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EVALUATION OF THE PERFORMANCE OF MAIZE GENOTYPES (*Zea mays* L.) FOR YIELD AND OTHER AGRONOMIC TRAITS

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ABSTRACT
A study was conducted at the Faculty of Agriculture, Research Farm, Bayero University, Kano State, (Lat. 11º54[1]N, Long. 8º25[1]E; 466m above sea level) between July and November 2015. The treatments consisted of twenty five genotypes which comprises of six parents, 15 cross and four checks derived from partial diallel cross, laid out in 5x5 lattice design and replicated three times; these were tested for fourteen characters to evaluate their performance. The means sum of squares due to genotypes indicated highly significant differences ($P \leq 0.01$) for plant height, kernel weight kg days to 50% pollen shed, and grain yield per hectare, while non-significant difference was observed for other traits. The significant differences observed revealed the presence of substantial variability among the genotypes. P5 recorded the highest grain yield of (1075.56kg/ha), while P2P5 recorded the highest yield of (897.78kg/ha), indicating that, the highest yield obtained may be due to the combination of P5 which appears as the higher yielding parent. P2P3 recorded the lowest yield of (222.22kg/ha). It is therefore recommended that P5 has the highest yield, and can be used for hybridization programs to come up with new improved varieties.
Keywords:

INTRODUCTION

Maize is thought to have originated at least 5000 years ago in the highlands of Mexico, Peru, Ecuador, and/or Bolivia because of the great density of native forms found in the region. America was the largest maize producer with a total production of 361,091.00 tonnes and then China with 215,500.00 tonnes (FAO, 2014) and Nigeria's production figure was 26 million tonnes on 3,845,000ha of land (FAO, 2008). The Northern states of Nigeria accounts for more than half of the total production in the country (Anonymous, 1987). Maize is becoming the miracle seed for Nigeria's agricultural and economic development. It has established itself as a very significant component of the farming system and determines the cropping pattern of the predominantly peasant farmers, especially in the Northern States (Ahmed, 1996). Maize also known as corn, it is the world third most important cereal after wheat and rice (CIMMYT, 2000). Here in Nigeria, it the second most important cereal (Ologunde, 1987). Grain yield is the most important and complex characters with which maize breeders work (Alake *et al,.* 2008). It is the product of several interrelated traits; hence, a successful breeding programme depends largely upon the information on genetic variability and association of desired quantitative traits with yield. Hence, consideration of quantitative approaches for exploitation of the extensive genetic variability available in maize cultivars is of paramount importance Alake *et al,.* 2008). Genetic improvement of a crop is pivoted on the strength of genetic diversity within the crop specie. Variability usually provides options from which selections are made for improvement and possible hybridization.

Maize has become a major food item in Nigeria and it is consumed in many forms. It is consumed as green maize when the ear is boiled or roasted. When dry, the grain may be processed into different forms of products such as Pap (Ogi) and Starch, it also an industrial crop in Nigeria (Fakorede *et al.*, 2008). Maize represents a staple food for a significant proportion of the world's population and supplements of the diets of the millions of many. Maize constitutes a stable food in many regions of the world. And it is a basic stable for large population groups particularly in developing countries (FAO and ILO, 1997).

The production and utilization potential of maize in the recent times is not only attracting the attention of Research Scientists, but also evolving major National and International Research thrusts, with a view to providing solutions to various problems of maize particularly in terms of poor genetic potential, low seed yield, poor adaptation to various agro ecologies, and overall poor performance of some varieties (Kim, 1994). For achieving the success of crop improvement programme not only depend on the amount of genetic variability present in the population but rather on the extent to which it is heritable, which sets the limit of progress that can be achieved through selection (Najeeb *et al.,* 2009).

Thus, evaluating the genotypes to study genetic variability for agronomic characters is a key component of breeding programmes for broadening the gene pool of crops (Ahmad *et al.,* 2011). That is why the present study was conducted to evaluate the maize genotypes for grain yield and other agronomic traits and also to identify appropriate germplasm for hybrid development.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Faculty of Agriculture, Research Farm, Bayero University, Kano State, (Lat. 11º54N, Long. 8º25E; alt. 466m above sea level) between July and November 2015.

Description of genotypes Used for the Studies:

The material consisted of 25 Genotypes, 6 of which were parent, 15 crosses and 4 checks, as shown in table 1 below.

Table 1. Genotypes evaluated

S/N	ENTRIES	STATUS
1.	P1 (P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B)	Parent
2.	P2(1368× HI ×4269-1368-7-2-B-B-B-B-B)	Parent
3.	P3(9071-B-B-B)	Parent
4.	P4((TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B)	Parent
5.	P5(1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B)	Parent
6.	P6(TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B-B)	Parent
7.	P1 × P2(P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B × 1368× HI ×4269-1368-7-2-B-B-B-B-B)	Hybrid
8.	P1 × P3(P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B × 9071-B-B-B)	Hybrid
9.	P1 × P4(P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B×(TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B)	Hybrid
10.	P1 × P5(P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B × 1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B)	Hybrid
11.	P1 × P6 (P43SRC9FS100-1-1-8-#1-B1-13-B1-B-B-B-B-B-B-B-B × TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B-B)	Hybrid
12.	P2 × P3 (1368× HI ×4269-1368-7-2-B-B-B-B-B × 9071-B-B-B)	Hybrid
13.	P2 × P4(1368× HI ×4269-1368-7-2-B-B-B-B-B × (TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B)	Hybrid
14.	P2 × P5(1368× HI ×4269-1368-7-2-B-B-B-B-B × 1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B)	Hybrid
15.	P2 × P6(1368× HI ×4269-1368-7-2-B-B-B-B-B × TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B-B)	Hybrid
16.	P3 × P4(9071-B-B-B × (TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B)	Hybrid
17.	P3 ×P5(9071-B-B-B × 1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B)	Hybrid
18.	P3 × P6(9071-B-B-B × TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B-B	Hybrid
19.	P4 × P5(TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B × 1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B)	Hybrid
20.	P4 ×P6 (TZMI501×KU1414×501)-1-4-3-1-B-B-B-B-B-B-B-B × TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B-B)	Hybrid
21.	P5 × P6(1368×ICAL224-1×1368-3-1-B-B-B-B-B-B-B-B-B-B-B × TZL-COMP3-C2-S2-34-4-1-2-B-B-B-B-B-B)	Hybrid

Experimental Design

Twenty five genotypes were arranged in 5x5 lattice design and replicated three times; one row of five metre long spaced 0.75m apart was used as a plot. Three seeds were planted at intra row spacing of 25cm and the later thinned to one plant per hill. Three hoe weeding were carried out, first one at two weeks after sowing, the second at four weeks after sowing and earthen up at six weeks after sowing with a split fertilizer application of compound fertilizer N P K (15:15:15) as a basal dressing and urea 46%N as top dressing, giving a total plant nutrient of 120kgn, 60kg P_20_5 60 K_20 per hectare. Data were collected for, days to 50% pollen shed, Days to 50% silking, Plant height (cm), days to maturity, ear height (cm), number of ear per plot, ear length (cm), ear diameter (cm), kernel row number, number of kernels per row, cob diameter (cm), cob weight (kg), threshing percentage and grain yield per hectare (kg) were also taken.

Data Analysis

Data collected were subjected to analysis of variance using Statistical Analysis System (SAS 1986). Significant treatment means were compared using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Analysis of Variance

The analysis of variance for yield and other agronomic trait is presented in table 2. Results indicated that means squares due to genotypes were highly significant ($P \leq 0.01$) for days to 50% pollen shed, plant height, kernel weight (kg) and grain yield per hectare, whereas days to maturity, ear height, ears per plot, kernel per row, kernel row number, ear diameter cob, diameter, cob weigh (kg) and threshing percentage, indicated non-significant difference. Hence, the significant differences observed showed a wide range of variability existing in the genotype tested.

Mean Performance

The mean performance of the genotype is presented in table 3. The result indicated that P6 for DPS ranges from 49.00 to 57.33, for DTS however, it ranged from 51.33 to 61.00. P6 had the highest DPS (57.33), DTS (61.00) and DTM (95.66), whereas QPM had the lowest DPS (49.00), DTS (51.33) and DTM (87.00) even though for DTM, it was at parity with P5P6, P4, P1P2, P1P4,P2P3,P2P4,P4P5,QPM and JO-F, QPM had the tallest plant height (149.66cm) while the shortest plant was produced by P1P2 (89.33cm). Highest ear height were recorded for entries P2, P4, P2P5, P2P6, and QPM and are similar to each other, while P5 produce the lowest ear height (42.96cm) whereas P5P6 produce the highest ear number per plot (13.33) while the lowest number was recorded by P1P2 (5.66) and it also produced the lowest kernel per row (22.66). P2and P3 recorded highest KPR of 37.33 and 37.66 respectively while; P3P5 and P4P6 recorded the highest KPR (36.66). Little differences were observed in respect to ear diameter, cob diameter and cob weight, QPM produce the highest ear diameter and cob weight of 16.066 and 0.70 respectively while P1P2 recorded the lowest days to maturity of, 87, 5.66, 22.66, 11.96 for EPP, KPR and EDM Respectively. P3P5 produces the highest cob diameter (5.50), while P4P5 recorded the least (3.95). The genotypes are almost similar in cob weight and kernel weight, although the highest Kernel weight and grain yield per hectare was recorded by P5 (0.40 and 107.56 respectively). P4P5 recorded the lowest kernel weight (0.08). P2P3 recorded the shortest grain yield per hectare (222.22) whereas P2P5 had the highest grain yield per hectare (897.78).

Discussion

The mean squares due to genotypes showed highly significant differences ($P \leq 0.01$) for DPS, pH, KwKg and Gypha; Thus indicating the presence of substantial genetic variability among the genotypes whereas the non-significant difference observed indicted that the performance of genotypes in respect to those traits are similar. P5 followed P6 in the days to 50% pollen shed (57.3) and maturity (95.7). In addition, it produce the highest grain yield (1075.56), and this may attributed to the fact that P5 is a late maturing genotype and this agreed with that of Badu-Apraku *et al.,* (1999) whose findings revealed that late maturing cultivars are usually more high yielding than early maturing ones. It was also observed that P2P5 recorded the highest grain yield of 897.78kg/ha indicated that, the highest yield obtained may be due to combination of P5 which appears as the higher yielding parents (1075.56kg/ha). The mean performance of ear height significantly differs among P2, P4, P2P5, and P2P6. QPM recorded the highest plant heights and ear heights (149.66 and 62.32 respectively) due to its late maturity genotype. Similar findings were reported by Saha *et al*. (1993).

Table 2: Mean Square from Anova for yield and other agronomic traits

S.V	DF	DPS	DTS	DTM	PH	EH	Eppt	Kpr	Krn	Edm	Cdm	Cwkg	Kwkg	Tp	Gypha
Entry	24	12.49**	14.54	14.04	312.83**	104.19	8.06	40.48	1.40	2.25	0.29	0.05	0.02**	666.47	159.42**
Rep	2	13.72*	6.82	23.29	25.11	178.61	1.66	179.57	0.66	17.30	0.35	0.04	0.01	809.25	284.14
Rep(Block)	12	5.27	7.19	7.47	233.44	350.45	10.87	55.87	1.17	3.95	0.14	0.06	0.01	419.26	169.43
Error	36	5.29	9.14	7.60	95.88	78.25	7.17	48.06	2.20	2.03	0.31	0.04	0.00	373.70	134.07
Total	74														

Keys:SV: Sources of variation; Df: Degree of Freedom; *; **:Significance at 5% and 1% respectively; **; DPS: Days to 50% pollen shed; DS: Days to 50% silking; DM: Days to maturity; pH: Plant height (cm); EH: EARS height (cm); Eppt: EARS per plots; Edm: EAR Diameter (cm); KRN: Kernel Row Number; KPR: Kernels per row; Cdm: Cob Diameter (cm); CWkg: Cob Weight (Kg); TP: Threshing percentage and GYPHA: Grain yield per hectare (kg)

Table 3: Mean performances for yield and other agronomic traits

ENTRY	DPS	DTS	DTM	PH	EH	EPPT	KPR	KRN	EDM	CDM	CW	KWKG	TP	GYPHA
P1	53^{b-f}	56^{abc}	90 ^{bc}	144.11 ^{abc}	59.96 ^{ab}	10.33^{a-d}	36.66^{a}	15.33^{a}	14.63^{a-d}	4.75^{a-c}	0.50	0.12 ^{hig}	26.96 ^{de}	337.78 $^{h-g}$
P2	54^{a-d}	56^{abc}	93^{ab}	141.00 $^{a-d}$	63.08 ^{a}	11.66^{a-c}	37.33 ^{a}	15.00^{a}	14.06^{a-d}	4.62 $^{a-c}$	0.65 ^{a}	0.12 ^{hig}	20.82^{c}	337.78 $^{h-g}$
P3	54^{a-c}	57^{abc}	91^{a-c}	129.55^{b-g}	56.06^{ab}	10.66^{a-d}	37.66 ^{a}	15.00 ^{a}	14.10^{a-d}	4.61 $^{a-c}$	0.53 ^{a}	0.21 $^{c-f}$	43.25 $^{a-e}$	577.78 $^{c-f}$
P4	51 $^{c-f}$	53 ^{bc}	87 ^{c}	133.22^{a-f}	62.120 ^{a}	11.00^{a-d}	29.00 ^{ab}	14.00 ^{a}	13.63^{a-d}	4.66 $^{a-c}$	0.50 ^{a}	0.27 ^{bc}	63.84 $^{a-d}$	737.78 ^{bc}
P5	53^{a-f}	56^{abc}	90^{bc}	114.44^{fg}	42.96 ^{b}	9.00 $^{a-d}$	29.33^{ab}	16.00 ^{a}	12.96^{b-d}	5.08^{ab}	0.66^{a}	0.40^{a}	70.79^{ab}	1075.56^{a}
P6	57^{a}	61^{a}	96^{a}	121.22^{e-g}	49.43^{ab}	9.33^{a-d}	32.33^{ab}	15.00^{a}	13.86^{a-d}	4.66^{a-c}	0.4^{a}	0.10^{h-g}	27.30^{de}	284.44^{h-g}
P1P2	50^{c-f}	53^{bc}	87^{c}	89.33^{h}	49.96^{ab}	5.66^{d}	22.66^{b}	13.33^{a}	11.96^{d}	4.37^{bc}	0.40^{a}	0.11^{h-g}	30.83^{c-e}	302.22^{h-g}
P1P3	52^{c-f}	54^{bc}	89^{bc}	125.44^{c-g}	54.98^{ab}	10.33^{a-d}	27.00^{ab}	15.33^{a}	13.53^{a-d}	4.91^{a-c}	0.63^{a}	0.13^{h-g}	25.00^{e}	364.44^{f-i}
P1P4	4z^{ef}	53^{bc}	88^{c}	145.44^{ab}	59.43^{ab}	7.00^{b-d}	31.66^{ab}	14.00^{a}	13.76^{a-d}	4.33^{bc}	0.39^{a}	0.17d^{e-g}	43.87^{a-d}	453.33^{d-g}
P1P5	51^{b-f}	55^{bc}	88^{bc}	124.44^{d-g}	59.08^{ab}	10.00^{a-d}	29.33^{ab}	13.33^{g}	12.43^{b-d}	4.75^{a-c}	0.41^{a}	0.15^{e-i}	40.00^{b-e}	400.00^{e-i}
P1P6	53^{a-f}	56^{abc}	88^{bc}	116.77^{e-g}	53.87^{ab}	6.66^{cd}	30.33^{ab}	14.66^{a}	13.76^{a-d}	4.50^{a-c}	0.35^{a}	0.19^{d-g}	64.34^{a-d}	506.67^{d-g}
P2P3	57^{c-f}	53^{bc}	87^{c}	124.77^{c-g}	52.18^{ab}	8.66^{a-d}	33.00^{ab}	16.00^{a}	14.83^{a-c}	4.83^{a-c}	0.45^{a}	0.083^{i}	26.06	222.22^{i}
P2P4	51^{c-f}	54^{bc}	88^{c}	126.99^{b-f}	54.96^{ab}	8.00^{a-d}	35.33^{ab}	15.66^{a}	12.50^{b-d}	4.66^{a-c}	0.35^{a}	0.14^{e-i}	43.33^{a-e}	382.22^{e-i}
P2P5	49^{ef}	51^{c}	88^{bc}	142.22^{a-d}	64.41^{a}	11.66^{a-c}	34.66^{ab}	14.00^{a}	13.20^{b-d}	4.75^{a-c}	0.58^{a}	0.33^{ab}	67.41^{ac}	897.78^{ab}
P2P6	56^{ab}	59^{ab}	92^{a-c}	134.99^{a-e}	62.00^{a}	9.00^{a-d}	35.33^{ab}	15.33^{a}	13.53^{a-d}	4.75^{a-c}	0.50^{a}	0.11^{h-g}	28.29^{de}	302.22^{h-g}
P3P4	52^{c-f}	56^{abc}	90^{bc}	115.55^{fg}	48.87^{ab}	7.66^{b-d}	29.66^{ab}	15.00^{a}	12.40^{b-d}	4.16^{bc}	0.36^{a}	0.28^{bc}	78.82^{a}	746.67^{bc}
ENTRY	DPS	DTS	DTM	PH	EH	EPPT	KPR	KRN	EDM	CDM	CW	KWKG	TP	GYPHA
P3P5	51^{c-f}	53^{bc}	88^{bc}	135.66^{a-e}	58.53^{ab}	12.33^{ab}	36.66^{a}	14.00^{a}	14.10^{a-d}	5.50^{a}	0.65^{a}	0.18^{d-g}	30.03^{c-e}	497.78^{d-g}
P3P6	53^{a-f}	56^{abc}	91^{a-c}	136.00^{a-e}	59.16^{ab}	9.66^{a-d}	34.00^{ab}	14.66^{a}	14.96^{a-c}	4.83^{a-c}	0.51^{a}	0.16^{e-i}	32.56^{c-e}	426.67^{e-i}
P4P5	50^{c-f}	53^{bc}	87^{c}	128.44^{b-g}	47.57^{ab}	9.66^{a-d}	26.6^{6ab}	13.66^{ab}	15.20^{ab}	3.95^{c}	0.40^{a}	0.08^{hi}	28.06^{de}	231.11^{h-g}
P5P6	56^{ab}	57^{ac}	92^{ac}	117.22^{e-g}	55.51^{ab}	13.33^{a}	36.33^{a}	15.00^{a}	14.30^{a-d}	4.75^{a-c}	0.66^{a}	0.09^{h1}	16.21^{e}	248.89^{hi}
P4P6	54^{a-e}	56^{abc}	92^{a-c}	131.63^{a-g}	53.31^{ab}	6.33^{cd}	36.66^{a}	14.00^{a}	15.20^{ab}	4.33^{bc}	0.30^{a}	0.22^{c-e}	78.89^{a}	586.67^{c-e}
QPM	49^{f}	52^{c}	87^{c}	149.66^{a}	62.32^{a}	10.66^{a-d}	38.33^{a}	14.66^{a}	16.06^{a}	4.91^{a-c}	0.70^{a}	0.24^{cd}	38.20^{b-e}	657.78^{cd}
JO-F	50^{e-d}	53^{bc}	88^{c}	112.77^{g}	51.74^{ab}	7.00^{b-d}	35.33^{ab-b}	14.33^{a}	13.63^{a-d}	4.66^{a-c}	0.38^{a}	0.10^{h-g}	32.67^{c-e}	284.44^{h-g}
S.15	51^{c-f}	53^{bc}	89^{bc}	132.00^{a-g}	60.60^{ab}	9.33^{a-d}	31.33^{ab}	14.66^{a}	13.83^{a-d}	4.66^{a-c}	0.66^{a}	0.28^{bc}	42.64^{a-e}	746.67^{bc}
Oba-98	52^{c-f}	54^{bc}	88^{bc}	128.11^{b-g}	58.87^{ab}	7.33^{b-d}	31.33^{ab}	14.33^{a}	13.20^{b-d}	4.33^{bc}	0.30^{a}	0.08^{i}	34.44^{b-e}	222.22^{i}
Mean	52	55	89	95.88	78.25	7.17	48.06	2.20	2.03	0.31	0.04	0.00	373.70	13046.07
CV	4.42	5.52	3.09	7.65	15.80	28.83	21.19	10.14	10.40	12.03	41.12	24.14	46.74	24.14
SE$\pm$	0.77	1.00	0.92	3.26	2.94	0.89	2.31	0.49	0.47	0.18	0.06	0.01	6.44	38.07

Keys:DPS: Days to 50% pollen shed; DTS: Days to 50% silking; DTM: Days to maturity; pH: Plant height (cm); EH: EPPT: EARS per plots; EDM: EAR Diameter (cm); KRN: Kernel Row Number; KPR: Kernels per row; CDM: Cob Diameter (cm); CW(kg): Cob Weight (Kg); TP: Threshing percentages and GYPHA: Grain yield per hectare (kg)

CONCLUSION AND RECOMMENDATION

In the present study, the means sum of squares due to genotypes indicated highly significant differences ($P \leq 0.01$) for DPS, pH, kwkg and Gypha; Thus revealed the presences of substantial genetic variability among the genotypes. It was observed in the study that P5 and P2P5 are the higher yielding genotypes with 107.56kg/ha and 897.78kg/ha respectively.

It is thus, recommended that:

1. P5 could be selected for hybridization program to come up with an improve varieties.
2. P2P5 was the higher yielding genotypes.
3. More research should be conducted in order to validate the findings.

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