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INVESTIGATING YIELD AND AGRONOMIC CHARACTERISTICS OF MAIZE HYBRIDS IN NIGERIA

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Article Info

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Abstract

A study was conducted at the Centre for Agricultural Research, School of Agriculture and Agricultural Technology of Federal University of Technology, Owerri, Nigeria, to evaluate the performance of maize genotypes for yield and other agronomic attributes. The study took place between July and November 2016 and included twenty-eight genotypes, consisting of seven parents and twenty-one crosses derived from a partial diallel cross. The genotypes were grown in three row plots and were tested for eighteen characters to assess their performance. Results showed highly significant differences ($P \leq 0.01$) among the genotypes for various agronomic traits including days to 50% emergence, days to 50% tasseling, leaf area, days to maturity, plant at harvest, days to 50% silking, plant height, ear height, cob length, number of rows/cob, grain weight/cob, field weight, number of grains/cob, and grain yield. However, no significant difference was observed in the parents. The significant differences observed indicate substantial variability among the genotypes. The crosses flowered and matured earlier than the parents, with the earliest crosses involving DTMA-4, POOL 66/ACR-91, and BENDE-WHITE. These crosses may be exploited for developing early maturing maize varieties. The highest grain yield was recorded by OKA BENDE-WHITE (2.86 t/ha) and the cross between DTMA-4 and OKA BENDE-WHITE (3.63 t/ha), suggesting that the high yield may be attributed to OKA BENDE-WHITE as the higher yielding parent. The lowest grain yield was observed in the cross between DTMA-4 and DMR-ESRY (2.36 t/ha). Based on these findings, OKA BENDE-WHITE is recommended for use in hybridization programs to generate new, improved maize varieties.

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Introduction

Maize (Zea mays L.) is one of the most important cereal crops produced worldwide, occupying a significant position in the global food system. It serves as a staple food for millions of people, particularly in sub-Saharan Africa, Latin America, and Asia (Shiferaw et al., 2011). In Nigeria, maize is a major staple crop for both rural and urban consumers due to its adaptability to various agro-ecological zones and diverse end-uses (Adejoro et al., 2019). The crop contributes immensely to food security, income generation, and poverty alleviation in the country. However, the average maize yield in Nigeria remains low, estimated at 1.8 tons per hectare, compared to the global average of 5.6 tons per hectare (FAOSTAT, 2019). This low productivity has been attributed to several factors, including the use of low-yielding varieties, pests and diseases, poor agronomic practices, and climate change (Adejoro et al., 2019; Oyekale, 2015).

To address the issue of low maize yields, efforts have been made by research institutions and seed companies to develop and disseminate improved maize hybrids with higher yield potential and adaptability to various agro-ecological zones (Badu-Apraku and Akinwale, 2011; Menkir et al., 2016). Maize hybrids have been reported to exhibit superior agronomic characteristics, such as high yield, improved resistance to diseases and pests, and better tolerance to abiotic stresses, compared to traditional open-pollinated varieties (Menkir et al., 2016; Nzuve et al., 2013). The adoption of such hybrids by farmers has the potential to significantly increase maize productivity and contribute to food security in Nigeria. However, the performance of these hybrids under different agro-ecological conditions and management practices needs to be investigated to provide farmers with reliable information on their suitability for cultivation.

Several studies have been conducted to evaluate maize hybrids in different parts of Nigeria (Badu-Apraku and Akinwale, 2011; Menkir et al., 2016; Nzuve et al., 2013). These studies have reported varying levels of performance in terms of yield and other agronomic traits, depending on the specific hybrids and the environmental conditions under which they were grown. Nevertheless, there is still a need for continuous evaluation of newly developed maize hybrids to identify superior genotypes that can be recommended for commercial cultivation by farmers in different agro-ecological zones of the country.

The objective of this study is to investigate the yield and agronomic characteristics of selected maize hybrids under different agro-ecological conditions in Nigeria. The specific objectives are to (i) evaluate the performance of the maize hybrids in terms of grain yield, (ii) assess the agronomic traits associated with high yield in the hybrids, and (iii) identify the most suitable hybrids for cultivation in different agro-ecological zones of Nigeria. This study will provide valuable information to maize breeders, seed companies, extension agents, and farmers on the potential of the evaluated hybrids for commercial cultivation and their contribution to enhancing maize productivity in Nigeria.

Materials and Methods Experimental Site

The research was carried out at the Centre for Agricultural Research, School of Agriculture and Agricultural Technology of the Federal University of Technology Owerri, Imo State,(Lat. $5^0$27' N, Long. $7^0$02'E, mean temperature of 29^0 C; relative humidity of 89%; and an altitude of 50-70 cm above sea level) between July and November 2016.

Description of genotypes used for the study:

The material consisted of 28 genotypes, 7 of which were parents and the remaining 21 were crosses as shown in the table below;

Table 1: Evaluated Genotypes

S/N	ENTRIES	EXPERIMENTAL CODE	STATUS

1	DTMA-4	V1	PARENT
2	DMR-ESRY (POOL 18-SR)	V2	PARENT
3	PVA SYM 8 F2 (PRO VIT A)	V3	PARENT
4	POOL 66/ACR-91 SUWAN – 1- SR (QPM)	V4	PARENT
5	DTMA – W	V5	PARENT
6	Oka Mbaise	V6	PARENT
7	Oka Bende-white	V7	PARENT
8	DTMA-4 X DMR-ESRY (POOL 18-SR)	v1v2	HYBRID
9	DTMA-4 X PVA SYM 8 F2 (PRO VIT A)	v1v3	HYBRID
10	DTMA-4 X POOL 66/ACR-91 SUWAN – 1- SR (QPM)	v1v4	HYBRID
11	DTMA-4 X DTMA – W	v1v5	HYBRID
12	DTMA-4 X Oka Mbaise	v1v6	HYBRID
13	DTMA-4 Oka Bende-white	v1v7	HYBRID
14	DMR-ESRY (POOL 18-SR) X PVA SYM 8 F2 (PRO VIT A)	v2v3	HYBRID
15	DMR-ESRY (POOL 18-SR) X POOL 66/ACR-91 SUWAN – 1- SR (QPM)	v2v4	HYBRID
16	DMR-ESRY (POOL 18-SR) X DTMA – W	v2v5	HYBRID
17	DMR-ESRY (POOL 18-SR) X Oka Mbaise	v2v6	HYBRID
18	DMR-ESRY (POOL 18-SR) X Oka Bende-white	v2v7	HYBRID
19	PVA SYM 8 F2 (PRO VIT A) XPOOL 66/ACR-91 SUWAN – 1- SR (QPM)	v3v4	HYBRID
20	PVA SYM 8 F2 (PRO VIT A) X DTMA – W	v3v5	HYBRID
21	PVA SYM 8 F2 (PRO VIT A) X Oka Mbaise	v3v6	HYBRID
22	PVA SYM 8 F2 (PRO VIT A) X Oka Bende-white	v3v7	HYBRID
23	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X DTMA – W	v4v5	HYBRID
24	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X Oka Mbaise	v4v6	HYBRID
25	POOL 66/ACR-91 SUWAN – 1- SR (QPM) X Oka Bende-white	v4v7	HYBRID
26	DTMA – W X Oka Mbaise	v5v6	HYBRID
27	DTMA – W X Oka Bende-white	v5v7	HYBRID
28	Oka Mbaise X Oka Bende-white	v6v7	HYBRID

Experimental Design

The diallel was generated during the second maize planting season of August, 2015 at the Centre for Agricultural Research, School of Agriculture and Agricultural Technology Teaching and Research Farm of Federal University of Technology Owerri. Half-diallel mating method involving the parents and excluding the reciprocals (that is, 21 crosses) in the first filial was used for the study. NPK 15:15:15 was applied at equivalent rate of 300kg/ha two weeks after planting and also at tasseling. The field was also treated with furadan 3% granular formulation of carbofuran to minimize stem borer and termite attack.

The maize genotypes were planted on sandy clay loam. The experimental design was randomised complete block design with four replications. The genotypes were grown in three row plots. The experimental area measures 12 m x 12 m. The whole area was divided into four blocks with spacing of 1m between each block. Each block contains twenty eight treatments with an inter row spacing distance of 0.75 m and intra row spacing distance of 0.25 m with the row 3 m long. The maize genotypes were planted under rain-fed conditions.

After harvesting, the seeds were dried to 15% moisture.

Data Collection

Data were collected for, Days to 50% emergence, Days to 50% tasseling, Leaf area (cm^2), Days to maturity, Plant at harvest, Days to 50% silking, Plant height (cm), Ear height (cm), Cob length (cm), Number of rows/cob, Grain weight/cob, Field weight (FWT), Number of grains/cob, Grain weight/cob, and Grain yield (t/ha). **Data Analysis** The data obtained were subjected to analysis of variance as described by Obi (2002). Fisher's least significant difference (F-LSD) was used to detect significant differences for mean separation among varieties.

Results and Discussion Analysis of Variance

Analysis of variance (ANOVA) for growth agronomic attributes of the F_1 genotypes (Table 2) showed that the mean square for crosses were highly significant (P = 0.05) for days to 50% emergence, leaf area, stem girth, plant height, days to 50% taselling, days to 50% silking and days to maturity.

The ANOVA revealed that general combing ability (GCA) is highly significant (P = 0.01) for all the growth agronomic traits studied except for days to maturity that is significant (P = 0.01). The specific combining ability (SCA) is highly significant (P = 0.01) for all the growth parameters measured except for days to 50% emergence that was not significant (NS) and leaf area that was significant (P = 0.05). The block, however, showed no significant difference among the studied traits.

ANOVA also showed that mean squares of the crosses were highly significant (P = 0.01) for plant stand, ear heights, field weight, cob length, number of row per cob, grain number per cob, grain weight per cob, 1000 dry seed weight and grain yield (Table 3). GCA for all the yield parameters were highly significant (P = 0.01) except for cob length that is not significant. The SCA for the yield attributes were highly significant except for plant stand and grain yield that were significant (P = 0.05).

Mean Performance

The mean performance for growth agronomic characters of the F1 presented in Table 4 showed that there were significant differences among the genotypes in terms of vegetative attributes. The cross between DTMA-4 X PVA SYM 8 F2 (3.75) and PVA SYM 8 F2 X OKA BENDE-WHITE (3.75) were earliest in emergence at 3 days after planting, while

DTMA-4 X DMR-ESRY, DTMA-4 X POOL 66/ACR-91, DTMA-4 X OKA BENDEWHITE, DMR-ESRY X PVA SYM 8 F2, DMR-ESRY X POOL 66/ACR-91, DMR-ESRY X OKA MBAISE, DMR-ESRY X OKA BENDE-WHITE, PVA SYM 8 F2 X POOL

66/ACR-91, POOL 66/ACR-91 X OKA BENDE-WHITE emerged at 4 days after planting and DTMA-4 X DTMA – W, DTMA-4 X OKA MBAISE, DMR-ESRY X DTMA – W, PVA SYM 8 F2 X DTMA – W, PVA SYM 8 F2 X OKA MBAISE, POOL 66/ACR-91 X DTMA – W, POOL 66/ACR-91 X OKA MBAISE, DTMA – W X OKA MBAISE, DTMA – W X OKA BENDE-WHITE and OKA MBAISE X OKA BENDE-WHITE emerged at 5 days after planting. The percentage emergence ranges from DTMA-4 X DMR-ESRY (63.50) to DMRESRY X POOL 66/ACR-91 (96.61). The cross between OKA MBAISE X OKA BENDEWHITE (24.50), PVA SYM 8 F2 X OKA BENDE-WHITE (24.50), DMR-ESRY X OKA BENDE-WHITE (24.25) and DTMA-4 X POOL 66/ACR-91 (24.00) had the highest plant stand while DMR-ESRY X POOL 66/ACR-91 (18.75), DMR-ESRY X DTMA – W (18.00), and DTMA-4 X DTMA – W (18.00) had the lowest plant stand.

Days to 50% tasseling and silking ranges from POOL 66/ACR-91 X OKA BENDE-WHITE

(41.00) to DMR-ESRY X OKA MBAISE (61.75) and PVA SYM 8 F2 X OKA BENDEWHITE to DMR-ESRY X DTMA – W (67.75) respectively.

The highest leaf area was recorded in the cross between OKA MBAISE X OKA BENDEWHITE (101.20 cm^2) while DMR-ESRY X DTMA – W (32.70 cm^2) had the smallest leaf area. Highest plant height was recorded in OKA MBAISE X OKA BENDE-WHITE (247.20 cm) while the shortest height was recorded in the cross between DTMA-4 X DTMA – W (97.20 cm). The stem girth ranges from PVA SYM 8 F2 X DTMA – W (0.50 cm) to DTMA – W X OKA BENDE-WHITE (1.33 cm).

Table 5 showed the mean performance for yield characteristics of the F1 genotypes which all had significant difference (P = 0.05).

The crosses between DTMA-4 X POOL 66/ACR-91 (89.50), PVA SYM 8 F2 X Oka Bendewhite (96.00), PVA SYM 8 F2 X POOL 66/ACR-91 (96.75), DTMA-4 X Oka Bende-white (98.25) and DTMA-4 X DMR-ESRY (98.50) were the earliest in maturity while DTMA – W X OKA MBAISE (132), PVA SYM 8 F2 X OKA MBAISE (130.50), DMR-ESRY X OKA MBAISE (132.30), DTMA-4 X Oka Mbaise (129.30) and OKA MBAISE x OKA BENDEWHITE (129.00) were late maturing. The cross between DTMA-4 X OKA BENDE-WHITE had the highest plant at harvest (17) while DMR-ESRY X PVA SYM 8 F2 had the least plant at harvest (9.50). Ear height ranges from DTMA-4 X DMR-ESRY (108.00) to OKA MBAISE X OKA BENDE-WHITE (135.00) among the cross. The highest cob length was recorded in the crosses between DTMA-4 X OKA BENDE-WHITE (16.12), DTMA-4 X OKA MBAISE (15.13), POOL 66/ACR-91 X DTMA – W (14.50), DMR-ESRY X OKA MBAISE (14.25), OKA MBAISE X OKA BENDE-WHITE (14.00) and the least recorded in the cross between DTMA-4 XDMR-ESRY (10.50).

The number of row per cob and number of grains per cob ranges amongst the crosses from DTMA-4 X DTMA – W (10.00) to OKA MBAISE X Oka Bende-white (15.25) and DTMA4 X DTMA – W (180.00) to OKA MBAISE X OKA BENDE-WHITE (347.00) respectively. The highest grain weight per cob was recorded in the cross between OKA MBAISE X OKA BENDE-WHITE (1.62 Kg) and the least between DTMA-4 X DMR-ESRY (0.34 Kg). The highest field weight was recorded in the cross between PVA SYM 8 F2 X OKA BENDEWHITE (181.40 kg) followed by DMR-ESRY X Oka Bende-white (177.80 kg) and OKA MBAISE X OKA BENDE-WHITE (156.50 kg). The least field weight of 111.80 kg was recorded in the cross between DTMA-4 X DTMA – W.

Highest 1000 dry seed weight was recorded in the cross between OKA MBAISE X OKA BENDE-WHITE (606.90 kg) and least was recorded in the cross between PVA SYM 8 F2 X DTMA – W (430.40 kg). The cross between DTMA-4 X OKA BENDE-WHITE (3.63 t/ha) had the highest grain yield, followed by POOL 66/ACR-91 X OKA MBAISE (3.43 t/ha), DTMA-4 X OKA MBAISE (3.40 t/ha), POOL 66/ACR-91 X DTMA – W (3.26 t/ha), PVA SYM 8 F2 X POOL 66/ACR-91 (3.23 t/ha), DMR-ESRY X OKA MBAISE (3.21 t/ha), OKA MBAISE X OKA BENDE-WHITE (3.15 t/ha) and PVA SYM 8 F2 X OKA MBAISE (3.15 t/ha). The cross between DTMA-4 X DMR-ESRY (2.36 t/ha) had the lowest grain yield.

Table 2: Combined analysis of variance for growth agronomic attributes of the F1 genotypes of the seven maize genotypes

Source of Variation	Df	Days to 50 % Emergence	Percentage emergence	Leaf area	Stem girth	Plant height (cm)	Days to 50% tasselling	Days to 50% silking	Days to maturity
Block	3	0.08NS	51.21NS	64.74NS	0.01NS	235.37NS	1.10NS	12.56NS	11.41NS
Cross	27	1.58**	248.46**	2161.34**	0.16**	4953.02**	294.56**	189.33**	1018.97**
GCA	6	5.99**	623.60**	8395.61*	0.62**	18480.30**	930.40*	414.07**	4165.64*

SCA	21	0.31NS	141.28**	380.12*	0.03**	1088.09**	112.90*	125.12**	119.92**
Error	81	0.23	59.22	187.91	0.02	211.99	9.02	11.97	29.52

*, ** = Significant at P = 0.05 and 0.01, respectively. NS = Non significant

Table 3: Combined analysis of variance for agronomic characteristics of the F1 genotypes of the seven maize genotypes

Source of Variation	Df	plant sand	Field weight (kg)	Cob length (cm)	Number of row per cob	Grain no per cob	Grain weight per cob	1000 dry seed weight	Grain yield (t ha^{-1})
Block	3	4.54^{NS}	5.08^{NS}	1.22^{NS}	0.67^{NS}	11461.60**	0.01^{NS}	1802.84^{NS}	1.69*
Parents	6	144.32**	2590.50**	20.33**	28.91**	33844.00**	0.002NS	29324.00**	1.31**
Crosses	27	20.36**	2137.73**	12.83**	9.27**	18480.27**	1.34**	13302.60**	1.71**
GCA	6	40.94**	3205.23**	6.27^{NS}	16.33**	37518.74**	0.53**	16674.90**	2.56**
SCA	21	14.47*	1832.73**	14.71**	7.26**	13040.71**	1.57**	12339.10**	1.47*
Parents x Crosses	1	28.3^{NS}	0.6^{NS}	158.54**	13.32^{NS}	44.30^{NS}	11.12^{NS}	134.32^{NS}	0.83*
Error	81	8.29	202.44	2.94	1.783	2440.28	0.15	2925.33	0.16

*, ** = Significant at P = 0.05 and 0.01, respectively. NS = Non significant

Table 4: Mean values for growth agronomic attributes of seven open pollinated maize genotypes and their F1 progenies

Genotypes	Days to 50% emergence	Percentage emergence	Plant stand	Days to 50% tasseling	Days to 50% silking	Leaf area (cm^2)	Plant height (cm)	Stem girth (cm)	Ear height
DTMA-4	4.23	59.98	34.22	39.71	50.77	46.14	114.60	0.88	
DMR-ESRY	3.98	84.83	31.97	39.46	56.27	31.34	111.60	0.93	97.06
PVA SYM 8	3.98	62.88	26.72	53.46	64.52	43.24	121.10	0.85	110.06
POOL 66	3.73	64.98	31.97	37.21	2.52	37.94	122.90	0.95	111.86
DTMA–W	3.98	85.01	16.47	54.46	67.27	30.84	106.90	0.85	52.86
Oka Mbaise	4.73	76.23	30.97	59.46	64.77	70.74	218.40	0.98	103.06
Oka Bende	3.50	81.56	35.72	37.21	57.77	73.74	168.70	1.05	119.26
v1v2	4.50	63.50	19.25	50.00	62.50	42.30	122.50	0.70	108
v1v3	3.75	91.15	23.25	58.75	67.25	44.20	110.50	0.70	134.3
v1v4	4.25	94.82	24.00	51.75	63.75	45.20	116.80	0.95	121.3
v1v5	5.50	76.07	18.00	59.75	65.00	40.30	97.20	0.68	118.5
v1v6	5.00	76.50	23.25	61.25	67.50	71.30	182.20	1.13	124.8
v1v7	4.00	86.92	25.00	42.25	53.50	86.20	178.50	0.98	133.8
v2v3	4.00	93.57	17.50	55.50	65.50	48.80	115.20	0.58	114.8
v2v4	4.25	96.61	18.75	47.50	58.75	42.20	120.00	0.78	110.8
v2v5	5.00	82.52	18.00	61.25	67.75	32.70	105.20	0.55	114
v2v6	4.75	77.68	24.75	61.75	66.75	79.30	149.20	0.80	120.8
v2v7	4.00	85.28	24.25	48.25	56.75	78.50	135.50	0.75	125.8
v3v4	4.25	91.12	21.00	50.75	62.25	48.90	124.00	0.78	120.8

v3v5	5.25	83.54	20.25	60.25	67.00	41.50	101.80	0.50	120.3
v3v6	5.00	79.88	23.25	59.50	62.50	92.00	134.20	0.80	113
v3v7	3.75	92.50	24.50	43.00	47.75	91.00	134.50	0.75	125.8
v4v5	5.00	81.96	19.50	60.50	65.00	52.70	115.80	0.80	114.8
v4v6	5.00	85.92	20.75	60.25	60.50	84.40	160.80	1.18	127.3
v4v7	4.25	94.00	21.75	41.00	49.50	86.50	165.50	1.03	127
v5v6	5.25	80.10	23.00	60.75	64.50	87.80	126.80	0.70	121.5
v5v7	5.00	88.73	23.25	59.75	65.25	89.10	139.80	0.73	128.3
v6v7	5.00	92.32	24.50	58.75	64.75	101.20	247.20	1.33	135
Mean Parent	4.02	73.64	29.72	45.85	51.98	47.71	137.74	0.93	100.35
Mean crosses	4.61	86.56	21.93	55.13	62.08	67.19	138.04	0.83	128.04
SED (0.05) Parent	0.59	7.71	5.39	4.59	5.75	23.77	32.85	NS	37.27
SED (0.05) crosses	0.67	10.83	4.05	4.23	4.87	19.29	20.48	0.20	13.48
SED (0.05) P vs C	0.32	NS	0.44	0.11	NS	NS	7.46	NS	NS

NS = non-significant

Table 5: Mean values for yield agronomic attributes of seven open pollinated maize genotypes and their F_1 progenies

Genotypes	Days to maturity	Plant at harvest	Cob length (cm)	Number of row per cob	Number of grain per cob	Grain weight per cob(kg)	Field weight (kg)	1000weight (g) seed	Grain yield (t ha^{-1})
DTMA-4	88.91	28.18	10.23	12.33	187.00	0.37	109.92	445.00	2.42
DMR-ESRY	102.41	25.93	8.86	8.83	73.80	0.37	92.42	363.00	2.02
PVA SYM 8	104.11	20.68	9.73	9.58	92.80	0.36	79.92	395.00	1.74
POOL 66	91.11	25.93	9.99	10.58	100.80	0.37	77.42	333.00	1.68
DTMA–W	60.41	10.43	5.39	5.08	81.10	0.32	54.92	180.00	1.18
Oka Mbaise	145.11	24.93	9.99	12.33	102.80	0.38	112.42	358.00	2.47
Oka Bende	101.91	29.68	12.99	12.58	293.80	0.37	129.92	395.00	2.86
v1v2	98.50	11.25	10.50	12.5	247.00	0.34	139.50	449.10	2.36
v1v3	104.80	15.25	11.80	13	278.00	1.24	138.20	448.60	2.67
v1v4	89.50	16.00	11.25	10.75	231.00	1.41	137.20	467.10	2.53
v1v5	103.00	10.00	12.75	10	180.00	0.91	111.80	431.10	2.87
v1v6	129.30	15.25	15.13	14.25	257.00	1.56	138.20	484.10	3.4
v1v7	98.25	17.00	16.12	13	210.00	1.46	158.00	546.30	3.63
v2v3	114.50	9.50	11.78	10.75	165.00	1.22	119.80	487.90	2.65
v2v4	102.50	10.75	12.25	12.25	227.00	0.74	127.20	473.10	2.76
v2v5	113.30	10.00	13.13	12.25	151.00	0.65	125.80	461.00	2.95
v2v6	132.30	16.75	14.25	14.5	270.00	1.53	145.50	509.40	3.21
v2v7	100.80	16.25	13.38	14	320.00	1.18	177.80	526.50	3.01
v3v4	96.75	13.00	14.38	10.75	177.00	0.66	115.80	504.50	3.23

v3v5	103.50	12.25	13.75	11.75	150.00	1.09	116.20	430.40	3.09
v3v6	130.50	15.25	14.00	13.25	215.00	1.09	150.50	506.90	3.15
v3v7	96.00	16.50	13.75	14.25	205.00	1.47	181.40	508.00	3.09
v4v5	111.80	11.50	14.50	12.25	237.00	1.18	112.50	439.40	3.26
v4v6	136.00	12.75	15.25	12.75	251.00	1.27	142.00	519.30	3.43
v4v7	98.25	13.75	12.88	12.75	345.00	1.58	133.80	541.40	2.9
v5v6	132.00	15.00	11.25	12.25	216.00	1.21	130.00	482.60	2.53
v5v7	105.50	15.25	11.38	13.5	243.00	1.52	147.50	467.10	2.56
v6v7	129.00	16.50	14.00	15.25	347.00	1.62	156.50	606.90	3.15
Mean Parent	99.14	23.68	9.60	10.19	133.16	0.36	93.85	352.71	2.053
Mean crosses	116.30	14.49	13.87	13.30	246.10	1.25	145.26	514.54	3.12
SED (0.05) Parent	38.81	5.41	3.81	3.54	71.52	NS	46.15	137.6	1.04
SED (0.05) crosses	7.64	4.05	2.42	1.879	69.50	0.55	20.14	76.1	0.544
SED (0.05) P vs C	0.52	NS	0.01	0.02	NS	NS	0.05	0.08	0.06

NS: non-significant

Discussion

Knowledge about germplasm diversity and relationships among diverse germplasm is useful for plant breeders because it assists them to select suitable parents for crossing (Dwivedi *et al.,* 2001). In the development of maize for fresh maize production, two factors are considered important; characteristics of the inbred line itself and behavior of the inbred line in a particular hybrid combination.

The highly significant genotype effect obtained for the agronomic parameters indicated that enough variability exists to allow identification of local germplasm with reasonable levels of desirable agronomic characteristics. This observation supports the earlier report by Ngwuta *et al.* (2001) that locally available germplasm can serve as sources of hybrid maize development.

The genotypes are morphologically differentiated and identified using morphological traits. The significant difference recorded in days to 50% emergence could be as a result of the differences in the thickness of seed coat and tissue layer, which agrees with the earlier report on maize (Prasanna *et al.* 2001). The differences observed on the number of days to 50% tasseling and silking were mainly due to varietal differences among the examined genotypes. However, the ANOVA suggested presence of ample genetic variability amongst the genotypes. Shahrokhi and khorsani (2013) also observed significant variation amongst maize genotypes for stem girth, plant height, ear height, days to maturity, number of grain per cob and grain yield. Ahmed (2013) also observed significant variation among maize genotypes for days to 50% emergence, days to 50% tasseling, days to 50% silking, days to maturity, plant height, ear height, cob length, 1000 grain weight and grain yield.

The ultimate goal of a plant breeding program is higher grain yield. The result from this study showed significant variation amongst maize genotypes for grain yield.

Similar results for grain yield suggesting heterotic effects in different cross combinations of maize hybrid have been reported by Venugopal *et al.* (2002), and Joshi *et al.* (2002). The assessment of the agronomic attributes of the parents and the crosses indicated that the variety crosses are superior to the parents in most of the traits studied.

The significant differences observed between the parents and the crosses are suggestive of the occurrence of heterosis in most of the agronomic attributes.

In terms of flowering and maturity, the crosses flowered and matured earlier than the parents. Furthermore, crosses involving the earliest parents; DTMA-4 and POOL 66/ACR-91 with BENDE-WHITE resulted in progenies which were earlier than the mean of the entire crosses.

This suggests that they may be exploited for use in developing early maturing maize variety. Early maturing maize can be very useful in areas where rainfall regime is short and unpredictable in order to escape short duration drought.

Conclusion and Recommendation

The means sum of squares due to genotypes from the present study indicated highly significant differences ($P = 0.01$) for yield and other agronomic characters studied, thus revealed the presences of substantial genetic variability among the evaluated genotypes.

It was observed that the cross between DTMA-4 X OKA BENDE-WHITE and POOL 66/ACR-91 X OKA MBAISE are higher yielding genotypes with 3.63 t/ha and 3.43 t/ha respectively.

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