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Genetic Variability among Maize Cultivars Grown in Ekiti-State, Nigeria

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Abstract: An appreciable level of variation within crop varieties is essential to initiate and sustain crop improvement using plant breeding methods. A field experiment was conducted with the aim of estimating variation among maize cultivars grown in Ekiti State. Twenty maize cultivars obtained from various locations within the state was evaluated between April to August 2005 at the Teaching and Research Farm, University of Ado-Ekiti. The twenty cultivars constituted the treatment, which was lied out in a Randomized Complete Block Design with three replicates. Result shows that there were significant ($p<0.05$) difference for in day to first silking and anthesis, days to 50% anthesis and silking, plant and ear heights, leaf blight and curvularia leaf spot and grain yield. Grain yield ranges from 3.02 t ha^{-1} for Ijelu and 4.91 t ha^{-1} for Ilupeju. Phenotypic and genotypic variance was highest for plant and ear heights and least for the foliar disease rating and significant for all the traits except ear $plant^{-1}$. Broad sense heritability estimates ranged from 0.16 for ear $plant^{-1}$ to 0.71 for Curvularia leaf spot. Correlation coefficient was positive and significant between grain yield and both plant and ear heights, but negative with Curvularia leaf spot. These results are suggestive that the cultivars evaluated in this study are good candidates on which improvement activates can be initiated the incorporation of high grain yield traits would also have a long run advantage.

Key words: Missing

INTRODUCTION

Maize *(Zea mays*) is a widely grown crop in most parts of the world due to its adaptability and productivity. It is one of the most important crops in West Africa accounting for over 24% of the total cereal production [1]. Maize production was limited to small area under the traditional farming system in the early days in Nigeria. With high demand for industrial uses and livestock feed, it has become one of the major crops grown in most part of Nigeria.

To guarantee high yield of maize crop, farmers often grow improved varieties usually from different sources either alone or with other local varieties, resulting in diversity among cultivars grown within and among farmers. 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. Progress from selection has been reported to be directly related to the magnitude of genetic variance in the population [2-4]. Large amount of genetic variability has been observed to occur in the original accessions and races among sampled population representing different climatic, geographical regions [5]. Abayi *et al*. [6] observed significant genetic variation in important agronomic traits, especially earliness to sufficiently justify the initiation of selection programme. The results of Jotshi *et al*. [7], Alvarez and Lasa [8], Lu *et al*. [9] and Zhang *et al*. [10] demonstrated the importance of quantifying genetic variability among maize cultivars grown in an area before initiation of breeding programme.

There is a dearth of information on variability among maize grown in Ekiti. Therefore, this study was undertaken to determine the genetic variability among the different maize cultivars grown in Ekiti State, Nigera. The results from this investigation would serve as a guide to plant breeders to initiate an improvement programme.

MATERIALS AND METHODS

The experimental study area was located at the Teaching and Research farm of the University of Ado Ekiti state. It lies between latitude 7° 31' and 7° 94' N. The land has been used continuously for the cultivation of arable crops like maize, yam, melon, cowpea and vegetables for more than six years.

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Table 1: Location of collection and kernel characteristics of maize cultivar used in the study

Cultivar	Location of collection	Kernel colour	Kernel type
1	Ado 1	White/yellow	Flint
2	Ado 2	White	Flint
3	Efon	White/yellow	Flint
4	Ejero	White	Flint
5	Emure	White	Dent
6	Ifaki	White	Flint
7	Igede	White	Flint
8	Igogo	White	Dent
9	Ijelu	Yellow	Flint
10	Ikere	Yellow	Flint
11	Ikole	Yellow	Flint
12	Ilawe	White	Flint
13	Ilupeju	White	Dent
14	Ire	White	Dent
15	Ise	Yellow	Flint
16	Iworoko	White	Dent
17	Iyin	White	Flint
18	Ode	White	Dent
19	Omuo	White	Flint
20	Otun	White	Dent

The twenty varieties used in this study were obtained from different locations in Ekiti State. The list of the varieties and collections area as well as some of their characteristics are presented in Table 1, the 20 varieties constituted the treatment which was laid out in a Randomized Complete Block Design with three replicates. The land preparation was done mechanically by ploughing and harrowing. Maize seeds were treated with Apron® plus to prevent downy mildew. Each plot consisted of a row 5 m long with an inter and intra row plant spacing of 0.75 x 0.5 m. Three seeds were planted per hill which was later thinned to two at 2 Weeks After Planting (WAP), to give an equivalent plant population of 53,333 plant ha^{-1}; each plot had a total of 22 plants which were considered for data collection. Border rows were planted to minimise undue advantage by varieties planted at the extremes. At 2 WAP, NPK 15:15:15 fertilizer was applied at the rate of 300 kg ha^{-1} and top dressed with urea at the rate of 150 kg ha^{-1} at flowering. Weeding was done manually at 7 and 10 WAP. The following data were obtained: (a) Plant height: the distance from the base of the plant to the first tassel branch measured in cm, obtained from five competitive plants. (b) ear height: the distance from the base of the plant to the node bearing upper ear measured in cm, obtained from five competitive plants. (c) days to 50% silk: the number of days from planting to 50% of the plants emerged silk. (d) days to 50% anthesis: The number of days from planting to when 50% of the plants have shed pollen. (e) *Bipolaris maydis* blight (leaf blight): Rating was done on a scale of 1 to 5, where 1= little or no blight and 5 = severe blight. (f) *Culvularia lunata* (Culvularia leaf spot): rating was done on a scale of 1 to 5, where 1 = little or no leaf infection and 5 = severe leaf infection. (g) Grain Yield (kg ha^{-1}) = (Ear weight (kg) / area in m^2) x (10000 x 0.80).

Data were subjected analysis variance by Statistical Analytical System (SAS). Mean were separated using least significant difference at 50% level of probability. Genetic variance was calculated using variance command of SAS/STAT [11].

RESULTS AND DISCUSSION

Mean days to 50% flowering differed significantly ($p<0.05$), with a difference of almost 3 days for anthesis and 5 days for silking among the extremes of the cultivars (Table 2). Cultivar from Otun had the least days to 50% anthesis (59.7), while the highest was observed in cultivar

Table 2: Means (±SE) of days to 50% flowering, plant and ear height of the maize varieties

	Days to 50%		Height	
Variety	Anthesis	Silk	Plant	Ear
Ado 1	61.67±0.67	60.67±0.67	212.00±7.51	114.00±8.96
Ado 2	62.33±0.88	64.33±2.60	203.73±20.69	116.07±13.93
Efon	61.67±0.33	64.00±1.53	212.67±4.81	117.73±7.17
Emure	61.67±0.67	63.33±0.33	231.00±8.70	135.20±14.24
Ifaki	60.67±0.67	59.00±0.58	199.33±3.84	111.80±11.10
Igede	61.00±2.08	63.00±3.46	240.80±22.11	141.67±13.67
Igogo	62.00±1.15	64.67±2.73	215.47±10.53	122.37±11.80
Ijelu	63.00±1.00	64.33±2.40	187.40±2.61	98.53±10.06
Ijero	61.00±0.58	63.33±0.88	202.67±6.89	108.67±5.93
Ikere	61.00±0.00	62.67±1.45	203.00±20.79	120.33±8.97
Ikole	61.67±0.33	62.67±2.67	216.13±6.97	115.07±1.07
Ilawe	61.33±0.88	62.67±1.45	223.33±4.26	115.13±4.95
Ilupeju	61.00±1.00	62.00±1.53	219.80±12.00	117.13±14.10
Ire	61.33±0.88	64.33±1.20	239.00±6.00	134.73±7.37
Ise	61.67±0.33	62.67±2.73	200.93±21.54	126.00±7.51
Iworoko	62.00±0.58	60.00±0.58	214.13±9.03	121.67±14.33
Iyin	62.33±0.33	62.00±1.53	212.67±12.57	114.00±11.37
Ode	62.00±0.58	64.33±2.60	223.87±15.89	124.07±12.30
Omuo	60.33±0.67	62.00±1.15	203.13±12.50	106.33±12.67
Otun	59.67±0.67	62.67±0.88	202.73±3.87	104.20±0.69
Mean	61.47	62.73	213.19	118.24
S.E.M	0.18	0.39	10.55	7.32
C.V (%)	2.27	4.87	13.18	8.52

Table 3: Mean and standard Error of foliar Disease rating among the varieties

Variety	Blight	Curvularia leaf spot	Ear plant^{-1}	Grain yield t ha^{-1}
Ado 1	2.67±0.33	2.00±0.29	0.93±0.02	4.34±0.40
Ado 2	2.67±0.73	2.50±0.50	1.00±0.09	3.94±0.17
Efon	2.33±0.17	2.00±0.00	0.97±0.11	4.05±1.19
Emure	2.83±0.17	1.67±0.17	0.98±0.02	4.91±0.75
Ifaki	2.67±0.17	2.33±0.17	0.91±0.08	3.59±0.17
Igede	2.50±0.29	2.00±0.29	0.95±0.00	4.51±0.58
Igogo	2.33±0.17	2.00±0.29	0.80±0.07	4.05±0.35
Ijelu	1.83±0.17	2.00±0.29	0.89±0.04	3.02±0.49
Ijero	3.00±0.50	2.33±0.17	0.96±0.06	4.34±0.49
Ikere	2.50±0.29	2.00±0.29	0.90±0.10	3.94±0.43
Ikole	2.17±0.17	1.83±0.17	1.00±0.03	4.05±1.10
Ilawe	2.50±0.29	2.59±0.29	1.00±0.07	3.71±0.96
Ilupeju	2.67±0.44	2.00±0.29	0.92±0.05	4.79±0.34
Ire	1.83±0.33	1.50±0.00	0.94±0.04	4.34±0.45
Ise	2.50±0.29	2.50±1.00	0.94±0.00	3.88±0.51
Iworoko	2.17±0.17	1.67±0.17	0.93±0.09	3.82±0.67
Iyin	2.83±0.67	2.00±0.29	0.94±0.06	4.34±0.50
Ode	2.67±0.17	1.67±0.17	0.89±0.06	4.45±0.69
Omuo	2.67±0.44	2.00±0.29	0.92±0.08	4.46±0.79
Otun	3.00±0.50	2.33±0.33	0.88±0.06	3.65±0.11
MEAN	2.49±0.12	2.14±0.1	0.94	4.11
S.E.M	0.08	0.07	0.01	0.27
C.V (%)	24.64	27.53	11.05	15.23

Scale of 1-5 1- Best plant form, free from disease

5- Most undesirable characterized by heavy diseases symptoms

from Ijelu (63.0). A different tread was observed for days to 50% silking with a range of 60.0 to 64.7 days observed in cultivars from Iworoko and Igogo, respectively. Generally there was a day delay in silking compared with anthesis. The Anthesis - silking interval (ASI) was 3 days as observed in cultivar from Ire. The shortened ASI observed in these cultivars is desirable because it has been reported that low ASI enhance maize tolerance to stresses during flowering and is ensures good graining filling [12, 13].

The trend in plant height and ear height of the cultivars are similar in this study. The highest heights were obtained in cultivar from Igede with 240.8 and 141.7 cm for plant height and ear height, respectively. While the least was obtained for cultivars from Ijelu with 187.4 cm plant height and 98.6 cm ear height. The mean plant height and ear height are within reasonable range compared with the report of Mankir and Akintunde [14].

The mean of two foliar diseases, ear per plant and grain yield are presented in Table 3. Leaf blight and curvularia leaf spot are generally not a serious problem, none of the cultivars exceeded rating of 3.00 on a scale of 1 to 5. Although the range in rating was close i.e. 1.83 to 3.00 for leaf blight and 1.50 to 2.59 for curvularia leaf spot, the variation among the cultivars for these leaf diseases was still statistically significant ($p<0.05$). The results obtained by Salami [15] for improved variety in Ikenne with similar ecology like Ado-Ekiti indicated higher disease rating than what was observed in this study.

The cultivar showed no prolificacy trait, none of the cultivar exceeded one ear per plant^{-1}. There might be a need to incorporate this trait in the base population before initiation breeding programmme, a positive correlation has been reported to be correlated with high yield in maize [3]. Grain yield ranged from 3.02 to 4.91 t ha^{-1} for Ijelu and Emure, respectively. The mean grain yield of 4.11 t ha^{-1} is considered high, although under farmer's own conditions it will be difficult to attain this level of yield because of poor management practices. The significant ($p<0.05$) differences in grain yield suggest the potentiality of the cultivars for improvement.

Pearson correlation among traits shows positive and significant correlation between grain yield and height, plant and ear (Table 4). Correlation between grain yield and days to 50% anthesis and curvularia leaf spot were negative and not significant ($p>0.05$). The highest correlation of 0.82 ($p<0.01$) was observed between plant and ear height. A high correlation between plant height and ear height has been reported by many authors to

Table 4: Pearson correlation coefficients among agronomic variable

		1	2	3	4	5	6	7	8
Days to 50% anthesis	(1)	-	0.33**	-0.05	0.06	-0.47*	-0.22	0.07	-0.18
Days to 50% silk	(2)		-	0.19	0.19	-0.24	-0.11	-0.05	0.07
Plant height	(3)			-	0.82*	-0.11	0.50*	0.24	0.65**
Ear height	(4)				-	-0.14	0.41	0.15	0.55*
Leaf Blight	(5)					-	0.42	0.06	0.39
Curvularia leaf spot	(6)						-	0.18	-0.42
Ear plant^{-1}	(7)							-	0.18
Grain yield	(8)								-

*, ** = Significant at 5 and 1%, respectively

Table 5: Genotypic and phenotypic variances estimates and broad-sense heritability of the agronomic traits

Traits	Variance estimates		Heritability estimates
	Genotypic	Phenotypic	(H_b) %
Days to 50% anthesis	0.56*	2.07**	0.27
Days to 50% silk	0.51*	2.52**	0.20
Plant height (cm)	65.31*	193.77*	0.34
Ear height (cm)	134.63*	382.23**	0.35
Leaf blight¶	0.21**	0.36**	0.58
Curvularia leaf spot¶	0.24**	0.34**	0.71
Ear plant^{-1}	0.61	3.81**	0.16
Grain yield t ha^{-1}	0.27*	1.14*	0.24

*, ** significant at p≤0.05 and 0.01, respectively

¶ based on a rating on a scale of 1-5

range from 0.78 to 0.88 [3, 15, 16]. The close relation among these traits will cause them to response similarly during improvement.

Genotypic and phenotypic variances and heritability estimate are presented in 5. There was significant genotypic variance for all the traits considered except ear plant^{-1}. However, all the traits showed significant phenotypic variance. This is an indication that variability within the maize cultivars is sufficiently divergent and constitutes potential candidate varieties on which improvement programme can be initiated. Additional sources of high grain yielding varieties of comparable flowering time can be obtained and recombined with these cultivars before initiating improvement. This will ensure that the resulting product of improvement would be able to compete favorably with the elite varieties already in use. Broad sense heritability estimates ranged from 0.16 to 0.71 for ear plant^{-1} and curvularia leaf spot, respectively. The estimates from this study compared well with those from other worker as compiled by Hallauer and Miranda [3]. Heritability estimates is of tremendous significance to the breeder, as its magnitude indicates the accuracy with which a genotype can be recognized by its phenotypic expression. One way to improve the estimate is to carry out evaluation in multiple environments generated either in location, time or both, perhaps the heritability estimates would have been improved if the evaluation had been conducted in multiple environments.

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