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EVALUATION OF SIX CHINESE MAIZE (ZEA MAYS) VARIETIES IN THE HUMID TROPICAL ENVIRONMENT OF CALABAR, SOUTH-EAST, NIGERIA.

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ABSTRACT: *Six hybrid Chinese maize varieties with a local best were evaluated for their growth and yield performance with a view to adoption in South east agroecological zone of Nigeria. A Randomised Complete Block (RCBD) Design was used. The cultivars did not differ ($p \leq 0.05$) significantly in some growth parameters, this included emergence percentage at 5DAP (days after planting), plant height at both 4WAP and 6WAP (weeks after planting). Tasseling and silking differed significantly, the exotic varieties tassled and silked better than the control at 8WAP and 10WAP respectively. The only significantly different yield parameters were the length and weight of undehusked cobs, circumference of dehusked cobs. The exotic varieties matured earlier than the control between 11 to 14WAP and 16WAP respectively. There was no significant difference in the grain yield between the maize varieties. The Chinese varieties did not show a marked difference in grain yield compared to the local*.

KEYWORDS: Maize, evaluation, growth, yield, environment, humid tropics,variety trial

INTRODUCTION

Maize (Zea mays) also known as corn, is an important grain crop of the world. It ranks second following wheat in the world production of cereal crops (Onwueme & Singha, 1991). It is the most important cereal in sub-Saharan Africa and it is mainly used for human consumption and in livestock industry with a small percentage used in agro-allied industries (International Institute for Tropical Agriculture, 2006). Maize is native to the Americas but was introduced to sub-Saharan Africa during the mid-1500s by Portuguese and Arab traders (Porteres, 1955). By the early 16th century, it was introduced along the West Coast of Africa through Ghana and this could include Nigeria (Purseglove, 1968).

The spread of maize cultivation in the world was due to its diversity, high adaptability and versatility (Obi, 1991). Maize grows well in the most varied conditions and in Nigeria it has almost replaced traditionally grown cereals such as sorghum particularly in the Northern savannah agro-ecological zone (Iken & Amusa, 2004). The reasons for its popularity include high yields per unit area, husk protection against birds and rain, fairly easy to weed as well as possession of a good competition rate with weeds because of its rapid vertical growth (Onwueme & Singha, 1991).

Despite an increased area of land which has been dedicated to cultivate maize since the mid-2000s, production per hectare is still low (1.3 t/ha) compared to the 8.6t/ha in developed countries (IITA, 2009). However, the yield of maize in recent years has increased significantly due to several breeding programs as a response to pest and diseases such as the American rust (Iken & Amusa, 2004). But improved high yielding maize variety can express its full genetic potential only when offered optimum management resources, (*ibid)*. Hybridisation is one of the many improvements methods for maize. Hybrids usually have higher yields and are more

resistant to weeds, other pest and diseases, and they have early maturing dates (Allard, 1966). But the full expression of these characteristics might vary with environments.

In order to adopt a crop variety, its growth as well as the yield potential in the target environment should be evaluated. Hence the objective of this work was to determine the growth and yield parameters in the six hybrid varieties from China using the best local variety (Ikom white) as the control in the Calabar agro-ecological area of south-east Nigeria. This was with a view to identifying the high yielding and early maturing variety (ies) for possible environmental adaptation and improvement.

Materials and Methods

This evaluation trial was carried out in the Teaching and Research Farm of the Faculty of Agriculture, University of Calabar which falls within the humid tropical rainforest agro ecological zone of Nigeria during the 2007 early planting season beginning in April to July. Calabar is located between latitudes 4.5˚ – 5.2˚ N and longitude 8.0 – 8.3˚ E, with a mean temperature of 26.8 ˚C during the first planting season. The soil for the experimental site was an acidic Sandy Loam as shown in Table 1 below.

pH	Organic Carbon (%)	Total Nitrogen (%)	P-Bray (Mg/Kg)	Exchangeable Cations				ECEC (cmol/ kg)	Base Saturation (%)	Texture (%)			Textural Class
				Ca	Na	Mg	k			Sand	Silt	Clay	
4.78	0.96	0.08	84.0	1.0	0.05	0.6	0.08	37.65	23.0	81.3	6.7	12.0	SANDY LOAM

Table 1. Physicochemical Properties of the Soil of the Experimental Site

The Six Chinese maize varieties were China Agricultural University ND 160, Jing Hai-5, 702, 26-617/618, CAU 4515 (high oil), CAU 541 (normal corn) while the local best was Ikom White.The experiment was laid out in a Randomised Complete Block Design (RCBD) with seven treatments (varieties) replicated three times. This gave a total of twenty one test plots. The gross plot size area was 390m² with each plot dimension of 3m X 3m and 1m path between replicates as well as plots. Manually tilled ridges were used and each replicate consisted of seven plots in consistency with the number of varieties used. The seeds were sown at a planting distance of 30 x 50cm and at a seed rate of two seeds per hole. There were 30 stands of the plant per replicate and a total plant stand of about 630. Weeds were controlled manually at 3WAP and 7WAP. The predominant weed was *Cyperus rotundus* (yellow sedge nut).

Nitrogen fertilizer was split applied at 3WAP and 7WAP at the rate of 120kg/ha. Nitrogen source was urea and the first application of Nitrogen was a side dressing while the second application was top dressing. Phosphorous and potassium were applied once at 3WAP at the rate of 80kg/ha and 60kg/ha respectively as recommended by Federal government (Nigeria) fertilizer department (FFD, 2002). Phosphorous source was Single Superphosphate (8%) while potassium was supplemented using Muriate of Potash (MOP-50%).

Data was collected on the following growth and yield parameters: emergence (%), plant height (cm), tasseling (%), silking (%), length of cobs with and without husk (cm), weight of cobs with and without husk (g), circumference of cobs without husk (cm), number of lines per cob, number of grains per line, number of filled grains per line, number of unfilled grains per line, weight of 100-grains (g), economic yield from five randomly sub-sampled plants.Data was statistically analysed using analysis of variance (ANOVA) in accordance with randomised complete block as described by (Gomez & Gomez, 1984). Treatments were compared and the means separated using the Least Significant Difference (LSD) test. The f values for treatment and block effects were compared at 5% (0.05) probability level.

RESULTS

Data on the growth and yield parameters measured are tabulated on the three tables below.

Cultivars	Emergence @ 5DAP (%)	Plant Height @4WAP (Cm)	Tasselling @ 8WAP (%)	Silking @10WAP (%)	Weight Of Undehusked Cobs (g)
ND 160	68.50	41.7	51.8	60.48	150.38
JING HAI 5	89.50	37.1	66.0	76.53	123.76
702	81.48	40.8	58.6	70.98	186.60
26-617/618	91.97	40.2	67.8	70.36	121.53
CAU 4515	91.97	51.4	88.9	89.50	115.33
CAU 541	87.03	40.7	26.5	65.42	174.31
Ikom White	77.15	41.1	17.3	43.20	147.66
Significance	NS	NS			
LSD	-	-	29.89	20.60	41.42

Table 2: GROWTH/YIELD PARAMETERS (MEANS) OF THE MAIZE VARIETIES

There was no significant difference in emergence among the maize varieties as shown in Table 2 above. However CAU 4515 and 26-617/618 had the highest percentage of emergence. Plant height both at 4 and 6 WAP did not differ significantly amongst the varieties. For tasseling and silking, the maize varieties differed significantly. CAU 4515 had both the highest tasseling and silking percentages while the control (Ikom white) had the lowest percentages for both tasseling and silking, (refer to Table 2).

The weight and length of undehusked cobs differed significantly. The weight and length ranged from 115 to 186g, and 21 to 27cm respectively. 702 had the highest weight of undehusked cob while the control had the longest undehusked cob (Tables 2&3.).

There were no significant differences between the varieties when the cobs were dehusked, both in the weight and length. The circumference of each of the dehusked cobs was significantly

different, ranging from 10.6 to 12.9cm. The cob circumference differed in the decreasing order: CAU 541, 702, Ikom white (control), JING HAI-5, 26-617/618, ND 160 and CAU 4515.
All other yield parameters were not significantly different and they were: number of lines per cob, number of grains per line, number of filled and unfilled grains, weight of 100-seeds at 15% moisture content, and the grain yield per hectare. The grains of the Chinese varieties were filled more than the control which had a great number of unfilled grains per line. CAU 4515 matured earliest at 11WAP while Ikom White was the lastest to mature at 16WAP.

Cultivars	Weight Of Dehusked Cobs (g)	Length Of Dehusked Cobs (cm)	Length Of Undehusked Cobs (cm)	Circumference Of Dehusked Cobs (cm)	No. Of Lines On Cob
ND 160	122.1	14.9	22.0	11.2	13.5
JING HAI 5	97.4	16.2	24.7	11.8	12.7
702	148.4	17.5	23.6	12.8	12.2
26-617/618	99.1	15.6	24.1	11.6	12.1
CAU 4515	70.4	13.5	21.3	10.6	11.8
CAU 541	133.2	16.1	23.9	12.9	12.4
Ikom White	115.9	15.5	27.1	12.8	13.6
Significance	NS	NS			NS
LSD	-	-	2.66	1.22	

Table 3: GROWTH/YIELD PARAMETERS (MEANS) OF THE MAIZE VARIETIES CONTD.

Cultivars	No. Of Grains Per Line	No. Of Filled Grains/Line	No. Of Of Unfilled Grains/Line	Weight Of 100-Grains (g)	Grain Yield (t/ha)	Time of Harvest (WAP)
ND 160	26.5	25.5	1.6	21.7	7.7	13
JING HAI 5	25.4	21.7	3.5	23.9	7.3	12
702	28.7	27.0	3.3	26.6	5.9	13
26-617/618	27.4	23.2	3.7	20.8	4.3	12
CAU 4515	25.1	23.5	3.4	21.4	8.0	11
CAU 541	26.3	24.6	1.9	29.1	5.8	14
Ikom White	22.3	12.7	9.4	24.5	6.6	16
Significance	NS	NS	NS	NS	NS	
LSD	-	-	-	-	-	

Table 4: GROWTH/YIELD PARAMETERS (MEANS) OF THE MAIZE VARIETIES CONTD

DISCUSSION

Plant population affects plant growth including its height which is as a result competition for light but Olson & Sanders, (1988) showed that hybrids are better adapted to tolerate high plant densities. However (Iken & Amusa, 2004) recommends a plant population of 53,333 plants/ha at 75cm x 50cm at 2plants per hill. But the plant population in this trial was about 133,333 plants per hectare which may have been above optimum and all varieties appear not to have been affected much by this high population. Also the height of maize and to some extent its yield potential are strongly influenced by environmental conditions during stem elongation (Evans, 1975). There was no significant difference for height of plants and so presumably the environmental conditions were favourable for stem elongation. The emergence of the control was comparable with the Chinese varieties and so the Chinese varieties did not show any edge being hybrids as proposed by Tollenaar & Daynard, (1982).

Maize is a species that presents a protandrous developmental pattern which pollen matures before ovum (Sangoi, 1996) and this characteristic is accentuated under adverse conditions such as nutritional deficiency, drought stress or high plant populations (Sangoi & Salvador, R. J, 1998). The timing of nutrient application also affects the growth of plants and in this instance the top dressing of nitrogen fertilizer at 7WAP probably favoured tasseling development. This was shown by the overall high percentage of tasseling in table 2.

Sangoi and Salvador (1998) indicated that delay in silking is the predictor of barrenness and the production of fewer kernels per ear in maize. The control indicated delay in silking and this could have been responsible for the low number of grains per line on the ear. Also the number

of filled grains conformed to the study by Cantarero, et al., (1999); and Otegui, et al., (1995) that silking, an indicator of growth rate affects the quality of grains/yield. Contextually this refers to the number of grains on cob and the filling of grains. The control had the least number of filled grain per line as well as the highest number of unfilled grain per line. This brings to mind the issue of yield quality for the control and its marketability compared to the Chinese varieties. The exotic varieties had faster growth rate hence lesser number of unfilled grains compared to the control.

The final kernel weight depends largely on grain filling duration. A higher nitrogen uptake from soil or remobilization of nitrogen from vegetative tissues to grains after silking delays leaf senescence, prolongs filling period producing heavier grains. CAU 541 which had a less rapid silking had heavier seeds (100) amongst all the varieties to corroborate the findings of Cantarero, et al., (1999) and Otegui, et al., (1995).
The grain yield of the Chinese varieties failed to corroborate strongly the claims by Kim et al. (1993), Ajibade and Ogunbodede (2000) and, Akande and Lamidi (2006), that normal maize hybrid varieties were known to be superior to other maize varieties in yield potentials. The local best, Ikom white performed comparably well as the Chinese varieties with a grain yield of 7.0kg/ha.
Conclusion

Maize grows well in the most varied conditions but the interaction between the environments and its genotype and variety is crucial to its production. The growth performance of the varieties in the trial indicated that the Chinese varieties possessed a good genetic potential perhaps because they are hybrids but the environment was probably not so conducive for full genetic expression particularly in grain yield. Out of sixteen growth and yield parameters measured, five differed significantly amongst the varieties. The Chinese varieties showed an edge over the local best variety, Ikom white in terms of tasseling and silking (growth). It could be inferred from the results obtained that some of the Chinese varieties would do well in the south east agro ecological zone of Nigeria. It is probably accurate to conclude that the high-oil variety CAU 4515 was the best performing variety of the Chinese varieties in terms of its vegetative growth and grain yield. The other varieties that can be grown as substitutes are: Jing Hai-5, Chinese Agricultural University ND 160 and the normal corn CAU 541. Overall the Chinese varieties had a faster growth rate compared to Ikom White.

FUTURE RESEARCH

For confirmation of the growth and yield parameters, further trial should be carried out and perhaps with increased fertilizer application as well as improved cultural practices. Also further research can focus on the quality of the grains. The control had many unfilled grains compared to the Chinese varieties and this could affect marketability considerably. Also, the Chinese maize varieties have a characteristic yellow colour while the local, is white as the name indicates. A yellow colour could influence the palatability of pap or Ogi, a popular by-product of maize in Nigeria. The implication of this is that a yellow Ogi might very well be me the substitute for custard which is a processed and more expensive form of pap. So it would be worthwhile investigating the quality of the Chinese varieties and it's market prospects.

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