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Full Length Research Article

Comparative study of different agronomic traits of maize (*Zea mays* L.) genotypes.

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Abstract

Suitable genotypes are very important to explore the potential benefits of different cultivars and to make pace with the seasonal environmental and climatic fluctuations as well. An experiment was laid out to investigate the performance of different maize spring genotypes against agronomic traits under the prevailing conditions of Faisalabad at Agronomic Research Area, University of Agriculture Faisalabad during spring, 2016. This study was carried out by using randomized complete block design with three replications. Different maize genotypes were collected from different national and international companies and allowed to grow till maturity. The standard procedures were followed to collect different morphological, yield and yield contributing traits i.e. plant population per square meter, cob length (cm), plant height (cm), number of grains per cob, 1000-grain weight (g), grain yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%).Data were analyzed by Fisher's analysis and treatments' means were compared by using Least Significant Difference (LSD) test at 5% probability level. Results indicated that maximum plant height (225.43 cm), cob length (20.39 cm), number of grains/cob (456.48), 1000-grain weight (266.57 g), biological yield (19.33 t ha^{-1}) and grain yield (11.37 t ha^{-1}) were obtained by the genotype FH-922

Keywords: Agronomic traits, maize, genotypes, spring season.

Introduction

Maize is one of the most valued cereals which are grown across the globe. It is source of edible grain. Maize is ranked among the top 10 staple foods in the world and consumed by millions of people on daily basis. Being a multi-purpose crop, it is used as staple food, feed for cattle and raw material for industries (Bibi *et al*., 2012). Being a vital grain, it is established everywhere throughout the world in both artificially irrigated and in rainfed areas (Ashraf and Hafeez, 2004). Grain of maize has many vital vitamins and minerals including, protein 10.4% and starch 71.8% (Shah, 2007). Worldwide, total maize cultivated areas is about 178.59 million ha and production are about 1008.52 million metric tons (World Agriculture Production, 2017). Maize is a not a photoperiod dependent crop and it can be grown all over the year (Verma, 2011). In Pakistan, maize is broadly sown most of the tropical, sub-tropical and temperate zones (Buriro *et al*., 2015). Maize have short life duration and it is a C4 plant which means they are efficient in hot, arid climate of Pakistan. Maize crop has gained much attentions in the under developed countries including Pakistan due to its brief duration and good economic value (Okwu and Ukanwa, 2007). Maize contributes 0.5% in GDP and was grown on almost 1,229 thousand ha in 2017-18 which shows 8.8 % decrease in total cultivated area under maize in Pakistan (Govt. of Pakistan., 2017). The capacity of our current assortments of agricultural practices is providing us lower yield levels. The capability of our current varieties is much lower at present yield level due to the selection of improper cultivars under a given set of conditions, lacking good quality and quantity of water supply and weed invasion. Improved genotypes not only promote healthy plant growth but also it increases the maize grain yield, and their tolerance against adverse factors additionally gives higher yield per unit area when compared with accustomed genotypes of maize (Abbas, 2001). Nevertheless, of higher proficiency of available genotypes, per unit area yield of maize is much lesser in Pakistan as compared with other countries (Batsmanova *et al*., 2013). A mammoth amount starch is gained by the grain of maize which is used as a part of the preparation of glues, papers, nourishment substances, apparel, pharmaceutical tablets, utilized as sweeteners in desserts, beverages, jams and edible kitchen items. On mechanical premise the crop maize is also used for delivering corn protein, corn sugar, corn syrup, corn oil and maize flack and so forth (Minfal, 2009). In Pakistan the sowing of maize is done on 1,229 thousand hectare and its yield is million tons (Govt. of Pak. 2017). Maize crop provides cover which is utilized for hominoid sustain.

If we want to enjoy productive generation of maize it counts on different government strategies and additionally identified with condition that influences execution of product (Echart, 2003). The Choice of suitable genotypes and the plant concentrations are the social performs which have incredible impact on capability of the production in maize and also its stability (Norwood, 2001). Small term crossovers in maize can impact the development and also production of corn. It may become right on time without the danger of penalties for the greatest ability of yield of half breeds. It may likewise diminish the danger of receiving juvenile cobs and furthermore push to the open door for re-spreading of the products (Hicks *et al*, 1993). Year after year change in plant genetic code, ailment and irritation administration makes issue to forecast the ideal dispersion for the maize genotypes (Oktem, 2000). An experiment was designed and carried out in Faisalabad region to explore the full genetic potential of different maize genotypes under same set of environments for their different morphological and agronomic characters.

Material and Methods

This experiment was laid out in spring 2016 at Agronomic Research area, Department of Agronomy, University of Agriculture, Faisalabad. Different soil samples were collected to a depth of 30 cm. Soil samples were analyzed from soil sampling lab of Ayub Agricultural Research Institute (AARI) for different soil physiochemical properties given in (Table 1). A total number of 33 of maize genotypes were acquired from different public and private companies (Table 2). The research trial was organized in Randomized Complete Block Design (RCBD) and plot size was 3 m × 6 m with three replications.

Seeds were sown by dibbling method while maintaining P×P and R×R distance 25 cm and 75 cm respectively by using seed rate of 25 kg per hectare. Recommended amount of nitrogen, phosphorus and potassium (N 250, P 125, and K 125 kg per hectare) was used and sources of nitrogen, phosphorous and potassium was urea, DAP and SOP respectively. All P and K and half of the nitrogen was applied at sowing while remaining half nitrogen was applied in two splits (at knee height and at flowering stage). Different effective methods were adopted to control the weeds, insects, pests and other pathogens during the growing season of crop under study. Plants were sun dried after harvesting when crop was fully matured, and grains were ripened during the 3rd week of May 2016. Cobs were detached manually for easy shelling and sun dried to minimized moisture content and after some time grains was separated from pith.

Agronomic parameters that were recorded are plant population (m^{-2}), cob length (cm), plant height (cm), number of grains per cob, 1000-grain weight (g), grain yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%). For recording parameters like Cob length (cm), Number of grains per cob, 1000-Grain weight (g) 10 cob samples were measured from each treatment according to parameter in hand then average was taken and for parameters like Plant Population, Plant height (cm), Grain Yield (t ha^{-1}), Biological Yield (t ha^{-1}) plants were taken per meter square from each treatment at the harvesting then measured according parameter under study and for harvest index following formula was used:

$$\text{H.I} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Fisher's analysis of variance technique was used to analyze the data. LSD (Least Significance Difference) test at 5% probability level was used to compare treatment's means (Steel *et al.,* 1997).

Results

Data concerning the plant population per square meter of different maize genotypes was non-significant result which was due to thinning, gap filling and by maintaining planting density (Table 4). Results were equivalent with Akram *et al.* (2010) who described that the genotypes had no noteworthy influence on plant population. The evaluation of specific treatments means indicates that maximum plant height (225.97 cm) was observed with YH-1898. However, it was statistically at par with FH-922 (225.43 cm), DK-6142 (225.33 cm), FH-1046 (224.47 cm), NK-8711 (223.20 cm), Pioneer-1543 (221.30 cm) and L-52 (209.47 cm). While minimum plant height (146.43 cm) was observed with Soneri (146.43 cm). The assessment of specific treatments means indicates that as respect to the different hybrids, the supreme value for cob length maximum (21.40 cm) was observed for NK-8711. However, it was statistically at par with DK-6142 (20.99 cm), FH-922 (20.39 cm). While shortest cob length (18.78 cm) was observed for Ageti-2000. The contrast of specific treatments means indicates that supreme number of grains per cob (463.79) was observed for DK-6142. However, it was statistically at par with FH-1046 (463.12), NK-8711 (455.81), FH-922 (456.48), FH-988 (457.20), FH-949 (452.16) and L-18 (448.50). While lowest number of grains per cob (292.76) were observed in Soneri which was statistically at par with genotype Golden (307.5) and Sultan (310.41) and genotypes with the supreme. While smallest 1000 grain weight (215.50 g) was observed in Soneri which was statistically at par with genotype Golden (217.63 g), Sultan (220.21 g), MMRI (Yellow) (220.40 g), FH-1046 (222.88 g), FH-988 (223.57 g) and Ageti-2002 (224.00 g). Results showed that supreme grain yield (11.35 t ha^{-1}) was observed for FH-922. While minimum grain yield (5.14 t ha^{-1}) was observed in Sultan which was statistically at similar with genotype Soneri (5.50 t ha^{-1}). The assessment of specific treatments means Table 2 indicates that highest biological yield (19.33 t ha^{-1}) was observed for FH-922. While smallest biological yield (10.21 t ha^{-1}) was observed in Sadaf. The evaluation of specific treatments means indicates that supreme harvest index (19.323%) was observed for FH-922. While smallest harvest index (10.203%) was observed in Sadaf.

Discussion

Plant population is the important agro-morphological attribute of crop plant and usually it displays the comparative development and potency of crop plant. It is an important meter of green area, additional plant population will harvest more green part thus extra photosynthetic movement which will be common to scrap yield. Plant height is one of the most important traits to gain high yield as frequently healthy or taller plant surrounds more cobs and also finally gives additional biological and grain yield also. Growth in plant height was mainly due to the genetic difference of the genotypes. These biological processes tends to play main character in cell partition, cell development and increase of ultimately affect the overall vegetation growth of maize. On the subject of maize genotypes, highly significant effect on the plant height might be due to the genetic variation of these genotypes. Selection of suitable cultivar completes the effect of the environment. Abdullah *et al*. (2003) and Ali *et al*. (2004) also recorded significant differences for the plant height in crop maize. In crop maize, cob length and cob diameter are imperative yield contributing parameters because it influences the number of grains per cob, grain size and subsequently to grain yield. The finding explained maximum cob height or length is accredited with in good physical shape vegetative development for appropriate cob development. Mullen *et al*., (2010) and Baligar *et al*, (2013) also recorded significant variations in cob length. It was observed that genotypes produced more cob length compared to local cultivars. These results are also in covenant with the conclusions of Salami *et al*., (2007). 1000 grains mass is the most imperative yield contributing factor which can give approximations for the grain harvest of any of the crop. The growth in 1000 grain heaviness in the genotype strength can be due to the purpose that they are an outstanding foundation of the inheritable factor and that's why that there is a significant conclusion of maize genotypes on 1000 grain weight. So it was recommended from the exceeding effects that maize hybrids performed much better compared to cultivars. Racez *et al*. (2003) and Ahmad *et al*., (2005 also conveyed that maize hybrids produced higher yield as compared with local varieties and cultivars. Probable clarification for growth in grain yield maybe developed due to the increase in 1000 grain weight, cob length from the same behavior YH-1898 together with the conclusion of most prominent genotype. Similar results also obtained by Norwood (2001) who reported that yield of maize increased with the use of synthetic variety and composite variety. Grain potential is also the most significant criterion which is measured by genotype and the environmental features. The possible reason for the observed differences for all the traits recorded could be because of variation in the genetic makeup of the studied genotypes. In support of this finding, different researchers have reported significant amount of variability in different maize genotypes studied. Grzesiak (2001) observed considerable genotypic variability among various maize genotypes for different traits. Significant genetic differences for morphological parameter for maize genotypes were also reported [10]. Ullah *et al.* (2010) and Norwood (2001), also described substantial differences for the biological and grain yield of different maize genotype. Neilson *et al.* (2002), Adetayo *et al.* (2008) also described same results that local cultivars produced more yield as compared with other genotypes.

Conclusion

The present study was designed to evaluate different agronomic traits of maize genotypes. Results showed that all the genotypes differed significantly for traits. Maximum plant height (225.97 cm) was observed with YH-1898. While minimum plant height was observed with Soneri (146.43 cm). Maximum 1000-grain weight (266.57 g) was observed for FH-922 and minimum (215.50 g) from Soneri. All the check genotype the maximum number of grains per cob (463.79) was observed for DK-6142, but minimum (292.76) were observed in Soneri and Harvest index was maximum (19.323%) was observed for FH-922, and minimum (10.203%) was observed in Sadaf, The maximum biological yield (19.33 t ha^{-1}) was observed for FH-922 and minimum (10.21 t ha^{-1}) was observed in Sadaf. The maximum grain yield (11.35 t ha^{-1}) was observed for FH-922. The grain yield of maize was minimum (5.14 t ha^{-1}) was observed in Sultan.The supreme value for cob length maximum (21.40 cm) was observed for NK-8711 which was statistically at par with DK-6142 (20.99 cm), FH-922 (20.39 cm). While smallest cob length (18.78 cm) was observed in Ageti-2000. It was concluded that overall performance of hybrids was better than maize genotypes when planted in conditions of Faisalabad, among genotypes FH-922 performed better than others.

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Table No.1. Soil physicochemical Analysis

	Determination	Unit	Value
a.	**Physical Analysis**		
	Sand	Percentage	46
	Silt	Percentage	39
	Clay	Percentage	15
	Texture class	Loamy soil	
b.	**Chemical Analysis**		
	Saturation	Percentage	32
	pH		7.69
	EC	dSm^{-1}	2.09
	Organic matter	Percentage	0.57
	Nitrogen	Percentage	0.042
	Phosphorus	ppm	6.68
	Potassium	ppm	182.9

Table 2: The research trial was contained of the following treatments

Treatments	Varieties
T_1	Faisalabad 949 (Hybrid)
T_2	Faisalabad 988 (Hybrid)
T_3	Faisalabad 1046 (Hybrid)
T_4	Faisalabad 922 (Hybrid)
T_5	Yousafwala (Hybrid)
T_6	Pioneer 1543 (Hybrid)
T_7	Pearl
T_8	Sahiwal 2002
T_9	Sadaf
T_{10}	NK 8711(Syngenta)
T_{11}	Yousafwala 1898 (Hybrid)
T_{12}	Jalandhar Private Limited 2066
T_{13}	MMRI (Yellow)
T_{14}	Ageti 2002
T_{15}	Pak Afgoi
T_{16}	L45
T_{17}	L52
T_{18}	L18
T_{19}	L63
T_{20}	L39
T_{21}	Ev 1089
T_{22}	Ev 5089
T_{23}	Ev 6089
T_{24}	Iz Population
T_{25}	Agati 2000
T_{26}	Agati 85
T_{27}	Sultan
T_{28}	Soneri
T_{29}	Golden
T_{30}	Malka
T_{31}	M6525
T_{32}	M6130
T_{33}	DK6142

Table 3. Mean sum of square for varieties on different yield related traits in maize

Parameters	**Source of Variation**	
	Variety (V)	**Error**
Plant population	4.277^{NS}	4.589
Plant height	0.3711^{*}	0.1816
Cob length	453.13^{*}	130.31
Number of grains per cob	257889^{*}	292049
1000-grain weight	572.332^{*}	52.435
Grain yield	0.039^{*}	0.018
Biological yield	13.3976^{*}	4.6177
Harvest index	13.638^{*}	3.101

Where:
* = Significant, NS = Non-significant

Table 4: Comparison of individual treatment's means for Plant parameters under study

Genotypes	Plant population (m^{-2})	Plant height (cm)	Cob length (cm)	No. of grains per cob	1000-grain weight (g)	Grain yield (t/ha)	Biological yield (t/ha)	**Harvest** index (%)
FH-949	5.33 A	158.36 HI	20.60 GH	452.16 AB	238.71	10.11 CD	16.52 ABC	16.51 ABCDE
FH-988	5.33 A	189.93 CDEF	20.60 GH	457.20 AB	223.57 MNO	10.18 C	18.22 AB	18.20 ABC
FH-1046	5.33 A	224.47 AB	20.63 FGH	463.12 A	222.88 MNO	10.23 B	18.66 AB	18.63 AB
FH-922	5.33 A	225.43 A	20.39 A	456.48 AB	266.57 A	11.35 A	19.33 A	19.32 A
YH	5.33 A	199.63 CDE	20.50 H	393.13 FGHIJK	227.63 KLMN	8.32 JK	12.18 BC	14.41 ABCDEF
Pioneer-1543	5.33 A	221.30 AB	20.78 DEF	457.26 AB	238.77 GHIJ	10.63 B	15.69 ABC	15.64 ABCDEF
Pearl	5.33 A	175.25 FGH	20.80 CDE	364.46 KLM	234.05 IJK	7.13 O	16.70 ABC	16.67 ABCDE
Sahiwal-2002	5.33 A	152.57 I	19.33 NO	420.30 CDEF	26I.57 B	9.19 FG	17.83 AB	17.80 ABCD
Sadaf	5.33 A	175.93 FGH	20.75 DEF	371.42 IJKLM	232.70 IJKL	7.16 O	10.21 C	10.20 F
NK-8711	5.33 A	223.20 AB	21.40 A	455.81 AB	251.59 CDE	10.29 BC	12.42 ABC	12.38 DEF
YH-1898	5.33 A	225.97 A	20.83 CD	400.49 EFGHI	244.22 EFGH	8.84 GH	13.83 ABC	13.78 ABCDEF
JPL-2066	5.33 A	174.47 FGH	20.65 EFG	413.80 DEFG	226.89 KLMN	8.84 GH	14.73 ABC	14.70 ABCDEF
MMRI (Yellow)	5.33 A	153.77 I	20.78 DEF	420.59 CDEF	220.40 NO	8.86 FG	13.78 ABC	14.78 ABCDEF
Ageti-2002	5.33 A	189.54 CDEF	19.71 IJ	396.00 FGHIJ	224.00 LMNO	7.60 MN	15.20 ABC	13.65 ABCDEF
Pak Afgoi	5.33 A	187.73 DEF	19.51 KLM	365.9 JKLM	230.09 JKLM	8.54 HIJ	16.04 ABC	15.47 ABCDEF
L-45	5.33 A	176.87 FGH	20.59 GH	375.69 HIJKLM	238.40 GHIJ	8.09 KL	14.25 ABC	13.49 BCDEF
L-52	5.33 A	209.47 ABC	20.58 GH	401.18 EFGHI	241.39 FGHI	8.79 GHI	15.14 ABC	16.87 ABCDE
L-18	5.33 A	199.60 CDE	19.39 MNO	448.50 ABC	243.52 EFGH	9.36 EF	15.45 ABC	13.76 ABCDEF
L-63	5.33 A	186.63 DEF	19.44 LMN	348.50 M	246.20 DEFG	8.29 JK	15.43 ABC	12.74 CDEF
L-39	5.33 A	204.58 BCD	19.57 JKL	356.21	234.03 IJK	7.79 LM	12.92 ABC	14.46 ABCDEF
Ev1089	5.33 A	183.93 EFGH	18.36 Q	382.13 HIJKL	257.37 BC	9.69 DE	13.71 ABC	13.07 BCDEF
Ev-5089	5.33 A	187.63 DEF	19.26 O	402.96 DEFGH	236.56 HIJ	8.34 JK	12.33 BC	12.96 BCDEF
Ev-6089	5.33 A	193.03 CDEF	19.78 I	433.93 ABCD	241.15 FGHI	9.37 EF	16.02 ABC	13.94 ABCDEF
Iz Population	5.33 A	181.87 EFG	19.65 IJK	448.22 ABC	239.62 GHI	7.64 M	17.86 AB	16.08 ABCDE
Agati-2000	5.33 A	147.70 I	18.78 O	427.64 BCDE	239.17 GHIJ	7.08 O	17.35 AB	17.14 ABCDE
Agati-85	5.33 A	148.95 I	19.60 JK	350.44 M	240.09 FGHI	7.42 MNO	14.27 ABC	12.30 DEF
Sultan	5.33 A	149.91 I	19.56 JKL	310.41 N	220.21 NO	5.14 Q	6.183ABC	12.02 EF
Soneri	5.33 A	146.43 I	19.62 JK	292.76 N	215.50 O	5.50 Q	13.84 ABC	12.41 DEF
Golden	5.33 A	150.83 I	19.64 IJK	307.05 N	217.63 O	6.23 P	14.68 ABC	12.95 BCDEF
Malka	5.33 A	187.50 DEF	20.50 H	288.37 GHIJK	243.97 EFG	8.37 IJK	13.42 ABC	12.88 CDEF
M-6525	5.33 A	193.40 CDEF	20.52 GH	369.0 JKLM	236.78 HIJ	7.21 NO	12.93 ABC	13.93 ABCDEF
M-6103	5.33 A	164.57 GHI	17.34 R	384.90 GHIJKL	248.73 CDEF	7.48 MNO	14.69 ABC	14.33 ABCDEF
DK-6142	5.33 A	225.33 A	20.99 AB	463.79 A	254.72 BCD	10.00 CD	17.56 AB	15.20 ABCDEF