.33 C	177.70 BC	81.33 BCD	30.33 CD	0.380 CD	9.716 B
ND6876	47.33 EF	49.67 C	224.30 A	98.00 AB	35.33 A	0.452 AB	12.51 A
LSD 0.05	1.95	1.83	17.95	16.14	2.351	0.53	1.730
CV %	2.4	2.3	5.2	10.9	4.6	7.4	11.7

Different letters showed significant while same letters showed non-significant variation at 0.05% probability level of LSD

breeder and researchers with useful information for germplasm preservation and the identification of group of inbred lines and other breeding materials that may be exploited by the production of highly heterotic hybrids.

Grzesiak (2001) observed considerable genotypic variability among various maize genotypes for different traits. Ihsan *et al.* (2005) also reported significant genetic differences for morphological parameter for maize genotypes. This variability is a key to crop improvement (Welsh, 1981). Abayi *et al.* (2004) observed significant genetic variation in important agronomic traits especially earliness to sufficiently justify the initiation of selection programme. The results of Jotshi *et al.* (1988), Alvarez and Lasa (1994), Lu *et al.* (1994) and Zhang *et al.* (1995) demonstrated the importance of quantifying genetic variability among maize cultivars grown in an area before initiation of breeding programme.

The study was conducted to determine the genetic variability among the different maize genotypes. The results from this investigation would serve as a guide to plant breeders to initiate an improvement programme.

## MATERIALS AND METHODS

The reported experiment was conducted at Agricultural Research Station, Baffa Mansehra. The experimental material comprised of 14 maize genotypes viz. CKD932, CKD933, 24K42, 39K71, 48K95, 25K56, KT303, KT304, 2234, 2235, 2236, ND6339, ND6340 and ND6876 obtained from National Agricultural Research Center (NARC), Islamabad. The genotypes were planted on 6th July 2008 in a well prepared soil under randomized complete block design with three replications. Plot size was kept as 5 m long with two rows having row to row distance of 75 cm. The crop was grown under normal conditions. Sowing was done with the help of hand drill. Six randomly selected plants were used to take the data from each plot of each replication. A basal dose of 140 kg

N and 60 kg P<sub>2</sub>O<sub>5</sub> in the form of diammonium phosphate (DAP and Urea) fertilizer was applied. Normal cultural practices for raising a successful crop were followed uniformly through out the experiment. Irrigation was applied at weekly intervals or as when needed. Data was recorded on days to 50% pollen shedding, days to 50% silking, plant height (cm), ear height (cm), 100 grain wt in gram, harvest index and yield kg per plot. The seed yield was measured as mature seed harvested and seed weight was recorded as weight of 100 randomly selected seeds from a bulk at each plot. The recorded data was then subjected to analysis of variance techniques appropriate for randomized complete block design. The planned mean comparisons were done to explain significant variation. For this purpose the significant data were further analyzed statistically using Least Significant Difference (LSD) test at 5% probability level to compare the differences among the genotype means (Steel and Torrie, 1984).

## RESULTS AND DISCUSSION

Means regarding different plant traits and their comparison are given in Table 1. The mean data indicated that maize genotypes differ significantly in days to 50% pollen shedding, days to 50% silking, plant height (cm), ear height (cm), yield kg/plot, 100 grain wt/g and harvest index.

The days to 50% pollen shedding ranged from 43.00 to 53.33 days. Maximum days to 50% pollen shedding were taken by genotypes 2236 (53.33 days) followed by 2234 (52.00 days) while 24K42 took the least periods (43.00 days) for days to 50% pollen shedding. Among other genotypes CKD932, 2235, 48K95, 39K71, the days to 50% pollen shedding were observed 51.33, 51.00, 50.67 and 50.00 days, respectively while genotypes 25K56, ND6876, ND6339 and KT303 took less time to shed 50% of their pollens for 46.00, 47.33 and 48.00 days, respectively. These results are in line with the finding of

Naushad *et al.* (2007), Olakojo and Olaoye (2005), Nazir *et al.* (2010), Salami *et al.* (2007), Zahid *et al.* (2004) and Akbar *et al.* (2008).

Similarly days to 50% silking were also found significant and showed variations ranged from 46.67 to 55.67 days. Genotype 24K42 was earlier (46.67 days) followed by 25K56 and ND6876 (49.33 and 49.67 days, respectively), whereas genotypes 2234 (55.67 days), CKD932 (55.00 days), 2236 (54.67 days) and KT303 (54.33 days) took the maximum duration to reach silking stage. While non significant variations were found among CKD933, 2235, KT304, ND6339 and ND6340 took 51.33 days to 50% silking. Similar results were also observed by Afzal *et al.* (1997), Shah and Deora (2002), Majid *et al.* (2010), Naushad *et al.* (2007), Olakojo and Olaoye (2005) and Nazir *et al.* (2010).

Plant height is an important trait in maize and usually positive correlated with more number of ears and yield. The present result revealed that height of plant was highly significantly affected due to various maize genotypes. The plant height ranged from 139.00 to 230.70 cm. The tallest plant were observed in KT304 (230.70 cm) followed by genotypes 2236, 2235 and ND6876 with the height of 227.00, 225.33 and 224.30 cm, respectively. The maize germplasms including 25K56, CKD932, KT303 and 24K42 were found short statured with height of 139.00, 154.33, 158.67 and 161.70 cm, respectively. Earlier reports of Nazir *et al.* (2010), Salami *et al.* (2007), Zahid *et al.* (2004) and Naushad *et al.* (2007) also showed highly significant variability in plant height in various maize genotypes.

Ear height is also the most desirable yield trait in maize and is an important factor to be considered during selection of desirable genotypes. The variations in ear height (cm) in present investigations were found to be highly significant due to divergent maize genotypes. The ear height ranged from 68.33 to 104.33 cm. The genotype 2236 with an ear height 104.33 cm remained significantly superior among all the 14 maize genotypes followed by CKD932 and 2235 with a 102.70 and 100.67 cm, respectively. The other genotypes KT303 (92.67 cm), KT304 (90.00 cm), ND6339 (86.00 cm), 48K95 (83.33 cm) and ND6340 (81.33 cm) showed average performance regarding ear height. All these germplasm were statistically at par with each other. These results get sufficient validation from the findings of Olakojo and Olaoye (2005), Nazir *et al.* (2010), Salami *et al.* (2007), Zahid *et al.* (2004) and Ajmal *et al.* (2000).

Grain weight is an important yield parameter and is vary from genotype to genotype. In the present study 100 grain weight (g) ranged from 26.67 to 35.33 g. ND6876 genotype showed maximum weight for 100 seeds (35.33 g) while 24K42 was noticed with minimum 100 grain weight (26.67 g). Similarly 2235 and ND6339 (34.67 and 33.00 g, respectively) were also recorded superior genotypes with high grain weight. Ihsan *et al.* (2005),

Ajmal *et al.* (2000) and Grzesiak (2001) reported the same results.

Harvest index is important yield parameters in various grain crops including maize. The more harvest index showed more grain yield over biological yield and vice versa. The variation in harvest index was highly significantly affected due to various maize genotypes. The ranged for harvest index was recorded from 0.311 to 0.461. The highest harvest index was noticed at genotype 2235 (0.461) followed by ND6876 (0.452) which remained superior among all others genotypes under study. Some other better but statistically uniform genotypes namely 24K42, KT303, KT304 and ND6340 were recorded with an average harvest index 0.371, 0.374, 0.375 and 0.380, respectively. The research work reported by White and Wilson (2006), Armen *et al.* (2007), Ajmal *et al.* (2000) and Nazir *et al.* (2010) regarding harvest index in maize and wheat is similar to the present investigation.

Grain yield being complex trait is highly influenced by various environmental factors including biotic and a biotic factors. It is also interplay of various morphological characters which either favor or worsen the final yield. Variation in yield shows a diverse genetic background of genotypes studied under these conditions. The possible reasons for the observed difference could be variation in their genetic make up. In present investigations grain yield in kg per plot was measured. Grain yield was found to be highly significantly different due to different maize genotypes. The line ND6876 superseded all the genotypes with highest yield of 12.51 kg/plot. It was closely followed by another high yielding line 2235 with grain yield of 11.91 kg/plot. These lines were statistically at par with some other high yielding lines including ND6340, ND6339, KT304 and KT303 with grain yield of 9.71, 9.63, 9.54 and 9.53 kg/plot, respectively. The genotypes 24K42 and CKD933 showed poor performance in this experiment producing only 5.35 and 6.71 kg of grain yield per plot respectively. It was further observed that the genotypes with highest grain weight produced higher yield. The two germplasms including ND6876 and 2235 remained superior in term of yield production as well as in other important yield components. It is, therefore suggested that these lines must be brought forward for testing across the various ecological zones of the country. The findings of Ajmal *et al.* (2000), Afzal *et al.* (1997), Grzesiak (2001), Naushad *et al.* (2007), Olakojo and Olaoye (2005), Nazir *et al.* (2010), Sokolov and Guzhva (1997) and Salami *et al.* (2007) are in accordance with these results.

## CONCLUSION

After estimating the genetic diversity of 14 different maize genotypes, it is concluded that the two lines ND6876 and 2235 remained superior in term of yield production as well as in other important yield

components. It is, therefore suggested that these lines must be brought forward for testing across the various ecological zones of the country.

#### ACKNOWLEDGMENT

The National Agricultural Research Center (NARC), Islamabad is highly acknowledged for providing the maize germplasm seeds used for the experiment. Officers and technical staff of Agricultural Research Station Baffa, Mansehra are also acknowledged for their valuable support and crucial assistance.

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