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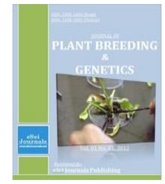

GENETIC VARIABILITY ANALYSIS FOR GROWTH AND YIELD PARAMETERS IN DOUBLE CROSS MAIZE (*ZEA MAYS* L.) GENOTYPES IN KITALE COUNTY OF KENYA

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A B S T R A C T

Present study was conducted to select hybrids with improved yield, to identify testers for grain yield and to determine the magnitude of genetic variability in maize hybrids for yield and its elements. Adaptability of double cross hybrids was studied under varying agro-climatic conditions of parts of Western Kenya. Seventeen experimental hybrids and one commercial maize variety (standard) were planted in a 6x6 balanced lattice design with three replicates. Physiological and agronomic traits were observed and recorded from germination to maturity. Collected data was subjected to analysis of variance (ANOVA) using the general linear model SAS. The results showed that ear height ranged between 169.0 and 214.0 cm showed by genotype (95xF)x(50x82) and (95x8)x(50x16) respectively. The plant height ranged between 309.0 and 330.7 cm showed by genotype (44xA)x(50x93) and (44xA)x(82x93) respectively, grain weight ranged between 253.3 and 441.7 g showed by genotype (44xA)x(82x93) and (64x8)x(82x93) respectively, rows per cob ranged between 12.3 and 13.9 showed by genotype (95xF)x(82x16) and (Fx82)x(93x16) respectively. Grains per row ranged between 34.3 and 42.1 which was shown by genotype (AxF) x (50x82) and (95x8)x(50x16) respectively, the cob length ranged between 19.6 cm and 23.4 cm shown by genotype (56x44)x(50x93) and (95x8)x(50x16) respectively and the grain yield ranged between 5.2 and 12.8 t/ha produced by genotypes (95xF)x(82x16) and (56x44)x(50x16) respectively. Evaluating the various results revealed that genotype (56x44)x(50x16) and (95x8)x(50x16) were the most promising and their adaptation to the agro-ecological condition to this area can bring a substantial increase in maize grain yield.

Keywords: Genetic variation, genotype, yield parameters, maize.

INTRODUCTION

Maize (*Zea mays* L.), is an important cereal crop, cultivated throughout the world. It has significant importance for countries like Kenya, where rapid increase in population has already outstripped the available food supplies. Maize is the third important grain crop, after wheat and rice, accounting for 4.8% of the value of agricultural output in the world. In the year 2005-2006, world area under maize crop was 147,562 thousand hectares with a production of 701,273 thousand metric tones and average yield of 4.752 t/ha. In Kenya this crop occupies 1,600,000 hectares with an average production estimated at 2.8 million metric tones giving a national mean yield of 1.7 metric tones per hectare (FAO, 2006). Maize is a short duration crop that is grown in highlands of Western Part of Kenya. Increased production per unit area is the primary objective of maize breeding programs around the world. Grain yield is the most important and complex trait as it is quantitatively inherited and is a result of different vital processes such as photosynthesis, transpiration and storage of food materials (Naushad *et al.,* 2007). Production and utilization potential of maize in the recent years is not only attracting the attention of research scientists but also involving major national and international thrust with a view to providing solution to various problems of maize which include low seed yield (Kim, 1994). Maize displays an orderly sequence of development of yield components namely;

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number of cobs/plant, number of kernel rows, number of kernels/row and kernel weight (Viola *et al.,* 2003). Thus, indirect selection can be used through searching for improved yield components (Ajmal *et al*., 2000). 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 at the same time is always the desired objective in maize breeding programs (Hallauer and Scobs, 1973). 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 program. Exogenous materials which are introduced from other regions abroad and have specific genetic makeup may play a great role in maximizing heterosis. The analysis of genetic diversity provides breeders 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 parameters for maize genotypes. Abayi *et al*. (2004) observed significant genetic variation in important agronomic traits especially earliness to sufficiently justify the initiation of selection program. The results from previous workers e.g. (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 a breeding program. The study was conducted to determine the genetic variability among the different maize genotypes in Kitale county of Kenya. The results from this study may serve as a guide to breeders in initiating a maize improvement program.

MATERIALS AND METHODS

The reported experiment was conducted at Kenya Agricultural Research Institute, Kitale, Kenya. The experimental materials comprised 17 double cross maize genotypes namely; (56x44)x(50x93), (95x64)x(82x93), (44xA)x(50x93), (95xF)x(82x16), (95x8)x(50x16), (56x44)x(50x16), (95xF)x(82x93), (AxF)x(50x82), (95x8)x(93x16), (Fx82)x(93x16), (95xF)x(50x82), (44x56)x(50x16), (44xF)x(82x93), (64x8)x(82x93), (44x56)x(82x93), (44xA)x(82x93) and H6213 obtained from Kenya highlands Maize Breeding programme in 2009. The genotypes were planted on 9th April 2009 in well prepared soils under a 6x6 balanced lattice design with three replications. Plots consisted of 3 rows of 11 hills at a spacing of 0.75 m inter row and 0.30 m between hills. The crop was grown under natural field conditions. A compound fertilizer, Diammonium phosphate (DAP) was applied at the recommended rate of 80 Kg P_2O_5 and 80 Kg N per hectare at planting. Normal cultural practices for raising a successful crop were followed uniformly throughout the experiment. Data was recorded on ear height, plant height, seeds per row, rows per cob, cob length, cob width, 1000-grain weight and yield in tones per hectare. Mature seeds were harvested and grain weight was recorded from 100 randomly selected grains from a bulk at each plot and multiplied by a coefficient of 10 for yield estimation. The recorded data was then subjected to analysis of variance techniques appropriate for 6x6 balanced lattice designs. The planned mean comparisons were done to explain significant variation. The significant data were further analyzed statistically using least significance difference (LSD) test at 5% probability level to compare the differences among the genotype means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Different maize traits and their comparison are given in Table 1. Study of mean data indicated that maize genotypes differed significantly in ear height (cm), plant height (cm), 1000-grain weight (g), rows per cob, grains per row, cob length (cm) and grain yield (t/ha). The variations in ear height in the present study were found to be highly significant probably due to divergent maize genotypes. The ear height ranged between 169.0 cm to 214.0 cm. The highest ear height were shown by genotype (95x8)x(50x16) (214.0 cm) followed by genotype (56x44)x(50x16) (213.3 cm) while genotype (95xF)x(50x82) showed the least ear height (169.0 cm). The other genotypes showed average performance regarding ear height. These results are similar to those from the findings of (Olakojo and Olaoye, 2005; Nazir *et al*., 2010; Salami *et al*., 2007 and Zahid *et al*., 2004). The present study showed that height of plants significantly differed among different maize genotypes. The plant height ranged from 309.0 cm to 330.7 cm. The tallest plant was observed in genotype (44xA)x(82x93)

(330.7cm) followed by genotype (Fx82)x(93x16), (95xF)x(50x82) and (AxF) (50x82) with 327.8, 324.8 and 323.7 cm respectively. The maize germplasm including genotypes (44xA)x(50x93), H6213 and (44xF)x(82x93) were found to be of short stature with height of 309.0 cm, 309.3 cm and 310.7 cm respectively. Earlier reports of (Naushad *et al*., 2007; Nazir *et al*., 2010; Salami *et al*., 2007 and Zahid *et al*., 2004), also showed highly significant variability in plant height in various maize genotypes. Grain weight is an important yield parameter that varies from genotype to genotype. In the present study 1000-grain weight (g) ranged from 253.3 g to 441.7 g. Genotype (56x44) x (50x16) showed the maximum weight of 1000-grains (441.7 g) while genotype (44xA) x (82x93) was found to have minimum 1000-grain weight (253.3g). Similarly, genotypes (95x8) x (93x16) and (AxF) (50x82) had 426.7 g and 385.7 g respectively. They also recorded superior genotypes with high grain weight. Ajmal *et al*., (2000), Grzesiak, (2001) and Ihsan *et al*. (2005) reported similar results when working with other genotypes. Data on rows per cob as in Table 1 showed that the tested genotypes differed significantly for grain wheight. Among the tested genotype (Fx82)x(93x16), (44x56)x(50x16) and (64x8)x(82x93) all had highest number of rows per cob of 13.9, while the minimum number was shown by genotype (95xF)x(82x16) with a mean of 12.3. The number of grains per row varied significantly with genotype (95x8)x(50x16) producing maximum number of grains per row (42.1), followed by genotype H6213 (40.9). Genotype (44xA)x(50x93) also produced 40.9 grains per row.

Table 1: Mean performance for various plant traits of maize genotypes planted at KARI Kitale Station.

Genotype	Ear height (cm)	Plant height (cm)	1000-grain wt (g)	Rows per cob	grain s/row	Cob length (cm)	Yield (t/ha)
(56x44)x(50x93)	208.0a	319.0ab	311.0cdef	12.6bc	36.7abc	19.6d	5.3g
(95x64)x(82x93)	211.3a	319.7ab	372.1abcd	13.3abc	37.1abc	22.1abc	8.9bcde
(44xA)x(50x93)	199.3ab	309.0b	345.7bcde	13.7ab	40.9a	21.5abcd	7.6def
(95xF)x(82x16)	208.7a	319.3ab	270.7ef	12.3c	39.1abc	22.1abc	5.2g
(95x8)x(50x16)	214.0a	317.0ab	344.7bcde	13.7ab	42.1a	23.4a	11.9a
(56x44)x(50x16)	213.3a	322.7ab	441.7a	13.7ab	40.7ab	22.5abc	12.8a
64xFx $R_{12}C_{11}$	209.7a	322.7ab	260.7ef	13.1abc	39.1abc	21.8abcd	9.5bcd
(AxF) (50x82)	204.3a	323.7ab	385.7abc	12.9abc	34.3c	22.2abc	9.7b
(95x8)x(93x16)	203.7a	315.0ab	426.7ab	12.7abc	38.8abc	23.1ab	9.6bcd
(Fx82)x(93x16)	211.3a	327.8ab	362.7abcd	13.9a	34.7bc	21.7abcd	9.0bcde
(95xF)x(50x82)	169.0ab	324.7ab	346.5bcde	12.7abc	36.6abc	22.0abc	9.1bcde
(44x56)x(50x16)	213.3a	314.3ab	330.5cdef	13.9a	39.1abc	22.7abc	6.6fg
(44xF)x(82x93)	205.3a	310.7ab	285.3efd	13.3abc	36.7abc	20.9bcd	7.2efg
(64x8)x(82x93)	192.7ab	322.0ab	335.8cdef	13.9a	38.2abc	22.2abc	6.7def
(44x56)x(82x93)	205.7a	322.3ab	362.9abcd	13.1abc	38.5abc	22.2abc	9.6bc
(44xA)x(82x93)	205.7a	330.7a	253.3f	12.9abc	40.2abc	20.8cd	5.4g
H6213 Standard	197.7ab	309.3b	309.6cdef	13.2abc	40.9a	20.7cd	6.5fg
LSD	**33.2**	**20.3**	**18.6**	**1.16**	**6.09**	**2.27**	**1.80**
CV%	**10.5**	**10.5**	**13.5**	**5.3**	**13.2**	**11.6**	**11.7**

Different letters on the same column showed significant difference while same letters showed non-significant difference at 0.05% probability level of Least Significant Difference.

Data on cob length in Table 1 also showed that the tested genotypes differed significantly. Among the tested genotypes, genotype (95x8)x(50x16) had maximum cob length (23.4cm) followed by genotype (95x8)x(93x16) with (23.1 cm) while genotype (56x44)x(50x93) showed minimum cob length of 19.6 cm. Grain yield being a complex trait is highly influenced by various environmental factors including biotic and abiotic factors. Variation in yield shows a diverse genetic makeup of genotypes studied under the conditions. The possible reasons for the observed differences could be variations in their genetic makeup. In the present study, grain yield in tones per hectare was measured. Grain yield was found to be significantly different due to different maize genotypes. Genotype (56x44) x (50x16) had the highest yield of 12.8 t/ha. It was closely followed by genotype (95x8) x (50x16) with grain yield of 11.9 t/ha. Genotypes (95xF) x (82x16) and (56x44) x (50x93) showed poor performance in this experiment producing only 5.2 and 5.3 t/ha respectively. It was further observed that the genotypes with the highest grain weight produced high grain yield. Two genotypes (56x44) x (50x16) and (95x8) x (50x16) remained superior in terms of yield production as well as in other important yield components. It is therefore suggested that these two lines could be recommended for testing across the various ecological zones of the country. The findings of Naushad *et al*. (2007), Ajmal *et al*. (2000), Afzal *et al*. (1997), Grzesiak, (2001), Olakojo and Olaoye (2005), Nazir *et al*. (2010) and Salami *et al*. (2007) are in accordance with these results though having studied other genotypes.

CONCLUSION

After analyzing the genetic diversity and variability of 17 different maize germplasm, it is concluded that the two genotypes (56x44) x (50x16) and (95x8) x 50x16) remained superior in terms of yield production as well as in other important attributes related to yield. It is therefore recommended that these genotypes can be brought forward to evaluate the yield constituency in various ecological zones across the country.

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