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ADAPTABILITY OF SEVEN MAIZE *(ZEA MAYS L.)* VARIETIES IN HIGH HUMID RAINFOREST ZONE OF NIGERIA

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ABSTRACT

Field experiment was conducted at National Cereals Research Institute (NCRI) Uyo-Out station in 2015 and 2016 cropping seasons. The aim was to evaluate the yields of seven maize varieties in humid rainforest of Uyo, Southeastern Nigeria in view of recommending high yield varieties. The experiment was laid out in a randomized complete block design, replicated three times. The treatments were seven maize varieties viz- : *Uwep* (local). FARZ 32, Oba super 2, Oba 98 and suwan-I-SR, Quality protein maize (QPM) and extra-early. Growth and yield data were subjected to analysis of variance. Significant mean were compared using least significant difference at $p<0.05$. The result showed significant difference($p<0.05$) plant height. FAR 32 was the tallest at 9WAP (159.37 and 163.33 cm in 2015 and 2016 cropping seasons, respectively) The shortest variety, 121.12 and 122.61 cm, respectively at 9WAP was recorded in QPM. The weight of grains varied significantly different. FARZ 32 had the heaviest 100 grain weight, 42.60 g and 41.30 g in 2015 and 2016, respectively. The least weight of 100 seeds 31.09 g and 32.99 g, respectively was recorded from Extra Early maize. Comparing the maize grain yield, the result indicated significant difference ($p<0.05$) in both cropping seasons. FARZ 32 had the highest grain yield, 4.37 and 4.30 tonnes per hectare in 2015 and 2016 in both cropping seasons. Oba super 2 had 4.30 and 4.20 tonnes per hectare in 2015 and 2016. The local cultivar *Uweb* had 2.49 and 2.59 tonnes per hectare grain yield in both years. The least grain yield, 2.32 and 2.45 tonnes per hectare, respectively was from Extra early maize. Oba, Farz -32, Oba super 2 and Oba 98 were recommended to farmers in the study area.

Keywords: Maize, Varieties and yield

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INTRODUCTION

Maize *(Zea mays L.)* is ranked third after wheat and rice in the world food grain production. It is grown extensively in both tropical and temperate parts of world. In 2017, maize production for Nigeria was 10.4 million tonnes. Though Nigeria maize production fluctuated substantially in recent years, it tended to increase through 1968 - 2017 period ending at 10.4 million tonnes in 2017 (FAO,2018). According to Statista's world corn production by country 2016/17, Nigeria only produces 7.2 million metric tons of Maize, a good chunk of Africa's corn production but considerably small when compared to USA's corn production which stands at 384 million metric units. Maize has different planting seasons depending on location and takes an average of 2 – 4 months to reach harvest. Maize is usually planted in well-loosed, well-drained soil with compost added to the planting area before planting begins. Maize is a good source of vitamins, minerals, and dietary fiber. Especially since a lot of small-scale farmers are involved in maize farming, it makes it an affordable source of vitamins and minerals for people living in rural areas.

Grains crop produce in Nigeria ranges from; maize, rice, cowpea, soybean, sorghum including millet (Adekunle and Nabinta,2000). Food and Agricultural Organization (2009) data indicated increase in maize production in Nigeria, in part because of the plant ability to strive in different ecological zone within the country. Maize is one of the most important grains in the world. The crop is consumed as staple food in Nigeria, accounting for about 43% calorie in the diet of an average Nigerian (Nweke,2004). Several studies on maize production has pointed out the crop increased across all agro ecological zones of the country.

The crop has been utilized by food processing industries, pharmaceutical, herbal including medicinal sectors. The crop was report- ed by Ayeni (1991) to be used as local 'cash crop', indicating that 30% of land has been devoted to maize cultivation. Increase in maize production to 1-3 hectares in any farming system was reported by Ogunsumi *et al* (2005) to be able to combat hunger in household, in addition to increase food production especially in Africa. Increase in maize production from 612 thousand tonnes to 70195 thousand tonnes has been reported by Alabi and Esobhawan (2006), representing 1000% increase. About 561397.29 hectares of arable land in Nigeria has been put into maize production with increase in the crop price, pointing to the importance of maize in the country's economy.

Maize is usually been intercropped, especially among the subsistence farmers in semi intensive system of farming. Survey by Eneh and Onwubuja (1992) presented maize mixed cropping as a means of better utilization of land and increase in annual crop output, when compared to maize monocropping. The large hectares of land been devoted to maize production indicates the potentials of the crop in fighting global food shortages. Report by IITA (2014) indicated maize production at 8 million tons in Nigeria. Annual production of maize in Nigeria accounts to a value of 5.6 million tons (CBN,1992). Hartmans (1985) findings revealed that maize is cultivation to 1 million hectares in Nigeria , out of the 9 million hectares cultivated in Africa, presenting Nigeria as one of the exporter of maize and the largest African producer of maize, contributing to increase production of crops to feed the fast growing human population, especially in developing countries like Nigeria.

Inspite of the fact that maize is cultivated virtually in every village and hamlet in Nigeria, the production of the crop for human consumption, livestock feeds and other multifarious industrial uses, is absolutely inadequate in Nigeria and other countries in Africa. This could be as a result of increased in domestic and industries use of maize. Increase in human population could be another factor while pest /diseases, poor soil fertility and unavailability of improved cultivars that could perform in different agro-ecology were among the major challenges of maize production. There is therefore an urgent need to double the national annual maize production through expansion of land under cultivation by selecting appropriate maize variety (ies) suitable to high humid agro ecological zone.

MATERIAL AND METHODS

The study was conducted at the National Cereals Research Institute (NCRI), Uyo Out-Station, Akwa Ibom state, during the early and late planting season of 2017 between the months of March and December. The experimental site is situated between latitude $04^{o}58^{'}$ N and longitude $07^{o}56^{'}$E and about 67 m above sea level. The area which lies within the humid tropical rainforest zone of southeastern Nigeria has average annual rainfall of about 2500 mm and mean monthly sunshine of about 3.14 hours. The mean annual temperature range is 26°C- 28°C. Uyo has an annual mean relative humidity of 79% and evaporation rate of 2.6 cm^2. The rainfall pattern of Uyo is bimodal. Rain usually starts in mid- March and ends in Mid-November, with a short period of relative moisture stress in August traditionally referred

to as "August Break" (Peters *et al*., 1989). Temperatures are generally highest in the months of February through April (Peters *et al*., 1989).The soil has been described as a typical acid soil. The experiment was carried out on a plot that had been cultivated continuously by other researchers and prior to the experiment; cassava was harvested on the experimental plot in November, 2014, while garden egg was harvested in July 2015 before planting in March, 2015 and 2016.

The experiment was laid out in a randomized complete block design and replicated three times. The treatments were namely: *Uwep* (local). FARZ 32, Oba super 2, Oba 98, Quality protein maize (QPM), extra-early and suwan-I-SR. The local variety was obtained locally while Oba super, suwan-I-SR, FARZ 32, Quality protein maize (QPM), extra-early and Oba 98 were obtained from National Seed Service Umudike, Umuahia Abia State.

The experimental area measured 26m x 19m. Each replicate contained 5 plots, each measuring 5m x 4m. Each plot and each replicate were separated by a path of 1.0 m. The maize seeds were planted on April 30, 2015 and 2016 at a planting distance of 75 cm x 30 cm with three seeds per hole which were later thinned to one stand per hole, giving a plant population of about 44444.44 stands of maize per hectare. Inorganic fertilizer was obtained from the procurement and distribution unit of Akwa Ibom State Ministry of Agriculture and Natural Resources. The fertilizer brand obtained was NPK-15:15:15. The method of application was ring method at the rate of 400kg/ha. Fertilizer application was done three weeks after planting (WAP). Application of fertilizer was done 5 cm away from plant roots to avoid wilting of crops. Weeding was done manually, twice, during the growing period of crop at three and six weeks after planting (3 WAP and 6 WAP). There was no serious pest attack. However, minor pests observed were leaf eating beetles and grasshoppers which were picked manually.

DATA COLLECTION AND ANALYSIS

The evaluation of the growth parameters of crop planted was done at three weeks interval from planting till tasseling stage. Five crops were tagged per plot and used for sampling. The growth parameters measured were: maize plants were measured from the base to the tip and the means calculated. Maize leaves were measured from base to tip using a metre rule. This was determined by measuring the width of leaves at three different points (distal, middle and proximate points) and finding the mean. This was determined on functional leaves of tagged

plants, using the length –width portions method and then subjected same to a correction factor of 0.75 (Singh and Saxena, 1965) using a correction factor of 0.75

L x W x 0.75 = Leaf Area

Where L = length of leaf

W = width of leaf (widest portion)

Number of kernels per row was done by counting the total number of kernels in each row.

Number of kernels per cob was determined by counting the total number of kernels in a dehusked cob. The weight of 100 dry kernels was taken using a measuring scale.

This was determined by taking the weight of maize grains and the mean expressed in tonnes per hectare. Data collected were subjected to analysis of variance and means that showed significant difference were separated using least significant difference (LSD) at 5% probability level.

RESULTS

The result showed that all the maize varieties were significantly different in plant height ($P \leq 0.05$) at 3, 6 and 9 WAP in both cropping seasons, with FAR 32 was the tallest at 9WAP, 159.37 and 163.33 cm in 2015 and 2016 cropping seasons, respectively. oba super 2 had the least height (192.60cm). Suwan-1-SR was 157.35 cm and 153.13 cm tall at 9 WAP, in both cropping seasons. The shortest variety, 121.12 and 122.61 cm, respectively at 9WAP was recorded in QPM. The local adaptable variety Uweb was 131.70 cm and 135.29 cm tall in 2015 and 2016, respectively at 9WAP.

The number of maize leaves per plant as influenced by varieties showed no significant different ($p>0.05$) in both cropping seasons (Table 2). The result showed that all the maize varieties were significantly different for leaf area ($p \leq 0.05$) at 3, 6 and 9 WAP. FARZ 32 had the largest leaf area; 97.70, 498.20 and 762.48 cm^2 at 3, 6 and 9 AWP, respectively in 2015. In 2016 cropping season, the corresponding leaf area values were recorded; 96.60, 512.01 and 779.40 cm^2, respectively. This was followed by 78.62, 481.70 and 741.18 cm^2, respectively in 2015 recorded from Oba super 2 variety. In 2016, Oba super 2 had 72.33, 477.64 and 749.69 cm^2 leaf area, respectively. Suwan-1-SR had 699.80 cm^2 and 695.95 cm^2 leaf area at 9WAP in 2015 and 2016 cropping seasons, respectively. Uweb the local variety

had the least leaf area at 3, 6 and 9 WAP in both cropping seasons (Table 3). The leaf area recorded from Uweb was 57.30, 325.10 and 469.55 cm^2 at 3, 6 and 9 WAP in 2015. In 2016, the leaf area of 62.33, 341.44 and 485.98 cm^2 at 3, 6 and 9 WAP, respectively was recorded from Uweb.

Yield components of maize as influenced by varieties is presented in Table 5. The result indicated significant difference ($p<0.05$) in number of kernel rows per cob. Oba super 2 had the highest number of kernel row per cob, 16.33 and 15.20 in 2015 and 2016 cropping seasons, respectively. This was followed by 15.83 and 15.18 rows per cob, respectively recorded from FARZ 32. Uweb, the local variety had 11.30 and 11.25 rows per cob in both cropping seasons.

Number of kernels per plant as influenced by varieties varied significantly in bothcropping seasons (Table 5). Oba 98 had the highest number of kernel per row, 27.31 and 27.30 in 2015 and 2016, respectively. This was followed by 26.31 and 27.30 kernels per row. The least number of kernels per cob 19.49 and 18.34, respectively was recorded from Uweb. Weight of 100 seeds of maize grain as influenced by varieties is presented in table 6. The weight of grains varied significantly different. FARZ 32 had the heaviest 100 grain weight, 42.60 g and 41.30 g in 2015 and 2016, respectively. Oba 98 had 38.60 and 37.99 100 grain weight in 2015 and 2016 cropping seasons, respectively. Oba super 2 had 36.60 and 36.78 g 100 seeds weight, respectively. The least weight of 100 seeds 31.09 g and 32.99 g, respectively was recorded from Extra Early maize.

Comparing the maize grain yield, the result indicated significant difference ($p<0.05$) in both cropping seasons (Table 6). FARZ 32 had the highest grain yield, 4.37 and 4.30 tonnes per hectare in 2015 and 2016 cropping seasons, respectively. Oba super 2 produced 4.30 and 4.20 tonnes per hectare in 2015 and 2016 cropping seasons, respectively. Oba 98 had 4.00 and 3.70 tonnes per hectare of grain yield in both cropping seasons while Suwan-1-SR produced 3.90 and 3.84 tonnes per hectare in both cropping seasons. The local cultivar Uweb had 2.49 and 2.59 tonnes per hectare grain yield in 2015 and 2016 cropping seasons, respectively. The least grain yield, 2.32 and 2.45 tonnes per hectare, respectively was from Extal early maize variety.

DISCUSSION

The result indicated that the growing of the hybrid maize types Oba 98, Oba super 2, Farz 32 gave the highest level of output than the local landrace *Uweb and* Extral Early maize. This result agrees with (Monday, 2018) who noted that the use of hybrid maize varieties for propagation leads to greater productivity. The result also indicated that out of the hybrid maize varieties FARZ 32 performed best (4.32tonnes/ha). This is in line with Udoh and Ndon (2016) who noted that the hybrid varieties of maize yield from 4-6tonnes/ha. It was also observed that factors such as genetic makeup influenced the growth and yield of the various varieties. An in depth study of the past maize improvement programmes revealed that impressive increase in yield of maize grain in the United States of America during the 20th century was due mainly to the increase uses of hybrid maize seeds (Eberhant, 1979) therefore FARZ 32, Oba super 2, and Oba 98 could be subjected to more field trials and incorporated into breeding programmes for selection in Uyo.

Table 1: Plant height (cm) as influenced by maize genotypes

Maize Varieties	2015			2016		
	Weeks after planting			Weeks after planting		
	3	6	9	3	6	9
Oba super 2	33.01	90.15	139.72	31.12	88.66	141.45
FARZ 32	50.13	101.33	159.37	51.02	112.81	163.33
Oba 98	35.10	70.70	142.70	32.55	71.11	143.04
Suwan-I-SR	40.15	99.70	157.35	39.45	101.53	153.13
QPM	28.55	70.55	121.12	27.61	73.07	122.61
Extra Early	40.12	94.50	148.30	41.12	97.33	145.67
Uweb (local)	28.00	77.70	131.70	30.13	60.44	135.29
LSD ($p \leq 0.05$)	**3.31**	**5.35**	**5.99**	**3.11**	**6.01**	**6.88**

Table 2: Number of leaves per plant as influenced by maize genotypes

Maize Varieties	2015			2016		
	Weeks after planting			Weeks after planting		
	3	6	9	3	6	9
Oba super 2	7.12	10.55	13.81	7.15	10.75	12.81
FARZ 32	7.33	11.38	13.56	7.70	11.45	13.33
Oba 98	6.56	12.13	14.10	7.01	12.74	14.32
Suwan-I-SR	7.18	11.39	14.90	7.55	11.70	14.50
QPM	6.23	10.55	12.56	6.13	10.59	12.77
Extra Early	8.34	12.70	13.77	8.51	12.91	13.81
Uweb (local)	6.71	11.30	12.56	6.62	11.42	12.51
LSD ($p \leq 0.05$)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

*NS= Not Significant

Table 3: Leaf area (cm^2) as influenced by maize Varieties

Maize Varieties	2015			2016		
	Weeks after planting			Weeks after planting		
	3	6	9	3	6	9
Oba super 2	78.62	481.70	741.18	72.33	477.64	749.69
FARZ 32	97.70	498.20	762.48	96.60	512.01	779.40
Oba 98	70.50	334.17	525.20	70.55	344.21	562.50
Suwan-I-SR	70.20	471.10	699.80	71.30	475.55	695.95
QPM	72.55	399.56	561.40	76.40	403.11	580.22
Extra Early	77.50	451.33	545.28	78.10	461.73	547.60
Uweb (local)	57.30	325.10	469.55	62.33	341.44	485.98
LSD ($p \leq 0.05$)	2.69	5.18	7.31	3.01	5.25	6.75

Table 5: Yield components as influenced by maize genotypes

	2015		2016	
	Number of kernel rows per cob	Number of kernels per row	Number of kernel rows per cob	Number of kernels per row
Oba super 2	16.33	26.43	15.20	27.40
FARZ 32	15.83	26.21	15.18	26.20
Oba 98	14.16	26.31	13.20	27.30
Suwan-1-SR	14.45	23.70	13.50	25.70
QPM	12.55	22.40	12.78	24.89
Extra Early	13.33	24..77	12.11	23.45
Uweb(local)	11.30	19.49	11.25	18.34
LSD(P≤0.05)	1.44	2.24	1.76	2.11

Table 6: Yield of Maize as Influenced by Varieties

Genotypes	**2015**		**2016**	
	Dry weight of 100 kernels (g)	**Maize Grain Yield (t/ha)**	**Dry weight of 100 kernels (g)**	**Maize Grain Yield (t/ha)**
Oba super 2	36.60	4.30	36.78	4.20
FARZ 32	42.60	4.37	41.30	4.30
Oba 98	38.60	4.00	37.99	3.70
Suwan-1-SR	35.00	3.90	34.20	3.84
QPM	32.90	2.89	33.78	2.99
Extra Early	31.09	2.32	32.99	2.45
Uweb(local)	33.30	2.49	33.00	2.59
LSD (P ≤ 0.05)	**1.55**	**1.12**	**1.67**	**0.02**

CONCLUSION

The study revealed that Farz -32, Oba super 2, and Oba 98 varieties could grantee high maize grain yield in high humid region of Nigeria. Farmers in the zone were advised to select the three maize varieties above for high grain yield. Adoption of the three varieties could enhanced high productivity of maize in the study area.

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