MORPHOLOGICAL CHARACTERIZATION OF CUCUMBER GERMPLASM FOR YIELD AND YIELD ASSOCIATED TRAITS IN OWERRI AREA SOUTHEASTERN NIGERIA.

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Abstract
In the present research work 16 genotypes of cucumber were evaluated to find out their similarities and differences based on morphological parameters. The experiment was laid out in Randomized Complete Block Design (RBCD) with three replications. Data were collected on the following parameters; day emerged, days to 50 percentage emergence, days to male flower initiation, days to female flower initiation, number of pistillate flowers plant^{-1}, days to fruit maturity, number of branches plant^{-1} ,vine Length, number of leaves, leaf area index , number of fruits plant^{-1} , fruit length, fruit girth, fruit weight plant^{-1} , total fruit yield hectare^{-1} . Data was subjected to Analysis of Variance (ANOVA) and correlation showed great variation for almost all the traits. Similarly highest yield was observed in Cu 100 (12.98), Nagano F1 (9.22) and Cu 999 (7.89). These genotypes could be chosen for crossing with other genotypes like Apulia Cu (2.48) and Israelic Cu (2.16) selection having low yield to get a better high yielding cucumber genotypes. Correlation analysis represent that yield was positively correlated with number of pistillate flower (0.583^{**} P≤0.01) , number of branches (0.427^{**} P≤0.01) , Vine Length (0.685^{**} P≤0.01) , number of leaves (0.728^{**} P≤0.01) , leaf area index (0.698^{**} P≤0.01) , number of fruits (0.912^{**} P≤0.01) , fruit length (0.398^{**}P≤0.01), Fruit girth (0.390^{**} P≤0.01) and fruit weight (0.794^{**} P≤0.01) while days to male (-0.463^{**} P≤0.01) and female (-0.487^{**} P≤0.01) flower initiation, days to maturity(-0.517^{**} P≤0.01) were negatively correlated with total fruit yield. Thus based on correlation matrix analysis, the traits viz., number of pistillate flower per plant, number of branches, vine length, number of leaves, leaf area, number of fruits per plant, fruit length, fruit girth, and fruit weight per plant may be considered as selection indices for high yield.

Keywords**:** cucumber; correlation; traits; fruit yield.

Introduction

Cucumis sativus Linn. is one of the most important and popular vegetable crops grown extensively throughout the tropical and subtropical region of the world (Wang *et al*., 2007). It is a thermophillic and frost-susceptible horticultural crop usually cultivated in fields during spring-summer period (Bacci *et al*., 2006) or in greenhouse in different seasons. It performs well in a temperature between 25 to 29°C with plenty of sunlight. The most efficiently important cucurbits according to world total production are water melon (*Citrullus lanatus* L.), cucumber (*Cucumis sativus* L.*)* and melon (*Cucumis melo* L.) (FAO, 2006). Cucumber is also called "Khira" and resident to Asia and Africa, where it has been used for 3,000 years. Today cucumbers are cultivated all over the world for well-liked salad and pickle. Though less healthful than most fruit, the fresh cucumber supply thiamine, vitamin C, niacin, phosphorus, iron, calcium and nutritional character (Gopalan *et al*., 1982). Cucumber also serves as insect killer due to steroid stuffing (Wang *et al*., 2007).

Although important cucumber production occurs in North Central America and Europe but half of world cucumber production occurs in Asia. Asian countries with high cucumber production are Turkey, Iran, Uzbekistan, Japan and Iraq. In Nigeria, cucumber production has not been ranked; it is grown mainly in Jos, Plateau State, and there was a general belief that cucumber can only be grown in the Northern part of the country. Cucumber cultivation in southeast Nigeria has been found to be achievable under moderate rainfall and in dry season using irrigation facilities (Enujeke, 2013a). The yield of cucumber In Owerri area southeastern Nigeria is quiet low due to non accessibility of varieties well suited for specific production zones, diseases caused due to low struggle to biotic and biotic stresses, an inappropriate cultural practices. Al-Rawahi *et al.* (2011) noted that the only possible solution to increase the yield of cucumber is to select high yielding genotypes according to the agro diametric condition of different area and their characterization. Distinguishing features of cucumber is of great significance for present and future genetic development program of the crop. Keeping this in view, in this study attempt has been made to characterize cucumber germplasm at morphological basis to assess the genetic pattern of morphological character of cucumber, to identify the most suitable and high yielding variety and to quantify yield potential of cucumber germplasm for future utilization.

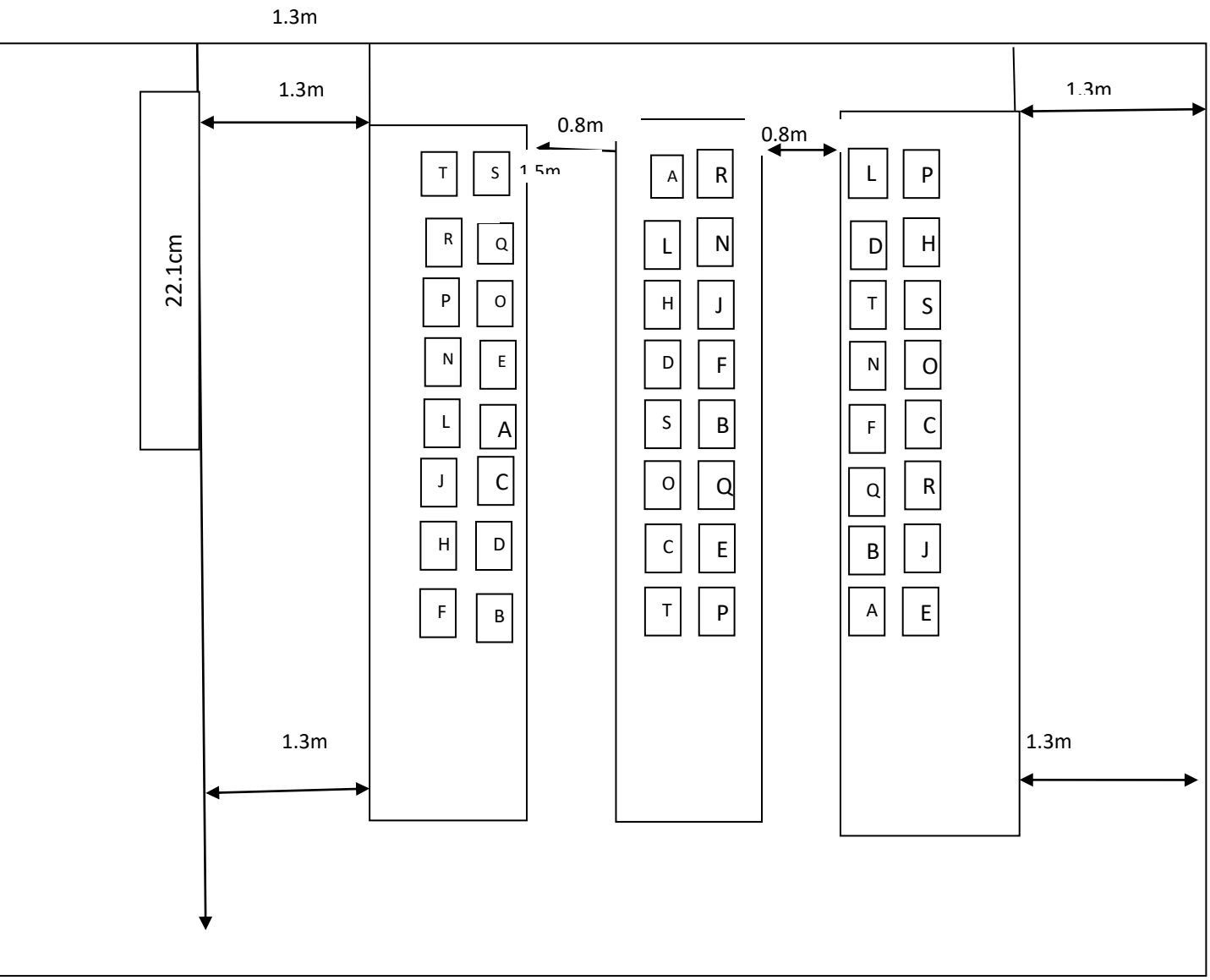
Materials and Methods

The experiment was conducted at the Teaching and Research Farm, Federal University of Technology, Owerri in 2018. The study site is located on latitude 5^0 29′N of the equator and longitude 7^0 2′E of the Greenwich meridian, and at an elevation of 55 about 55m above sea level. Sixteen genotypes of cucumber (*Cucumis sativus* L.) sourced from different geographical regions of the country were

investigated in an experimental field size measuring 22.1m by 11.7m (258.57m^2) which is equivalent to 0.025857ha. The experimental design was a randomized complete block design (RCBD) with three replications. Sixteen cucumber seed genotypes (treatments) were sown on the plots at three seeds per hill at a depth of 2.5cm, using spacing of 0.5m x0.5m. A total of 18 seeds were sown in each plot which was later thinned down to six after two weeks of planting. Insect pests were controlled using Knockoff (*Lamda cyhalothrin*) insecticide and manual weeding was done to keep weed pressure low. Data on fifteen (15) quantitative and six (6) qualitative traits were collected using the standard description list developed by the international plant genetic resources institute (IPGRI) for Cucurbitaceae (Esquinas and Gulick, 1983).

Statistical analysis

Collected data were subjected to ANOVA for RCBD using GenStat Release 10.3 Discovery Edition (PC/Windows; VSN International, Hemel Hempstead, Hertfordshire, UK). Correlation analysis was performed for quantitative data using SPSS 16.0.



Results and Discussion

The cucumber genotypes displayed significant differences (p<0.05) for days to emergence and in days to 50%emergence (Table 1). Greater number of days (5.67) to emergence was recorded for genotypes AOA/Cu and OHE/Cu, respectively. While lowest number of days to emergence (3) was recorded for genotype Cu 999. Similarly the cucumber genotypes showed significant variation in days to 50% emergence. Greatest number of days (6.83) to 50% emergence was recorded for genotype Supermarketer whereas minimum number of days (3) was recorded for genotype Cu 999 selection. This findings aligned with the finding of Hamid *et al*., (2002) and Ahmed *et al*., (2004), who reported that variations in days to emergence and days to 50% emergence could be possibly due to the genetic constituent of the genotypes, which responded differently to the environmental conditions. The results of the vegetative growth parameters of the sixteen cucumber genotypes evaluated were shown Table 1. The result showed that there was a great significant difference (p<0.05) among the sixteen cucumber genotypes for all the vegetative traits evaluated. The cucumber genotypes displayed significant differences (p<0.05) for days to male flower initiation, days to female flower initiation, number of pistillate flower per plant, number of branches at, vine length, number of leaves and leaf area index. Greater number of days (38.67) to male flower initiation was recorded for genotype Marketer, while lowest number of days (24) to male flower initiation was recorded for genotype CU999. There was significant difference ($p<0.05$) in days to female flower initiation of the genotypes evaluated. Marketer and Pov Variety ADP genotypes had the greatest number of days to female flower initiation with a mean value of 44.67 while Cu 999 had the lowest number of days to female flower initiation with a mean value of 28. Number of pistillate flower also was significant difference ($p<0.05$) among the cucumber genotypes investigated. Cu 100 had the greatest number of pistillate flower per plant with a mean value of 9.33 while the lowest number of

pistillate flower per plant was found in Marketer with a mean value of 4. Number of branches per plant showed great variation that differed significantly ($p<0.05$) among the genotypes at 8 weeks after planting (WAP). Cu 999 had the highest number of branches with a mean value of 3, while Songhai local, Israeli Cu, Apulia Cu, Nagano F1 and Supermarketer genotypes had the least value for number of branches. There was significant difference ($p<0.05$) in vine length of the genotypes assessed at 8 weeks after planting (WAP). Cu 999 genotype had the highest vine length with a mean value of 235.45cm while Holland pop genotype had the lowest vine length with mean value of 60.72cm. Number of leaves per plant for the genotypes evaluated also showed significant difference ($p<0.05$) 8 weeks after planting (WAP). Cu 999 genotype had the highest number of leaves per plant with a mean value of 36.15 followed by Cu 100 with a mean value of 29.53, while Pov Variety ADP genotype had the lowest number of leaves per plant with a mean value of 9.53. There was significant difference ($p<0.05$) in leaf area index of the genotypes assessed at 8 weeks after planting (WAP). Cu 999 genotype had the highest leaf area index with a mean value of 200.42cm followed by AOA /Cu with a mean value of 173.9cm, while Apulia Cu genotype had the lowest area index with mean value of 58.83cm. Table 1 showed that Cu 999 genotype had superior values in days to male flower initiation, days to female flower initiation, number of branches at 8WAP, vine length at 8WAP(cm), number of leaves at 8WAP and leaf area index at 8WAP(cm), while Cu 100 genotype showed superior value for number of pistillate flower per plant. The significantly ($p<0.05$) higher values obtained in Cu 999 and Cu 100 genotypes over the other cucumber genotypes tested could be attributed to superiority in their genetic constitution with respect to vegetative growth and suitability of the genotypes to the growing conditions of the study area. The result was similar to the findings of Majanbu *et al*. (1996); and Ibrahim *et al*. (2000) who reported that genetic constitution of crop varieties influences their growth characters.

Yield parameters

The results of the analysis of variance on yield parameters of sixteen cucumber genotypes studied were presented in Table 1. There were significant differences ($p<0.05$) in all the yield parameters evaluated. In Fruit length, Fruit girth, and Fruit weight per plant, Cu 999 genotype had the highest mean values of 37.25cm, 11.25cm and 2.16 kg respectively. Whereas in terms of number of friuts per plant and total fruit yield per hectare, Cu100 genotype had the highest mean values of 10.42 and 12.98 tons respectively. Apulia and Supermarketer genotypes had the lowest mean values of 2.00 with regards to number of fruits per plant, while Israelic Cu had the lowest mean value of 2.16 tons with regards to total fruit yield per hectare.

It is evident from the results presented in Table 1, that Cu 999 genotypes also had superior performance in fruit length (cm), fruit girth (cm), fruit weight per plant(kg), while Cu 100 showed superiority in number of fruits per plant and total fruit yield per hectare respectively. Moreover, the superior performance of Cu 999 and Cu 100 genotypes in fruit size and total fruit yield/ha can be attributed to their fruit length, fruit girth, fruit weight, longer vines, higher numbers of branches and leaves per plant. It is worthy to note that the absence of high number of fruits by Cu 999 genotype may be responsible for high fruit weight obtained as most nutrients were deposited into fewer sinks. Thus, Cu 999 and Cu 100 maintained their superior performance in most of the traits studied. This findings aligned with Gichimu *et al.* (2008) where high fruit length, fruit girth, fruit weight, longer vines, number of branches and leaves have been shown to produce sizable fruits and higher yields than those with fewer branches in watermelon.

Table 1. Variation in Quantitative characteristics among cucumber genotypes.

Genotypes	D-emerged	D50%E	DMFI	DFFI	NOPFPP	DMATURITY	NOB8WAP	VL8WAP	NOL8WAP	LAI8WAP	N0FP	FL	FG	FWPP	TFY/HA
Songhai local	4.00	4.67	35.33	44.00	6.67	59.00	0.00	95.63	18.10	84.79	2.50	16.67	3.87	0.60	3.93
Marketer	5.00	6.33	38.67	44.67	4.00	59.33	1.00	72.37	16.61	74.70	2.33	17.30	4.52	0.52	3.12
AOA/Cu	5.67	5.82	38.33	43.00	7.33	56.33	2.33	158.67	23.37	173.90	5.27	17.73	5.13	1.20	7.18
Beitalpha	3.33	4.00	38.00	44.00	7.17	59.00	1.33	163.43	24.08	163.30	4.33	23.00	4.43	1.07	6.46
Israelic Cu	5.00	5.33	36.00	42.00	4.83	59.00	0.00	72.22	15.73	76.63	2.65	15.75	3.65	0.36	2.16
Holland pop	5.33	5.33	36.67	42.67	5.33	57.67	1.00	60.72	14.05	77.79	2.44	17.78	4.24	0.57	3.41
Apulia Cu	3.67	6.00	36.33	43.33	6.00	58.00	0.00	66.24	11.90	58.83	2.00	13.78	3.90	0.41	2.48
Nagano F_1	4.67	5.67	33.00	39.00	6.87	55.00	0.00	170.53	24.17	166.65	6.60	19.67	5.09	1.53	9.22
Cu 102	4.33	5.17	28.00	32.33	6.93	51.00	1.33	101.90	17.92	91.17	3.10	19.80	5.75	0.83	5.00
Cu 986	3.67	4.67	29.33	33.33	5.55	52.00	2.00	99.35	20.50	132.91	3.03	21.10	5.01	0.87	5.19
Super Marketer	3.67	6.83	35.67	41.67	5.67	58.00	0.00	84.89	17.78	83.49	2.00	17.78	3.68	0.67	4.03
OHE/Cu	5.67	6.17	37.67	43.67	5.67	59.00	1.67	170.27	22.32	153.70	4.20	24.20	8.28	0.70	4.20
Pov Variety ADP	3.33	5.50	37.67	44.67	6.83	58.33	1.00	69.08	9.53	74.59	2.83	17.00	4.16	0.53	3.18
Cu 100	4.00	4.17	27.33	31.67	9.33	51.33	1.67	177.07	29.53	160.81	10.42	21.47	6.01	1.32	12.98
Cu 971	3.67	3.83	26.33	30.33	5.83	52.67	1.67	104.05	20.28	97.52	4.95	31.05	6.62	0.97	5.79

Cu 999	3.00	3.00	24.00	28.00	5.25	50.00	3.00	235.45	36.15	200.42	6.45	37.25	11.25	2.16	7.89
Mean	4.25	5.16	33.65	39.27	6.20	55.98	1.17	118.87	20.13	116.95	4.07	20.71	5.35	0.89	
F –$LSD_{0.05}$	1.39	2.01	4.68	5.52	1.78	4.65	1.15	42.22	4.51	39.50	1.64	3.57	1.58	0.31	5.39 1.84

Table 2. Correlation Matrix of cucumber genotypes.

Characters	Days to 50% emergence	Days to male flower initiation	Days to female flower initiation	Number of pistillate flower per plant	Days to maturity	Number of branches at 8WAP	Vine Length at 8WAP (cm)	Number of leaves at 8WAP	Leaf Area Index at 8WAP(cm)	Number of friuts per plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight per plant(kg)	Total fruit yield per hectare t ha-^{1}
Day emerged	0.443**	0.303*	0.272	-0.017	0.235	0.038	-0.075	-0.067	0.028	-0.031	-0.300*	-0.119	-0.179	-0.064
Days to 50%emergence		0.440**	0.443**	-0.048	0.374**	-0.21	-0.264	-0.356*	-0.232	-0.317*	-0.476**	-0.348*	-0.348*	-0.248
Days to male flower initiation			0.973**	-0.132	0.859**	-0.380**	-0.299*	-0.441**	-0.305*	-0.473**	-0.565**	-0.475**	-0.551**	-0.463**
Days to female flower initiation				-0.139	0.900**	-0.422**	-0.340*	-0.461**	-0.333*	-0.482**	-0.586**	-0.497**	-0.567**	-0.487**
Number of pistillate flower per plant					-0.191	0.102	0.308*	0.219	0.355*	0.525**	0.005	-0.019	0.26	0.583**
Days to maturity						-0.491**	-0.307*	-0.417**	-0.378**	-0.506**	-0.430**	-0.406**	-0.566**	-0.517**

Number of branches at 8WAP	0.450**	0.581**	0.545**	0.459**	0.566**	0.553**	0.564**	0.427**
Vine Length at 8WAP(cm)		0.805**	0.776**	0.647**	0.635**	0.707**	0.807**	0.685**
Number of leaves at 8WAP			0.813**	0.679**	0.688**	0.670**	0.826**	0.728**
Leaf Area Index at 8WAP(cm)				0.660**	0.523**	0.573**	0.775**	0.698**
Number of fruits per plant					0.428**	0.438**	0.720**	0.912**
Fruit length(cm)						0.860**	0.683**	0.398**
Fruit girth(cm)							0.670**	0.390**
Fruit weight per plant								0.794**

The correlation study indicates the degree of interrelationship of plant characters for improvement of yield as well as important quality parameters in any breeding programme. However, the result of the correlation coefficient among some agronomic traits of cucumber genotypes evaluated is presented in Table 2. From the correlation matrix, almost all the traits showed high significant ($p<0.01$) correlations with total fruit yield/ha. Number of pistillate flower per plant, number of branches, vine length, number of leaves, leaf area, number of fruits per plant, fruit length, fruit girth, and fruit weight per plant gave positive correlation with total fruit yield while days to male and female flower initiation; and days to maturity were negatively correlated with total fruit yield. Machikowa and Laosuwan (2011) however, noted that correlation of particular traits with other traits and with yield is important in selection of genotypes for yield improvement. Fayeun *et al.*(2012) opined that significant and positive correlation between two characters shows that these characters can be improved simultaneously in a selection programme . This is as a result of mutual relationship among characters and selection for one will translate to selection and improvement of the other (Fayeun *et al*., 2012). The result of the correlation matrix indicated that all the traits except day emerged(-0.064 $P\leq0.01$), days to 50%emergence (-0.248 $P\leq0.01$), days to male(- 0.463^{**} $P\leq0.01$) and female flower initiation(- 0.487^{**} $P\leq0.01$) , days to maturity(- 0.517^{**} $P\leq0.01$) correlated positively with total fruit yield/ha. This implies that selection for such traits that showed positive relationship with yield would result to higher total fruit yield per hectare. This is in agreement with those of Islam *et al*. (1993) and Cramer and Wehner (2000) who reported significant positive correlation between these traits and yield in cucumber. Negative correlations shown between days to male and female flower initiation; days to maturity and fruit yield suggest earliness or lateness to flower initiation and fruit maturity which would have an inverse effect on yield (Cramer and Wehner, 2000). Afangideh *et al.* (2005) also observed significant positive correlations between number of fruits per plant, stem length and total fruit yield per ha in cucumber. A strong positive and significant relationship between number of fruit per plant, fruit diameter and flesh thickness and total fruit yield/ha have also been reported in cucumber (Ullah *et al*., 2012). Negative correlation between days to male flower initiation, days to female flower initiation and total fruit yield per hectare showed that high fruit yield was a function of least number of days to flower initiation which resulted to earliness in fruit maturity. The finding is in line with those of Afangideh and Uyoh (2007) and Ogbodo *et al.* (2010) on cucumber. Number of fruits per plant and fruit weight showed significant and positive correlation with total fruit yield at 5% level of probability. The finding is in consonance with results of Golabadi *et al*. (2013) in their studies on determining relationships between different horticultural traits in *Cucumis sativus* L. genotypes.

Conclusions

The Cu 100 genotype recorded the highest total fruit yield/ha, followed by Nagano F_1 and Cu 999. These genotypes are recommended for cultivation in the Owerri-west, Southeastern Nigeria agro ecological zone. Correlation matrix analysis revealed that traits that show mutual relationship with yield is of utmost importance and be selected in contributing to yield improvement.

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