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Introducing Cucumber for Cultivation at New Different Zone in Ebonyi State, Southeastern Nigeria

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Abstract: A two study was conducted at the four major agricultural zones of Ebonyi State (Abakaliki, Ezzamgbo, Ikwo and Okposi), Southeastern Nigeria. The aim was to evaluate the possibility of producing cucumber in the area. The soil and climatic conditions of the area were assessed for their suitability for the production of the crop. The experiments were laid out in a randomized complete block design (RCBD) in each location. The parameters measured included soil physical and chemical properties, weather factors, crop growth and yield attributes. The results showed no significantly consistent variations in the weather factors observed among different sits. Soil bulk density values were significantly ($P>0.05$) lower at Abakaliki and Ezzamgbo than at Okposi and Ikwo locations. The soil total porosity, moisture content and hydraulic conductivity were significantly ($P<0.05$) higher at Ezzamgbo and Abakaliki than at Okposi and Ikwo locations. It was also observed that soil pH, organic matter, exchangeable bases and Cation-exchange capacity were significantly ($P<0.05$) higher at Ezzamgbo and Abakaliki than at Okposi and Ikwo location. The average cucumber yield range of 18 - 35 t/ha obtained in the study was lower than the world average yield of 50 t/ha. However, cucumber vegetative growth characters including number of leaves per plant, leaf area per plant, vine length and shoot dry matter yield were consistently significantly ($P<0.05$) higher at Ezzamgbo and Abakaliki than at Okposi and Ikwo locations. Cucumber average fruit yield values at Ezzamgbo and Abakalliki and Ikwo were significantly ($P<0.05$) higher than the fruit yield at Okposi location. The fruit yield at Ezzamgbo was 21 and 8 t/ha more than the yield at Okopsi and Ikwo. The yield at Abakaliki was 16 and 3 t/ha more than the yield at Okposi and Ikwo, whereas the yield at Ikwo was 13 t/ha higher than that of Okposi location.

Key words: Cucumber Production % Location % Soil Environment % Climatic Environment % Agro-ecology % Southeastern Nigeria

INTRODUCTION

Cucumber is essentially a temperate, cool season crop that produces best at high altitudes [1]. The Nigerian tropical climatic environment is predominantly worm and moist. This condition poses a limitation to the production of the crop under Nigerian environment. Much of the cucumber production in Nigeria therefore takes place at the Jos Platue because of its characteristics montane climate. As a result, cucumber supply is limited and the demand outstrips the production. Even much of the ones produced perish in transit to other parts of the country where they are needed.

There is the need to explore the potential of other areas to produce the crop even if it means ‘forcing’ the production. It behooves one to study the general characteristics of the soil and climate of the areas likely to be used for cucumber production in order to optimize the success of the endevour. The Ebonyi State of Southeastern Nigeria is an agrarian area; the farmers produce mostly roots and grains. The introduction and adoption of cucumber production by the farmers would increase the range of crops produced in the area, thus improving the nutritive intake and the wealth base of the farmers.

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The study had the assessment of the suitability of the soil and climate of the area for the production of cucumber as the major thrust.

MATERIALS AND METHODS

Description of the Study Area: Ebonyi State lies between latitude 7°30'E and longitudes 5°40'N and 6°45'N, within the Southeast of the derived Savanna Zone of Nigeria. The soil of the area is characterized by shale parent materials and of shallow depth [2]. The mean monthly temperature ranges between 24°C and 28°C. The rainfall pattern is bimodal with peaks in the months of July and September. Annual amounts of rainfall range between 1500 mm and 2000 mm. Rainfall stabilizes around May and stops around October living a dried period between November and April [3]. The weather data collected during the growing seasons are shown in Tables 1a - 1d.

The Test Crops: The seeds of the test crop were sourced from National Horticultural Research Institutes (NIHORT) Okigwe, Imo State, Nigeria.

Field Work

Locations: The field experiments were carried out in four locations in the State. The locations were in the community farm Ezzamgbo, Research and teaching farm College of Education Ikwo, Okposi and Research and teaching farm Ebonyi State University, Abakaliki. The locations differed with respect to soil texture and chemical properties and are representative of the major centers of farming activities in the area.

Experimental Layout: The trials were carried out for two seasons (2008 and 2009). The crops were planted on raised beds in a randomized complete block design (RCBD) with four blocks. The size of the experimental area in each location was 385 m^2 (17.5 m x 22 m). The size of each block was 22 m^2. Each replicate contained five plots, each measuring 16 m^2 (2 m x 8 m). The plots were separated from one another by 0.5 m space while the replicates were separated by 1.0 m alleys. A plant spacing of 50 cm between rows and 50 cm between plants was adopted at all the locations.

Cultural Practices

First Year Trial: The clearing and tillage operations were done in the second week of June, while planting took place immediately after seedbed preparation. Two seeds were sown per stand and thinned down to a single plant per stand fourteen days after emergence, giving a plant population of 65,000 stands per hectare. Fertilizer NPK at the rate of 80 kg N / ha, 40 kg P / ha and 40 K / ha was applied at 21 DAP by side placement method. Weeding was carried out manually as the need arose using hand hoe, while pesticide (Malathion) was applied at the rate of 5 litres per hectare, mixed in 80 litres of water at 7 intervals from 30 DAP through the life cycle to control pests, while Dithane M45 was used to control fungi. Bamboo sticks were used as sticks at 15 DAP with the emergence of tendrils. Five plants were randomly selected within the net plot, in each plot and tagged for vine length, leaf area measurements and number of leaves count. The measurements were taken at 30 DAP. Vine length was measured as the lateral distance from the base of

Table 1: The soil physical and chemical properties of the locations before the experiment

Physical Properties	Abakaliki Location	Ezzamgbo Location	Ikwo Location	Okposi Location
Fine Sand (%)	50.00	17.00	22.00	40.00
Coarse Sand (%)	8.00	67.00	36.00	26.00
Silt (%)	25.00	9.00	25.00	21.00
Clay (%)	17.00	7.00	17.00	13.00
Textural Class	Silty Clay Loam	Silty Clay Loam	Silty Loam	Silty Loam
Chemical Properties				
pH (H_20)	6.00	6.40	5.00	4.60
Organic Matter (%)	1.86	2.90	1.29	1.06
Total N (%)	0.08	0.10	0.06	0.06
Available P (gm/kg)	20.90	18.90	20.07	19.87
Na [Cmol(+)/kg]	1.39	1.39	1.06	1.06
K [Cmol(+)/kg]	3.20	8.40	2.10	0.09
Ca [Cmol(+)/kg]	3.20	5.80	2.80	1.03
Mg [Cmol(+)/kg]	1.20	1.80	1.89	1.55
CEC[Cmol(+)/kg]	24.40	30.80	18.80	14.40

the shoot to the tip of the lateral main vine. Leaf area was determined by measuring the length and width of all the leaves on a plant with a simple ruler and the average leaf area of the five plants recorded as the leaf area. Numbers of leaves was measured by counting all the leaves on each plant and the mean of the five plants assumed as the number of leaves. Shoot dry matter was also taken at 30 DAP by cutting, oven drying and weighing the entire above ground vegetation of five plants randomly selected from the boarder rows of each plot. The mean weight of the five plants was assumed as the shoot dry matter. Fruit were harvested at maturity before the seeds ripen and when the fruits began to harden. The harvest was from a net plot of 2 m^2 in the center of each plot and converted to tons per hectare.

Second Year Trial: The second year trial was a repeat of the first year trial.

Observation and Data Collection: Data on rainfall, temperature and relative humidity were collected during the two growing seasons and analyzed (Table 1a - 1d). Six soil auger samples from 0-20 cm soil depth (for determination of pre-plant soil chemical properties and texture) were randomly collected from each location for laboratory analysis. Another six auger samples for the post harvest determination of chemical properties were collected from each plot after each season's cropping. Six undisturbed soil core samples from 0 -5 cm depth (for analysis of dry bulk density and soil total porosity) were collected from each plot at 30 days after planting each season. Six other soil core samples were collected from each plot at 30 DAP for the determination of soil hydraulic conductivity. The soil core samples collected using cores of 5cm diameter and 5cm height were analyzed separately and mean result used, whereas the auger samples were mixed and a composite sub sample taken for analysis. Measurements for bulk density, total porosity and gravimetric soil water content were made in July each year. Plant leaf area, number of leaves per plant, vine length, shoot dry matter yield were measured.

Laboratory Methods: The composite soil samples taken at the depth of 0 - 20 cm were analyzed in the laboratory for N, P, K, Ca, Mg, pH, organic carbon and CEC. Total nitrogen was determined by the macro Kjeldahl method [4]. Available phosphorus was determined using Bray II method as outlined in Page *et al.* [5] and Organic Carbon by the Walkely and Black method [6]. Soil pH in water (2:1) was determined by the glass electrode pH meter [7]. Particle size distribution was determined by the hydrometer method, [8]. Dry bulk density was determined by the cone method [9]. Total porosity was calculated from the dry bulk density as the fraction of total volume not occupied by soil assuming a particle density of 2.65 mg m^{-3}. Soil gravimetric moisture was measured using the method outlined by Klute [10] whereas the hydraulic conductivity was determined by method outlined by Stolte [11].

Data Analysis: The data collected from the two experiments were subjected to statistical analyses using Analysis of Variance (ANOVA) and Correlation methods according to SAS program [12].

RESULTS

The Weather Records: The weather records for the growing seasons are shown in Table 2. The mean annual rainfalls for the locations were in the order: Ezzamgbo > Ikwo > Okposi > Abakaliki in the first year and Okposi > Ikwo > Ezzambgo > Abakaliki in the second year. There was no consistent trend in rainfall during the cropping season across the four locations. It was also observed that annual mean rainfall was lowest at Abakaliki during the two seasons. There was also no consistent trend in the range of temperature and relative humidity values across the four locations during the two years study.

The Soil Physical Properties: The physical characteristics of the soils at the four locations are presented in Table 3. The soil at Okposi and Ikwo were more compacted compared to the soils at Ezzamgbo and Abakaliki as evidenced by their higher bulk density values. Soil bulk density values at Ezzamgbo were 0.27 and 0.25 cm^3 significantly ($p>0.05$) lower than at Okposi and Ikwo, while that of Abakaliki was 0.23 and 0.21 cm^3 significantly lower ($p>0.05$) than Okposi and Ikwo soils in the first year. During the second year, Ezzamgbo and Abakaliki soils had 0.19 and 0.18 cm^3 significantly lower ($p>0.05$) bulk density values than the Okposi soil. Soil moisture at Abakaliki was 48 % significantly higher than at Ikwo in the first year, while the soil moisture at Abakaliki, Ezzamgbo and Okposi on the one hand and at Ezzamgbo, Ikwo and Okposi on the other hand, were statistically comparable respectively. In the second year, soil moisture at Abakaliki and Okposi were 25 % and 32 % significantly higher ($p<0.05$) than at the Ikwo location. No significant differences in soil moisture were observed between Abakaliki and Okposi and also between

Table 2: Weather Record for the Experimental location

	2007			2008		
Month (%)	Rainfall (mm)	Temperature (°C)	Relative Humidity (%)	Rainfall (mm)	Temperature (°C)	Relative Humidity (%)
Abakaliki						
April	117.2	24.00	61.00	106.8	24.00	72.00
May	118.5	22.00	62.00	118.8	21.00	78.00
June	113.4	21.00	75.00	111.5	22.00	75.00
July	264.8	20.00	85.00	249.8	20.00	85.00
August	125.3	20.00	88.00	114.0	21.00	83.00
September	216.8	21.00	82.00	275.7	20.00	88.00
October	177.9	20.00	80.00	158.1	22.00	80.00
Total	1073.90	148.00	533.00	1134.7	150.00	561.00
Mean	153.41	21.14	76.14	162.1	21.43	80.14
Ezzamgbo						
April	159.15	17.05	76.40	262.10	24.50	68.00
May	231.53	15.71	73.80	321.90	23.30	71.00
June	223.77	18.54	79.70	104.25	22.60	67.00
July	288.49	13.90	84.10	202.70	24.60	51.00
August	239.96	15.26	94.28	215.00	22.70	85.00
September	258.30	16.58	94.75	215.70	25.00	80.00
October	238.19	15.61	93.88	97.75	18.05	90.93
Total	1639.39	112.65	596.91	1419.40	160.75	512.93
Mean	234.20	16.09	85.27	202.77	22.96	73.28
Ikwo						
April	110.04	16.62	81.15	231.40	23.8	87.00
May	89.70	14.56	70.37	286.30	24.0	87.00
June	216.13	14.54	86.04	193.40	21.8	65.00
July	281.21	19.49	83.50	234.20	26.0	73.00
August	186.93	15.37	93.36	224.60	23.0	82.00
September	291.30	16.13	94.17	234.10	29.4	83.00
October	132.08	15.48	93.93	101.20	26.3	50.00
Total	1306.59	112.19	602.52	1505.20	174.3	527.00
Mean	186.66	16.03	86.07	215.03	24.9	75.29
Okposi						
April	96.60	23.00	76.25	104.03	21.09	80.00
May	101.20	20.57	78.00	165.80	20.37	85.44
June	224.40	20.19	78.76	257.69	18.66	87.54
July	283.25	20.48	85.17	299.13	19.00	89.76
August	117.24	21.22	83.81	229.00	21.24	88.16
September	240.65	20.70	90.28	239.90	17.06	90.28
October	190.90	21.08	82.77	198.36	20.22	89.60
Total	1254.25	147.24	576.04	1493.91	137.64	610.78
Mean	179.18	21.03	82.29	213.42	19.66	87.25

Table 3: The soil physical properties

	2008					2009				
Locations	Bulk Density (Mg/m^3)	Total Porosity (%)	Soil Moisture (%)	Hydraulic Conductivity (Cm/hr)	Soil Temperature (°C)	Bulk Density (Mg/m^3)	Total Porosity (%)	Soil Moisture (%)	Hydraulic Conductivity (Cm/hr)	Soil Temperature (°C)
Abakaliki	1.47	45.00	19.93	105.0	36.00	1.48	44.00	12.33	80.30	36.00
Ezzamgbo	1.43	54.00	14.07	176.3	32.50	1.47	45.00	10.84	135.80	36.25
Ikwo	1.70	36.00	10.46	50.0	28.25	1.62	39.00	9.30	74.50	27.00
Okposi	1.68	37.00	16.54	83.5	33.75	1.66	37.00	13.74	56.50	27.00
$LSD_{(0.05)}$	0.18	5.24	8.56	9.21	NS	0.17	4.82	2.96	28.36	3.04

Table 4:The Post harvest Mean Soil Chemical Properties

Locations	pH (H_20)	Organic Matter (%)	N (%/Kg)	Na	K	Ca	Mg	CEC	P Mg/Kg
				---Cmol (+) Kg---					
Abakaliki	5.76	2.26	0.087	0. 70	0.055	6.81	0.74	29.80	24.46
Ezzamgbo	6.28	2.49	0.089	0.76	0.145	8.04	1.95	31.20	26.38
Ikwo	5.20	1.97	0.077	0.72	0.055	4.58	2.00	24.60	25.89
Okposi	4.65	1.76	0.078	0.71	0.075	2.71	1.28	26.80	23.87
$LSD_{(0.05)}$	0.99	0.25	NS	NS	0.023	3.36	1.22	2.40	NS

Table 5: The Cucumber growth and yield

	2008					2009				
Locations	No. Leaves	Vine Length (cm)	Leaf Area (cm^2)	Dry Matter (gm)	Fresh Fruit (t/ha)	No. Leaves	Vine Length (cm)	Leaf Area (cm^2)	Dry Matter (gm)	Fresh Fruit (t/ha)
Abakaliki	43.84	12.12	197.57	311.72	47.68	39.71	76.29	70.76	174.06	22.55
Ezzamgbo	93.25	11.35	222.02	306.10	48.79	82.23	98.23	111.50	251.18	30.73
Ikwo	63.95	9.61	152.71	235.10	41.16	27.88	45.10	66.98	168.18	22.81
Okposi	55.30	8.03	128.38	159.50	22.84	16.42	14.64	37.62	97.95	14.26
$LSD_{(0.05)}$	8.98	1.23	33.94	39.10	8.25	22.73	30.54	29.01	67.85	7.82

Ezzamgbo and Ikwo. The soil hydraulic conductivity value of the Ezzamgbo soil was significantly higher ($p<0.05$) than that of Okposi, Ikwo and Abakaliki soils by 123.3, 92.8 and 71.3 cm / hr in the first year and by 79, 69.3 and 55.5 cm / hr in the second year. The result also showed that the Abakaliki soil had 55 cm / hr significantly higher ($p<0.05$) hydraulic conductivity than the soil of Okposi location. The soil temperature did not show any significant variations among the locations in the first year of the experiment, however, in the second year, the soils at Abakaliki and Ezzamgbo had 9 °C significantly higher ($p<0.05$) soil temperature respectively than the soils of Ikwo and Okpsi locations.

The Soil Chemical Properties: The mean post harvest chemical properties of the soils valued across the four locations are presented in Table 4.

The soil of Okposi and Ikwo locations had 19 and 17 % significantly lower ($p>0.05$) soil pH values respectively, when compared with the Ezzamgbo location. Soil pH values between Abakaliki and Ezzamgbo on one hand and Okposi and Ikwo locations on the other hand were respectively statistically comparable. The soil organic matter level was 15 and 38 % significantly higher ($p<0.05$) at Ezzamgbo than at Okposi and Ikwo. Similarly, the soil at Abakaliki location had 49 and 35% significantly higher ($p<0.05$) organic matter values than that of Okposi and Ikwo. No significant differences in organic matter levels were found between Abakaliki and Ezzamgbo and between Okposi and Ikwo locations, respectively. There were no significant differences in soil available P, total N and exchangeable Na among the locations during the second years study. The Cation Exchange Capacity values of the soil were significantly higher ($p<0.05$) at Ezzamgbo and Abakaliki than at Ikwo and okposi locations during the two years study. The level of soil K at Ezzamgbo location was 65% significantly higher ($p<0.05$) than the K levels at Okposi and Ikwo locations respectively, while Abakaliki soil also had 50% significantly higher ($p<0.05$) soil K than the Okposi location. The soil at Ezzamgbo and Abakaliki had 67 and 66% significantly higher ($p<0.05$) soil Mg than that of Okposi location. No significant differences in soil Mg content were observed between Abakaliki and Ezzamgbo on one hand and between Okposi and Ikwo locations respectively. The level of soil exchangeable Ca at Ezzamgbo location was 76 and 49% significantly higher ($p<0.05$) than at Ezzamgbo and Ikwo, while the soil exchangeable Ca content at Abakaliki was 71% significantly higher than at Okposi.

Cucumber Growth: Table 5 shows the result of the growth performance of Cucumber at the four experimental locations. The leaves numbers of the Cucumber plants at Ezzamgbo location were 50, 38 and 29 significantly ($p< 0.05$) higher than the leaves numbers of the plants at Abakaliki, Okposi and Ikwo locations respectively, whereas the leaves of the plants at Ikwo and Okposi locations were 20 and 15 significantly ($p<0.05$) higher than those of the plants at Abakaliki in the first year.

In the second year the plants at Ezzamgbo had 66, 54 and 43 leaves significantly ($p<0.05$) higher than that off the plants at Okposi, Ikwo and Abakaliki locations, whereas the Cucumber plants at Abakaliki had 23 leaves significantly ($p<0.05$) more than those at Okposi. The pooled result for the two years showed that the plants at Ezzamgbo had significantly ($p< 0.05$) higher number of leaves than the plants at Abakaliki, Ikwo and Okposi locations.

The result showed that the plants at Abakaliki and Ezzamgbo had significantly longer vines than those at Okposi, whereas the length of the vines of the plants at Abakaliki, Ezzamgbo and Ikwo on the one hand and those of the plants at Ikwo and Okposi on the other hand, were comparable.

In the first year of the study, the Cucumber plants produced at Ezzamgbo had 94 and 69 cm^2 significantly ($p<0.05$) larger leaf area than those at Okposi and Ikwo, whereas the plants at Abakaliki also 69 and 45 cm^2 significantly ($p<0.05$) larger leaf area than those at Okposi and Ikwo locations. In the second year, the Cucumber plants at Ezzamgbo location had 74, 45 and 41 cm^2 significantly ($p<0.05$) larger leaf area than the plants at Okposi, Ikwo and Abakaliki, while the plants at Abakaliki and Ikwo had 33 and 29 cm^2 significantly ($p<0.05$) larger leaf area respectively than the plants at Okposi. The two years average, valued across the four locations, showed that the crops had significantly ($p<0.05$) larger leaf area at Ezzamgbo than at Okposi, Ikwo and Abakaliki in that order. The plants at Abakaliki also had significantly larger leaf area than those at Ikwo and Okposi, whereas the plants at Ikwo had significantly larger leaf area than those at Okposi.

The Cucumber plants at Abakaliki accumulated 152 and 77 grams significantly ($p<0.05$) heavier shoot dry matter yield than those at Okposi and Ikwo, while the shoot dry matter yield of the plants at Ezzamgbo was 147 and 71 grams significantly ($p<0.05$) heavier than at Okposi and Ikwo locations in the first year. Also, the plants at Ikwo had 76 grams significantly ($p<0.05$) heavier dry matter yield than the ones at Okposi. In the second season, the plants at Ezzamgbo location had 153, 82 and 77 grams significantly ($p<0.05$) higher dry matter than those at Okposi, Ikwo and Abakaliki, while the plants at Abakaliki and Ikwo produced 76 and 71 grams significantly ($p<0.05$) greater dry matter than the plants at Okposi location. The two years average Cucumber shoot dry matter yield, valued across the four locations, showed that the plants at Ezzamgbo and Abakaliki produced significantly greater dry matter than the ones at Okposi and Ikwo, while the plants at Ikwo similarly had significantly greater dry matter than at Okposi location.

Fruit Yield: The Ezzamgbo, Abakaliki and Ikwo locations produced 26.0, 24.8 and 18.3 t / ha significantly ($p<0.05$) higher fruit yield than Okposi location in the first year. In the second year also, Cucumber fresh fruit yield at Ezzamgbo was 16.8, 8.2 and 7.9 t / ha significantly ($p<0.05$) higher than the yield at Okposi, Abakaliki ad Ikwo locations, while fruit yields at Abakaliki and Ikwo were 8.6 and 8.3 t / ha significantly ($p<0.05$) higher than the yield at Okposi. The average yield values for the two years showed that Ezzambgo location produced significantly higher Cucumber fruit yield than Ikwo and Okposi, whereas no significant difference in Cucumber fruit yield was observed between Ikwo and Abakaliki locations on the one hand and Ezzamgbo and Abakaliki locations on the other.

Correlation Results: The result of the relationships between Cucumber fruit yield and soil physical properties indicated that the soil physical properties did not have pronounced influence on Cucumber fruit yield (Table 6).

However, the result of the correlation between cucumber fruit yield and soil chemical properties indicated that while some chemical properties had negative relationships with fruit yield, some others showed positive relationships with fruit yield (Table 8). The soil pH had very negative correlation with fruit yield ($r = -0.83$). Also, fruit yield had negative relationships with soil CEC ($r = -0.70$); exchangeable Na ($r = -0.68$); exchangeable K ($r = -0.64$) and exchangeable Ca ($r = -0.62$). On the other hand, fruit yield had minor positive relationships with organic carbon ($r = 0.30$) and with total N ($r = 0.32$), whereas soil available P had strong positive relationship with fruit yield ($r = 0.62$). However, the result showed very strong positive interrelationships among the other soil chemical variables considered.

The result of the correlation between Cucumber fruit yield and the yield components showed that fruit yield had strong relationship with number of leaves ($r = 0.64$), with leaf area ($r = 0.88$) and shoot dry matter ($r = 0.93$) (Table 9). There were also multiple relationships among the yield components. These included strong relationships between number of leaves and shoot dry matter ($r = 0.68$), very strong relationships between number of leaves and leaf area ($r = 0.71$) and also very strong relationships between leaf area and shoot dry matter ($r = 0.83$).

Table 6: Relationship between Cucumber Fruit Yield and Soil Physical Properties (N =6)

	Fruit Weight Yield	Bulk Density	Total Porosity	Gravimetric Moisture	Hydraulic Conductivity	Soil Temp.
Fruit Wt. Yield	-	0.19	-.30	0.018	-.35	0.16
Bulk Density		-	-.80**	0.22	-.011	-.048
Total porosity			-	0.055	0.012	-.038
Gravimetric Moisture				-	0.007	0.20
Hydraulic Conductivity					-	-.49
Soil Temp.						

The relationships between the atmospheric variables and Cucumber fruit yield (Table 7) showed that fruit yield had positive relationships with only rainfall (r = 0.49) and humidity (r = 0.50)

Table 7: The Relationship between Cucumber Fruits Yield and Atmospheric condition (N = 5)

	Fruit Weight Yield	Rainfall	Maximum Temperature	Minimum Temperature	Humidity
Fruit Weight Yield	-	0.49	-.028	-.322	0.50*
Rainfall		-	0.29	0.37	0.55*
Maximum Temperature			-	0.90**	0.006
Minimum Temperature				-	-.048
Humidity					-

Table 8: Relationship between Cucumber Fruit Yield and Soil Chemical Properties (N = 10)

	Fruit Yield	pH	OC	Total N	Na	K	Ca	Mg	CEC	P
Fruit Yield	-	-.83**	0.30	0.32	-.68*	-.64*	-.62*	0.076	-.70**	0.62*
pH		-	.26	0.45	0.79**	0.41	0.74**	-.33	0.86**	0.67**
OC			-	0.25	-.76**	-.09	0.34	0.29	-.62*	0.68*
Na				-	0.23	0.59*	0.80**	0.086	0.39	0.19
K					-	0.28	0.31	-.48	0.96**	0.75**
Ca						-	0.58*	0.21	0.39	-.28
Mg							-	0.003	0.45	-.21
CEC								-	-.57*	0.25
P									-	-.78**

Table 9: Relationship between Cucumber Fruit Yield and Yield Components (N = 5)

	No. of Leaves	Vine Length	Leaf Area	Dry Matter	Fruit Wt. Yield
No of Leaves	-	0.22	0.71**	0.68*	0.64*
Vine Length		-	-.10	0.0065	-.21
Leaf Area			-	0.83**	0.88**
Dry Matter				.	0.93**
Fruit Weight Yield					

DISCUSSION

The average cucumber fruit yield range of 18 - 35 tons per hectare in the study was rather low compared to world average yield of 50 tons ha^{-1} [13]. Yamogueb [14]; Grubben, [15] and Swaider *et al.* [1] also reported the world average potential fruit yield to be 50 tons per hectare. Yield ranges of other African countries were also observed to be higher than the average yield obtained in the study. These include 20 - 40 t ha^{-1} in Mauritania and Niger, 25 - 50 t h^{-1} in Gabon, 30 t ha^{-1} in Ivory Coast and 30 - 75 t ha^{-1} in Senegal [16]. The lower yield was ascribed more to the influence of poor chemical properties of the soils of the study areas than the physical properties. The adverse soil chemical properties, particularly the low organic matter and low pH must have played a major role in the low yield of the crops observed. This observation was manifested in the strong negative correlation between fruit yield and soil pH (r = - 0.83). The low soil pH might have reduced the solubility and availability of soil nutrients, activity of microorganisms responsible for the breakdown of organic matter, hence negatively influenced most other chemical functions in the soil. This situation lowered the availability of several plant nutrients necessary for the production of the crop. The reliance and influence of the performance of the crop on the availability of nutrients in the study was also shown by the very strong negative correlation between the crop fruit yield and soil chemical properties including Na [(r = - 0.68), K (r = - 0.63), Ca (r = - 0.70) and CEC (r = 0.70)] (Table 8). These chemical properties are dependent on soil pH and organic matter. Therefore, if the pH and level of soil organic matter are raised, the tendency is that there will be improvement in soil chemical properties, mobilization of plant nutrient elements and possibly increased uptake of nutrients by the cucumber plants. These situations could have ensured vigorous crop growth and increased fruit yield in the study area.

The low level of soil organic matter observed also accounted for the low Cucumber fruit yield. Jeff *et al.* (1996) also indicated that organic matter influences many soil properties, including infiltration rate, bulk density, aggregate stability, CEC and biological activities, all of which are important detriments of plant growth and yield.

It is likely that the significantly higher Cucumber fruit yield at Ezzamgbo and Abakaliki than at the other locations was as a result of the response to their higher fertility shown by superior soil chemical and physical properties. These included more vigorous plants, occasioned by superior number of leaves, vine length, leaf area and dry matter yield at the two locations. The lower yields at Okposi and Ikwo could be as a result of the less vigorous growth and thus the inability of the plant to effectively explore the poor physical and chemical properties of the soils at the locations for fruit yield.

CONCLUSION

The general characteristics of the soils of the study locations show that the fertility status of the soils is rather low for optimum Cucumber production. However, if the observed soil physical and chemical constraints are ameliorated, the production of Cucumber could be adopted at Ezzamgbo, Abakaliki and Ikwo environs.

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