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Comparative Studies of the Yield Performance of Improved and Adapted Genotypes of Cucumber (*Cucumis Sativus* L.) In Owerri, Southeastern Nigeria.

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Abstract
Background: *In Southeastern Nigeria, cucumber has become a major component of the cropping system due to the overwhelming importance of its health benefits along with skin care. In the rain forest zone of southern Nigeria, three cropping cultivations of cucumber are possible per year. The first cropping can be planted from January to March in a field or greenhouse using irrigation facilities while the second can be planted from first week of May to July and third season plantings from October to December using irrigation facilities. Thus, this indicates that cucumber is an all year round field and important greenhouse vegetable in southeastern Nigeria. Unfortunately, the yield per unit area of cucumber produced in these three planting seasons is greatly low, due to the growing of unimproved cucumber varieties used by the majority of farmers.*
Materials and Methods: *Consequently, a research study was carried out to evaluate the agronomic characteristics of some cucumber genotypes intended for cucumber production. The genotypes comprised of nine adapted and seven improved cucumber genotypes. The experiment was conducted using a Randomized Complete Block Design (RCBD) with three replications. Data were collected on agronomic traits.*
Results: *The analysis of variance revealed superior performance in vegetative and yield attributes displayed by the improved genotypes than the local genotypes. Significant positive relationships were obtained between yield and other agronomic traits, suggesting direct and indirect contributions to yield.*
Conclusion: *Thus, the improved genotypes can be used as source of genes for increase in total fruit yield amounting to higher productivity of cucumber.*
Key word: *Cucumber production, improved genotypes, Southeastern Nigeria*

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I. Introduction

Cucumber (*Cucumis sativus* L.) is ranked as the second most important vegetable in Western Europe after tomatoes and the fourth in Asia after tomatoes, cabbage and onion (Tatilogu,1997). The world's largest cucumber producer is China with 48,000 million kilograms which is 73% of total global production. Russia is second largest producer with 1,742 million kg (2.68%) followed by Turkey, with a production of 1,600 million kg (2.46%) FAO, (2016) . In tropical Africa, its production has not been ranked because of its limited use. Production of cucumber in Nigeria has not been ranked; in fact, it is mostly done in the northern part of the country. However, cucumber cultivation in the south-eastern Nigeria has been found to be achievable under moderate rainfall in season and off-season with standard irrigation facilities either in the field or in a green house.

There is an increased consumption of *C. sativus* fruit possibly because of its high nutritional value. The nutritional composition of *C. sativus* includes protein, fat and carbohydrate as primary metabolites; along with dietary fibre which is important for the digestive system. Till date, the present study on *C. sativus* represents variety of pharmacological activities like anticancer, anthelmentic, antimicrobial, hypolipidemic, antiulcer, analgesic and antioxidant (Dhande *et al*., 2013). It is believed that *C. sativus* seed has flavonoid, tannin, terpenoids and some phytochemicals (Kumar *et al*., 2010).

In plant breeding, the first step in the process of crop introduction is to execute a field evaluation to ascertain the agronomic performance with the aim of using it as a variety or a source of useful gene. Perhaps, such cultivars prove valuable, recurrent selection; backcross and hybrid breeding methods could be adopted to integrate them into the cropping system of the people. Thus, the objectives of this study was; to assess the agronomic characteristics of sixteen cucumber genotypes for cucumber production, estimate the amount of variability in the characters and estimate the relationships between yield and other agronomic traits evaluated.

II. Materials and Methods

The study was conducted at the Teaching and Research Farm of the Federal University of Technology, Owerri, Nigeria. Table no 1 represents the cucumber genotypes and their sources. The experimental field size measured 22.1m x 11.7m (258.57m^2) was marked out using measuring tape, rope and pegs. Land clearing was done manually using cutlass and the debris packed using rake. The field was partitioned into 3 blocks with each block containing 16plots. Forty-eight plots of 1.5m x 1.0m (1.5m ^{2}) each was prepared using hoe. About 0.8m and 0.5m alleys separated adjacent blocks and plots respectively. Dry weight of poultry droppings was incorporated into the soil. The sixteen cucumber genotypes were evaluated using randomized complete block design (RCBD) with three replications. The treatments were sown on the plots at three seeds per hill at a depth of 2.5cm, using spacing of 0.5cm x 0.5cm.

Table 1: Cucumber genotypes and their sources.

S/N	Genotypes	Origin
1.	'Songhai local'	ADP
2.	'Marketer'	NIHORT
3.	'AOA/Cu'	NIHORT
4.	'Beit alpha'	ADP
5.	'Israelic Cu'	ADP
6.	'Holland POP'	NIHORT
7.	'Apulia'	ADP
8.	'Nagano F_1'	ADP
9.	'Cu 102'	THAILAND
10.	'Cu 986'	THAILAND
11.	'Super marketer'	NIHORT
12.	'OHE/Cu'	NIHORT
13.	'Pov variety'	ADP
14.	'Cu 100'	THAILAND
15.	'Cu 971'	THAILAND
16.	'Cu 999'	THAILAND

NIHORT: National Horticultural Research Institute Kano, Nigeria: ADP: Agricultural Development Programme, Owerri,Nigeria.: Thailand Agro Seed Company, Owerri, Nigeria.

Data Collection

Two middle stands from each plot were tagged and used as sample plants upon which data collection was made. Data were collected on the following parameters;

Days to 50 percentage emergence: This was determined by counting the days from the date of planting to the date up to half of the sown seeds emerged.

Days to male flower initiation: This was determined by counting the days from the date of sowing to the date first male flower was seen in each sample plot.

Days to first female flower initiation: This was determined by counting the days from the date of sowing to the date first female flower was seen in each sample plot.

Number of pistillate flowers plant^{-1}: This was determined by counting the number of pistillate flowers seen in each sample plot.

Day to fruit maturity: This was determined by calculating the number of days from sowing to when the first fruit matured in each of the sample plot.

Number of branches plant^{-1} 8WAP (Weeks After Planting): This was determined by direct counting of the branches per plant.

$$\text{Number of branches per plant} = \frac{Total\ no.of\ branches\ on\ sample\ plants}{No.of\ sample\ plants}$$

Vine Length at 8WAP: Vine length was measured with measuring tape from the base to the growing tip of the main vine.

Number of Leaves (8WAP): This was determined by direct counting of the leaves per plant.

$$\text{Number of leaves per plant} = \frac{Total\ no.of\ leaves\ on\ sample\ plants}{No.of\ sample\ plants}$$

Leaf Area Index (LAI) 8WAP: This was determined using direct method as postulated by Brenda (2003) . This was done by measuring the leaf length and width per plant.

$$\text{LAI} = \frac{Avg.leaf\ \ lengt\,h(m) \times Avg.leaf\ \ widt\,h\ (m) \times No.of\ \ leaves\ \times plant\ \ density}{Area\ \ of\ \ plot\ \ (m^2)}$$

Number of fruits plant^{-1}: This was determined by direct counting of the number of harvested fruits from the sample plants in each plot and dividing by the number of sample plants.

$$\text{Number of fruits per plant} = \frac{Total\ \ number\ \ of\ fruits\ \ harvested\ \ from\ \ the\ sample\ \ plants}{Number\ \ sof\ sample\ \ plants}$$

Fruit length: This was measured from base to the apex of the fruit using meter rule.

Fruit girth: This was measured in centimeters at maximum thickness with the help of venire caliper

Fruit weight plant^{-1}: This was computed using the number of fruits per plant and weight of a fresh fruit.

Total fruit yield hectare^{-1}(ton): Total fruit yield hectare^{-1} was computed using fruit weight per plant multiplied by the plant density.

Statistical analysis

Analysis of variance (ANOVA) was computed for the genotypes using GenStat Release 10.3 Discovery Edition (PC/Windows) and detection of the differences between treatment means as outlines by Obi (2002).

III. Results

Table 2: Is the summary statistics for the studied plant traits which revealed an appreciable variability in the traits. Overall means for agronomic characteristics of the genotypes evaluated indicate that on the average, genotypes emerged from the soil in approximately 4 days. In days to male and female flower initiations, the staminate flower influx began in approximately 34days while the female flower initiated in 39.00 days with. Similarly, genotypes attained maturity in approximately 56 days. The mean value for number of fruits per plant of the genotypes was four indicating that the cucumber genotypes grown in Nigeria produced less number of fruits per plant. Mean fruit length and girth was 20.71cm and 5.35cm respectively. The mean fruit weight per plant was 0.89kg. Fruit yield, which is the most important trait in breeding programme, gave a mean value of 5.39 ton ha^{-1}. Improved genotypes out yielded the local genotypes.

Coefficients of variation, a measure of the relative levels of variability for traits, obtained in this study showed that the trait, number of branches per plant had the highest coefficient of variability value of 131.30%. Coefficient of variations for other traits were much lower ranging from 10.55% for days to maturity to 96.36% for number of fruits per plant.

Table 2: Means, Range, Percentage coefficients of variation of the evaluation of the 16 Cucumber genotypes.

Traits	Mean	Minimum	Maximum	Range	%CV	$LSD_{(0.05)}$
Day emerged	4.25	3.00	7.00	4.00	35.25	42.15
Days to 50%emergence	5.16	3.00	8.00	5.00	34.67	28.43
Days to male flower initiation	33.65	22.00	42.00	20.00	25.38	4.68
Days to female flower initiation	39.27	27.00	48.00	21.00	26.11	5.52
Number of pistillate flower per plant	6.20	3.50	10.50	7.00	34.71	1.78
Days to maturity	55.98	50.00	64.00	13.00	10.55	4.65
Number of branches at 8WAP	1.17	0.00	3.00	3.00	131.30	1.15
Vine Length at 8WAP(cm)	118.87	45.54	250.10	204.60	76.56	42.22
Number of leaves at 8WAP	20.13	7.50	38.10	30.60	56.88	4.51
Leaf Area at 8WAP(cm)	116.95	40.26	220.20	179.90	68.05	39.50
Number of fruits per plant	4.07	1.30	11.00	9.70	96.36	1.64
Fruit length(cm)	20.71	10.33	38.50	28.17	50.23	3.57
Fruit girth(cm)	5.35	2.76	11.50	8.74	64.72	1.58
Fruit weight per plant	0.89	0.24	2.29	2.05	92.65	0.31
Total fruit yield per hectare tha-1	5.39	1.44	13.74	12.30	91.44	1.84

Table 3: The result of the ANOVA test indicated that there were significant differences in all the traits evaluated. The result of the emergence parameters showed that most of the improved cultivars emerged earlier than the local cultivars. The local cultivars AOA/Cu and OHE/Cu (5.67) respectively, had the greatest number of days to emergence. Furthermore, the improved cultivar Cu 999 showed outstanding performance to earliness in days to emergence and days to 50% emergence (3 days) over other improved cultivars.

Table 3: Emergence parameters of the sixteen genotypes of cucumber (*Cucumis sativus* L.).

Genotypes	Days to emergence	Days to 50%emergence
Songhai local	4.00	4.67
Marketer	5.00	6.33
AOA/Cu	5.67	5.82
Beitalpha	3.33	4.00
Israelic Cu	5.00	5.33
Holland pop	5.33	5.33
Apulia Cu	3.67	6.00
Nagano F_1	4.67	5.67
Cu 102	4.33	5.17
Cu 986	3.67	4.67
Super marketer	3.67	6.83
OHE/Cu	5.67	6.17
Pov Variety ADP	3.33	5.50
Cu 100	4.00	4.17
Cu 971	3.67	3.83
Cu 999	3.00	3.00
Mean	4.25	5.16
F –$LSD_{0.05}$	1.39	2.01

Table 4: In days to male flower initiation, the result showed that Cu 999, Cu 971, Cu 100, Cu 102 and Cu 986 flowered early (24 to 29 days) whereas Nagano F_1, Songhai local, Super marketer, Israelic Cu, Apulia Cu, Holland pop, OHE/Cu, Pov Variety ADP, Beitalpha, AOA/Cu and Marketer flowered approximately within 33 to 39 days after planting.The result of days to female flower initiation followed the same trend as in days to male flower initiation. The result also showed that the genotypes Cu 100, AOA/Cu, Beitalpha, Cu 102, Pov Variety ADP, Nagano F_1 and Songhai local had highest number of pistillate flower per plant. In mean number of branches at 8WAP, Cu 999 had the highest number of branches (3.00) followed by AOA/Cu (2.33) and Cu 986 (2.00).The results showed that the improved genotypes had tallest vines ranging from 99.35cm to 235.45cm while the local genotypes were between 60.72cm to 170.27 cm tall. In mean number of leaves produced, Cu 999 had the highest number of leaves (36.15) followed by Cu 100 (29.53), Nagano F_1 (24.17), Beitalpha (24.08) and AOA/Cu (23.37) while Pov Variety ADP (9.53) had the least number of leaves. The results also showed that the genotype Cu 999 (200.42cm^2) had the largest leaf area followed by AOA/Cu (173.90cm^2), Nagano F_1 (166.65 cm^2) and Cu 100 (160.81 cm^2) while Pov Variety ADP (74.59 cm^2) had the least leaf area.

Table 4: Vegetative and reproductive growth parameters of 16 genotypes of cucumber.

Genotypes	Days to male flower initiation	Days to female flower initiation	Number of pistillate flower per plant	Number of branches at 8WAP	Vine Length at 8WAP(cm)	Number of leaves at 8WAP	Leaf Area at 8WAP(cm)
Songhai local	35.33	44.00	6.67	0.00	95.63	18.10	84.79
Marketer	38.67	44.67	4.00	1.00	72.37	16.61	74.70
AOA/Cu	38.33	43.00	7.33	2.33	158.67	23.37	173.90
Beitalpha	38.00	44.00	7.17	1.00	163.43	24.08	163.30
Israelic Cu	36.00	42.00	4.83	0.00	72.22	15.73	76.63
Holland pop	36.67	42.67	5.33	1.00	60.72	14.05	77.79
Apulia Cu	36.33	43.33	6.00	0.00	66.24	11.90	58.83
Nagano F_1	33.00	39.00	6.87	0.00	170.53	24.17	166.65
Cu 102	28.00	32.33	6.93	1.00	101.90	17.92	91.17
Cu 986	29.33	33.33	5.55	2.00	99.35	20.50	132.91
Super marketer	35.67	41.67	5.67	0.00	84.89	17.78	83.49
OHE/Cu	37.67	43.67	5.67	1.67	170.27	22.32	153.70
Pov Variety ADP	37.67	44.67	6.83	1.00	69.08	9.53	74.59
Cu 100	27.33	31.67	9.33	1.67	177.07	29.53	160.81
Cu 971	26.33	30.33	5.83	1.67	104.05	20.28	97.52
Cu 999	24.00	28.00	5.25	3.00	235.45	36.15	200.42
Mean	33.65	39.27	6.20	1.17	118.87	20.13	116.95
F –$LSD_{0.05}$	4.68	5.52	1.78	1.15	42.22	4.51	39.50

Table 5: The results of the yield and yield components of sixteen genotypes of cucumber showed that the genotype Cu 100 (10.42) produced significantly highest number of fruits per plant, followed by Nagano F_1 (6.60) and Cu 999 (6.45) all improved cultivars while Apulia Cu (2.00) and Super marketer (2.00) had the least mean number of fruits per plant respectively. Fruit length measured revealed that Cu 999 had the longest fruits (37.25cm) while Apulia Cu genotype had the shortest fruits (13.78cm). In fruit girth, results showed that the maximum fruit girth (11.25cm) was recorded for Cu 999 while Israelic Cu had the minimum fruit girth

(3.65cm), the same trend was observed for fruit weight per plant. Results obtained for fruit yield showed that the improved cucumber genotypes were higher yielding (5.00 to 12.98 t ha-1) than the local ones except AOA/Cu with the fruit yield of 7.18ton ha-^{1} .

Table 5. Yield and yield components of sixteen genotypes of cucumber (*Cucumis sativus* L.).

Genotypes	Number of friuts per plant	Fruit length(cm)	Fruit girth(cm)	Fruit weight per plant(kg)	Fruit yield (ton ha^{-1})
Songhai local	2.50	16.67	3.87	0.60	3.93
Marketer	2.33	17.30	4.52	0.52	3.12
AOA/Cu	5.27	17.73	5.13	1.20	7.18
Beitalpha	4.33	23.00	4.43	1.07	6.46
Israelic Cu	2.65	15.75	3.65	0.36	2.16
Holland pop	2.44	17.78	4.24	0.57	3.41
Apulia Cu	2.00	13.78	3.90	0.41	2.48
Nagano F_1	6.60	19.67	5.09	1.53	9.22
Cu 102	3.10	19.80	5.75	0.83	5.00
Cu 986	3.03	21.10	5.01	0.87	5.19
Super marketer	2.00	17.78	3.68	0.67	4.03
OHE/Cu	4.20	24.20	8.28	0.70	4.20
Pov Variety ADP	2.83	17.00	4.16	0.53	3.18
Cu 100	10.42	21.47	6.01	1.32	12.98
Cu 971	4.95	31.05	6.62	0.97	5.79
Cu 999	6.45	37.25	11.25	2.16	7.89
Mean	4.07	20.71	5.35	0.89	5.39
F –$LSD_{0.05}$	1.64	3.57	1.58	0.31	1.84

Correlation Study

Table 6 : A simple correlation among the agronomic traits revealed significant relationships with yield except days to emergence and days to 50% emergence. The result showed that days to emergence was significant and negatively correlated with fruit length (*r = - 0.30*) whereas days to 50% emergence was significant and negatively correlated with number of fruits per plant (*r* = - *0.32*), fruit length (*r* =- *0.48*), fruit girth (*r* = - *0.35*) and fruit weight per plant (*r* = - *0.35*). Days to male and female flower initiation and days to maturity were significant and negatively correlated with fruit yield *(*r = − 0.46*), (*r = − 0.49*)* and *(r = − 0.52)* respectively.

Table 6. Correlation matrix of the agronomic parameters of the evaluated cucumber (*Cucumis sativus* L.) genotypes.

IV. Discussion

The observable phenotypic differences displayed by the cucumber genotypes are attributable to gene and environmental effect. However, the genetic constitution of crop species influences their performance and of course does not alter its make up in different environments with regards to qualitative traits. It was evident from the results of the emergence parameters that the improved cultivars emerged earlier than most of the local ones probably because they were able to effectively exhibit their good genetic make-up to exploit the newly found favourable agro-climatic conditions of the study area for rapid growth. This result was in harmony with the findings of Akinfoesoye *et al*. (1997) and Ray and Sinclair (1997) who attributed growth characters of crop species not only to genetic constitution of the crop but also to the suitable agro-ecological zone where they can express their full genetic resources for growth and yield enhancement. In terms of yield, the improved cultivars of Cu 100, Nagano F1 and Cu 999 produced top yielders than the local cultivars. The result of yield and yield components traits agreed with the findings of Resende (1999), who found that with regard to number of fruits per plant, the improved cultivars of ; Indaial, Colonia, Ginga AG-77, Score and Tamor showed the best performance by producing more number of fruits per plant as compared to other cultivars evaluated.

Furthermore, days to emergence and days to 50% emergence, that were not correlated with yield showed correlation with other yield related traits an indication of a form of indirect relationship that exist among the traits. Days to male and female flower initiation and days to maturity which were negatively correlated with fruit yield suggest that lateness to flower initiations and fruit maturity have inverse effect on fruit yield. This result was similar to the findings of Ngwuta *et al*. (2009) who observed that days to 50% silking was significant and negatively correlated with grain yield in maize.

V. Conclusion

The results of the study showed that the local genotypes are low yielders thus, are the resultant effect of low productivity by cucumber farmers. The improved genotypes performed extremely well in their yield performance and are already being grown by intercrossing them with local genotypes. This is hoped to increase the yielding components of the local genotypes.

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