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Influence of Different Growth Media on Growth and Yield Performances of Cucumber (Cucumis Sativus Linn.)

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Abstract
Growth and yield performances of cucumber (*Cucumis sativus Linn.*) as influenced by different growth media were experimented at the field research site of the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria. Loamy/top soil, mixture of top soil + pulverized poultry droppings, sandy soil, clayey soil and washed river sand (as control) were employed as growth media/treatments (A, B, C, D & E respectively) and their physicochemical analyses (pH, total nitrogen, organic carbon, available phosphorus, K, Ca, Mg, Na, Mn, Fe, Cu, Zn, exchangeable acidity, ECEC, textural class) were carried out prior to the commencement of the study. The experiment was a completely randomized design consisting of 5 treatments and 5 replicates. Seedlings' emergence percentage, morphological growth characters (tendril collar girth, number of leaves, leaf area, number of branches, tendril length) and yield indices (number of flowers, number of fruits, size of fruits and fruit fresh weight) were assessed. Data collected were analyzed using SPSS 20.0. 100% seedlings' emergence was observed in all the treatments except B which had 50% only, ANOVA indicated significant differences (at $P<0.01/P<0.05$) among the treatments of which treatment B (mixture of top soil + pulverized poultry droppings) emerged as the best treatment that outstandingly and positively influenced the growth and yield of the cucumber plant and was recommended for its commercial cultivation/production.
Keywords: Growth, yield, performance, cucumber, growth media.

1.0 INTRODUCTION

One of the oldest vegetables extensively cultivated since the past fifty centuries is cucumber (*Cucumis sativus Linn.*) which belongs to the family 'Curcurbitaceae' otherwise called the gourd family and mainly raised/planted for its edible fruits (Greensil, 1964; Lower and Edward, 1986). It is not characterized with erect/woody stem but possesses creeping tendrils or climbing vines which produces cylindrical fruits. Cucumber has three varieties which are named Slicing, Pickling and Burpless from which other varieties/cultivars had ensued/come up, though Greensil, (1964) asserted that two varieties exist which are the 'ridge' type (whose size is 30cm in length and 5cm in diameter and easily grown in both tropical temperate climates) and 'English hothouse' type (45cm length x 3.75cm diameter: difficult to cultivate in the tropics but easier in temperate climates and is of better quality). The vegetable was said to have originated from southern Asia, though presently thrives in most continents of the world and China is the largest producer of cucumber amounting to about two third of the global supply (Martinez and Nagai, 2006). Certain varieties need stable warm temperature for optimal/ reasonable yield (Cobeil and Gosselin, 1990, Sebastian and Schaefer, 2010) and when planted in poor/infertile soils, the quality of the fruits are often adversely affected as bitter and misshapen fruits are produced which are not demanded by consumers (Adam and Carmen, 2000).Unlike some leguminous crops which can thrive in soils of very low nutrient status owing to their nitrogen fixing ability, cucumber cannot produce optimally infertile soils (Abiodun, 2010; Enujeke and Ojeifo, 2013).

Therefore, it is imperative to beef up the soil nutrient status with organic manures other than inorganic or chemical fertilizers in addition to proper choice of soil type for cultivation of crops since prolonged/continuous application of chemical fertilizers are detrimental to soil and human health (Alenxander, 1982; Kareem *et. al*., 2014; Ayoola and Adeniran, 2006; Makinde *et. al.,* 2007). Indubitably, chemical fertilizers rapidly release nutrients and not steadily after application but adversely affects the soil structure as opposed to organic manures which release nutrients slowly but steadily/sustainably especially when supplied by tree legumes and even non-leguminous tree species (from their pruned branches and profuse litter deposition) under agro-forestry system as alley cropping or alternate row planting (El-Shakweer *et. al.,* 1998; Belay *et al.*, 2001).

Procurement of organic manures such as green manure from leaves, cow dung and poultry droppings are often given priority attention but are very difficult to procure in terms of availability, expensiveness and transportation cost. Also, they should not be applied in wet condition because their decomposition process is exothermic which causes scorching/burning effect on plants' roots, though this scorching effect can be circumvented by ensuring proper drying, pulverization/powdering and sieving prior to application (Belay *et. al.*, 2001; Kareem, 2015). It is pertinent to stress or emphasize that organic and inorganic manures could be complementarily used though it requires proper calculation/determination of the correct ratio or level of concentration to prevent toxicity.

Thus, the objectives of this study are to evaluate the effect of different growth media (different soil types and top soil + organic manure) on the germination, growth rate and yield of cucumber and to give a reliable recommendation on the best growth medium for optimal growth, yield and commercial production of cucumber.

2.0 Materials and Method

The experiment was carried out in the screen house of the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba -Akoko, Ondo State, Nigeria before being transferred to the open field for proper growth and yield. The area is characterized by two climatic seasons: the rainy and dry season, with latitude of $7^0 28^1$ N and longitude of $50^0 44^{1.}$

Viable Seeds of cucumber were procured from an Agro Allied Company at Ibadan, Oyo State, Nigeria. Polythene bags (14cm by 17cm) were purchased from a market in University town, they were finely perforated at the bottom to enhance free drainage of water and prevent flooding or water-logging. The soil types used were river sand, top soil, clayey soil and sandy soil which were procured from the University premises while the poultry droppings (pulverized and sieved) was sourced from a poultry in the University town.

The experimental design employed for the experiment is complete randomized design (CRD) with five treatments and five replicates.

Table 1: Plot-Layout for the Experiment

A	B	C	D	E
C	D	B	E	A
D	B	E	A	C
E	A	D	C	B
B	E	A	D	C

Note: A = Top Soil, B = Top Soil + Poultry Droppings, C = Sandy Soil, D = Clayey Soil
E=River Sand (control)

Prior to filling the polythene bag with different soil types, they were analyzed and the parameters considered were pH, organic carbon, total nitrogen, available phosphorus, K, Mg, Ca, Na, Fe, Zn, Cu and Mn. Mixture of top soil and poultry droppings was in ratio 2:1 respectively (as treatment B). Two seeds of cucumber were sown at a depth of 2.3cm in each pot and 5cm spacing between polythene bags in the propagator. Each treatment was replicated (5) times and randomly arranged. Plants were watered every morning and evening and the seedling were thinned to one per pot two weeks after planting. Germination rate was taken daily and ended at the 7th day after planting while germination percentage per treatment (after seven days) was calculated by dividing the number of seeds that germinated by the total number of seeds planted and then multiplied by 100.

Morphological growth characters such as the tendril length (measured using thread which was later placed on the meter rule) , number of leaves and branches (by visual counting), stem collar girth (with the aid of venier caliper) and the leaf area (cm^2) were measured using the meter rule (average of 3 widths of each leaf x leaf length x total No. of leaves on the plant for that treatment). Yield indices such as the flower emergence rate, number of flowers/fresh fruits (by manual/physical counting) and weight of matured fresh (green) fruits from each of the treatments was also determined by using sensitive chemical analytical balance. Data collected on the seedlings' emergence percentage and morphological growth characteristics were analyzed by employing analysis of variance technique (ANOVA) by employing SPSS version 20.0

3.0: Results and Discussion

3.1 Results

3.1.1 Physicochemical Analyses

The results from the analyzed soil samples (river sand, sandy soil, clayey soil, top soil) and poultry droppings indicated that poultry droppings had the highest organic carbon (O.C) of 53.73 %, this was followed by top soil with 52.7 %, sandy soil with 30.48 %, river sand with 18.93 % and the lowest was clayey soil with 16.71 %. One could have expected river sand to have had the lowest value, but it was clay soil, probably because some organic materials had recently dissolved in the river where the river sand was procured more so it was not washed (Table

4). The pH also varied among the treatments, sandy soil had the highest value of 7.5 followed by river sand with 7.2, loamy/top soil with 6.5, clayey soil with 6.1 and poultry droppings had the lowest value was 6.0.

The total nitrogen also varied in all the treatments. It was treatment B (top soil +poultry droppings) that had the highest value of total nitrogen (8.75 %), followed by top soil (5.45 %), clay soil (3.55 %), sandy soil (2.23 %) and the lowest value was in river sand (1.96 %). The trend was maintained when considering other parameters such as available phosphorus, K, Ca, Mg, Cu, Na, Ca, Mn, Fe, Zn, exchangeable acidity and the effective cation exchange capacity (ECEC). Detailed soil parameters and their values are shown in Table 4 below.

Table 2: Pre-planting soil physicochemical analysis of the growth media and poultry droppings

Parameter	River Sand	Sandy Soil	Clayey Soil	Top Soil	PD
pH (H_20)	07.50	06.10	0 6.40	06.50	06.00
O.C. (%)	30.48	16.70	48.00	52.70	53.73
T.N (%)	03.55	08.75	03.90	05.45	08.75
Av. P. (ppm)	32.58	33.38	39.58	42.02	61.29
K($molkg^{-1}$)	00.26	00.29	00.49	00.34	02.53
Ca(mg/kg)	00.23	00.28	00.33	00.29	39.08
Mg($cmolkg^{-1}$)	01.00	01.20	01.39	02.28	-
Cu($cmolkg^{-1}$)	02.33	08.26	01.98	08.26	-
Na($cmolkg^{-1}$)	00.34	00.39	00.34	00.34	-
Ca(mg/kg)	00.30	00.38	00.33	00.32	-
Mn(mg/kg)	03.70	04.80	03.77	04.30	-
Fe(mg/kg)	21.30	23.80	23.00	28.30	-
Zn(mg/kg)	00.55	01.83	00.69	01.54	-
E.A. ($cmolkg^{-1}$)	00.42	00.42	00.52	00.83	-
ECEC($cmolkg^{-1}$)	30.43	42.45	32.94	46.80	
Textural class	River Sand	Sandy Soil	Clayey Soil	Top Soil	PD

Note: PD= Poultry Droppings, OC = Organic carbon, TN = Total nitrogen, Av. P= Available phosphorus, E.A= Exchangeable acidity, ECEC= Effective cation exchange capacity

3.1.2 Seedling emergence percentage, morphological and yield indices

Seedling emergence percentage (SEP): It was observed that germination of cucumber seeds in topsoil + poultry droppings had the lowest percentage of 50 as opposed to other treatments which had 100% SEP seven (7) days after planting.

Table 3: Seedling emergence percentages in all the treatments

Treatments	No. of Planted Seeds	No. of Emerged Seedlings	Seedling Emergence. Percentage
Top soil	10	10	100
Top soil +PD	10	05	50
Sandy soil	10	10	100
Clayey soil	10	10	100
River sand	10	10	100

*PD=Poultry Droppings

Tendril Length: The highest mean value of 98.6 cm on tendril length was obtained from seedlings sown in treatment B (top soil + poultry droppings) at the 8th week after planting, this was seconded by treatment A (top soil) with 53.6 cm, treatment C (clayey soil) with 13.7 treatment E (river sand) with 11.5 cm and the lowest mean was treatment D (sandy soil) with 9.50cm. ANOVA showed significant differences among the various treatment on the tendril length produced by cucumber [since $F_{cal}(4.066) > F_{tab}(0.014)$].

Table 4: Mean tendril length (cm) of cucumber plants based on treatments from weeks 2-8

Treatment	Week2	Week3	Week4	Week5	Week6	Week7	Week8
TS	8.80±0.37	17.4±0.75	22.0±0.75	27.0±0.84	33.4±1.47	48.0±2.79	53.6±2.75
TS + PD	3.20±1.32	17.0±6.96	32.0±13.2	63.8±28.7	82.4±36.2	92.6±40.7	98.6±42.9
SS	4.70±0.30	5.50±0.22	6.00±0.16	7.04±0.32	7.86±0.33	9.08±0.54	9.50±0.51
CS	7.00±0.16	8.30±0.30	8.80±0.49	10.4±0.66	11.7±0.92	12.8±0.89	13.7±1.07
R S	6.50±0.32	7.50±0.50	8.30±0.58	9.50±0.55	10.5±0.62	11.1±0.58	11.5±0.65

Note : TS =Top Soil, PD= Poultry Droppings, SS=Sandy Soil, CS= Clayey Soil, RS=River Sand

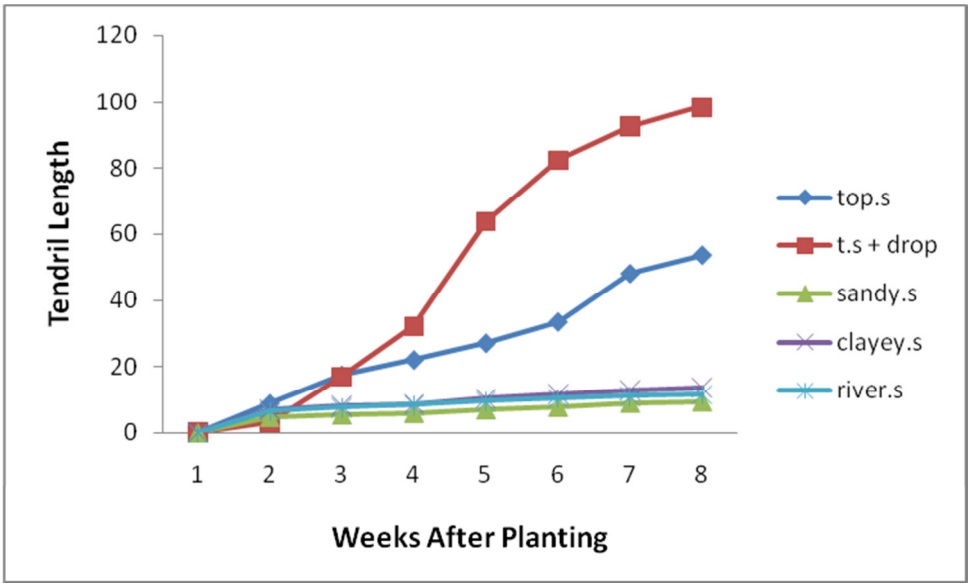

Fig.1: Mean tendril length of cucumber based on treatments from weeks 1 -8

Leaf Area: Result on leaf area showed that the highest mean value of 110.8 cm^2 was obtained from seedlings sown in treatment B at the 8th week after planting, followed by top soil with 53.0 cm^2, clayey soil with 40.6 cm^2, sandy soil with 30.1 cm^2 and the lowest mean was in river sand with 27.2 cm^2. Since $F_{cal}(2.689) > F_{tab}(.061)$ from the ANOVA table it therefore shows that there were significant differences among the various treatments used on the leaf area produced by cucumber the plants.

Table 5: Mean leaf area (cm^2) of cucumber based on treatments from weeks 2-8

Treatment	Week2	Week3	Week4	Week5	Week6	Week7	Week8
TS	23.6±0.40	26.6±1.03	32.4±0.98	36.2±3.09	44.8±1.59	47.8±1.71	53.0±2.14
TS/PD	12.0±4.89	53.0±22.0	78.4±33.2	99.2±41.6	106.2±41.6	108.8±45.2	110.8±46.4
SS	18.8±0.48	23.0±1.22	22.0±1.22	26.6±1.39	26.6±1.39	28.4±0.68	30.1±1.19
CS	22.9±1.64	26.9±1.27	26.9±1.27	33.7±1.51	37.2±3.36	38.6±3.74	40.6±3.12
RS	10.2±0.73	12.6±1.12	14.8±1.46	18.0±1.22	21.0±1.61	25.2±1.95	27.2±2.59

*TS=Top Soil, TS/PD = Top Soil + Poultry Droppings, SS = Sandy Soil, CS = Clay Soil, RS=River Sand

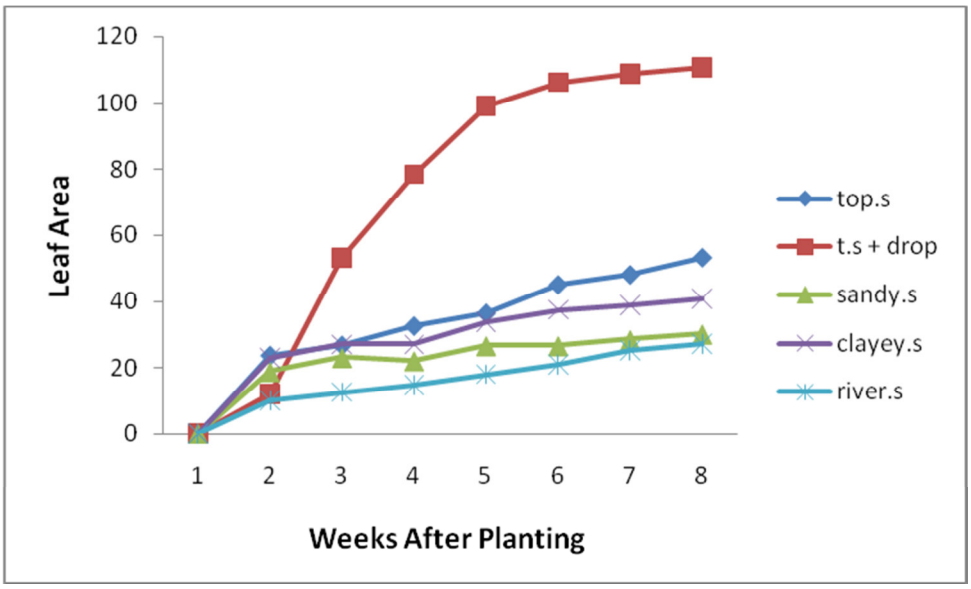

Fig.2: Mean leaf area of cucumber based on treatments from weeks 1- 8

Number of Branches: The result obtained the on number of branches indicated that the highest mean value of 10.6cm was obtained from seedlings sown in treatment B at the 8th week after planting followed by top soil with 8.80 cm, clayey soil, sandy soil and river sand with the lowest mean value of 2.40 cm. Significant differences were recorded in the various treatments used on the number of branches [since $F_{cal}(4.251) > F_{tab}(.012)$ from the

ANOVA table

Table 6: Mean Number of Branches (cm) of Cucumber Based on Treatments from Weeks 2-8

Treatment	Week2	Week3	Week4	Week5	Week6	Week7	Week8
top soil	1.00±0.00	2.00±0.00	4.40±0.24	5.00±0.00	8.40±0.24	8.40±0.24	8.80±0.37
TS + PD	0.00±0.00	3.20±1.32	5.40±2.23	9.20±3.81	11.4±4.69	11.4±4.69	10.6±4.35
SS	0.00±0.00	0.00±0.00	0.00±0.00	1.20±0.20	2.20±0.20	2.40±0.24	2.40±0.24
CS	0.00±0.00	0.00±0.00	0.00±0.00	1.20±0.20	2.40±0.24	2.60±0.24	2.40±0.24
RS	0.00±0.00	0.00±0.00	0.40±0.24	1.40±0.24	2.20±0.37	2.20±0.37	2.40±0.24

*TS=Top Soil, TS/PD = Top Soil + Poultry Droppings, SS = Sandy Soil, CS = Clay Soil, RS=River Sand

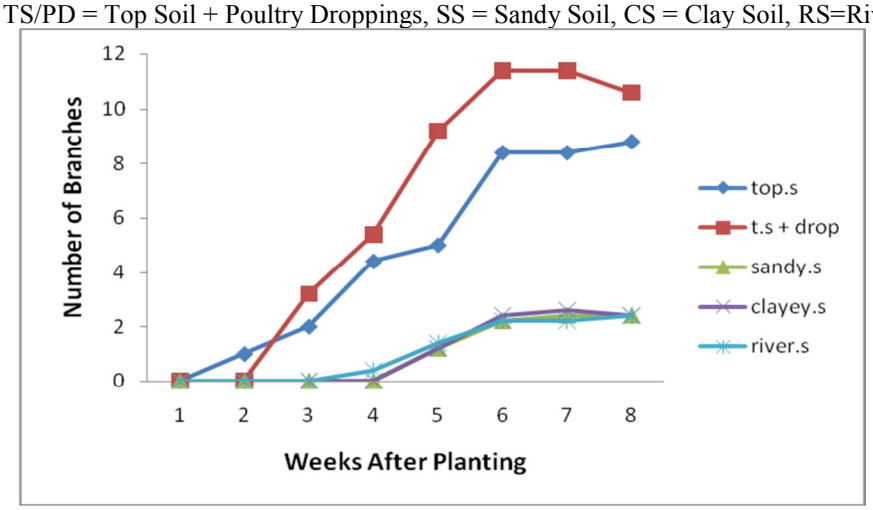

Fig.3: Mean number of branches of cucumber based on treatment from weeks 1-8

Collar Girth (Basal Stem Diameter): In stem collar girth, the highest mean value of 2.24 cm was obtained from seedlings sown in treatment A (top soil) at the 8th week after planting followed by treatment (top soil + poultry droppings) with mean value of 1.88 cm, sandy soil with 1.56 cm, clayey soil with 1.52 cm and the lowest mean was in river sand with mean of 1.26 cm. In the same vein significant differences were observed in the various treatments used on the tendril stem collar girth produced by cucumber plants.

Table 7: Mean Collar Girth (cm) of Cucumber Based on Treatments from Weeks 2-8

Treatment	Week2	Week3	Week4	Week5	Week6	Week7	Week8
TS	1.32±0.49	1.72±0.05	1.92±0.04	1.98±0.02	2.18±0.02	2.24±0.02	2.38±0.04
TS/PD	0.60±0.24	1.12±0.46	1.26±0.52	1.58±0.65	1.82±0.75	1.88±0.77	1.88±0.77
SS	0.46±0.02	0.88±0.08	0.90±0.06	1.20±0.09	1.36±0.08	1.46±0.09	1.56±0.07
CS	0.84±0.04	0.96±0.05	0.98±0.05	1.20±0.03	1.36±0.04	1.40±0.04	1.52±0.08
RS	0.50±0.00	0.72±0.06	0.82±0.06	0.90±0.06	1.08±0.07	1.22±0.09	1.26±0.07

*TS=Top Soil, TS/PD = Top Soil + Poultry Droppings, SS = Sandy Soil, CS = Clay Soil, RS=River Sand

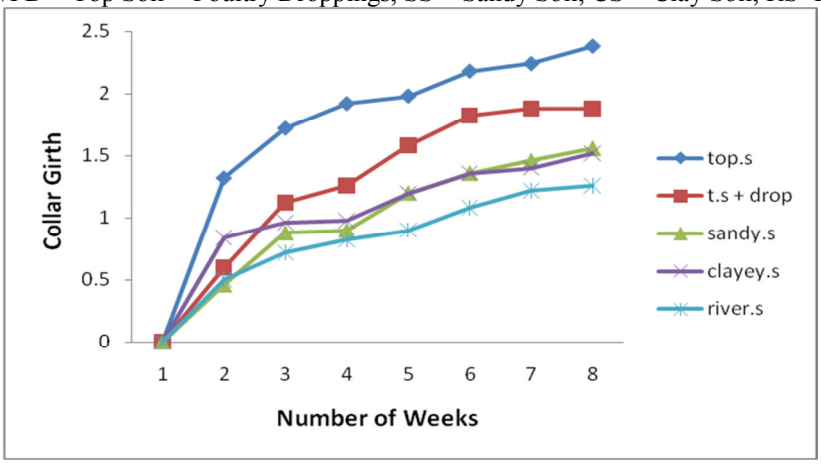

Fig.4: Mean collar girth of cucumber based on treatment from weeks 1-8

Number of Leaves: From the results obtained on number of leaves, it was observed that the highest mean value of 16.0 was gotten from seedlings sown in treatment A (top soil) at the 8th week after planting, followed by top soil mixed with poultry droppings with mean value of 15.0, clayey soil with 8.00, river sand and sandy soil has

the same mean value of 7.20. Significant differences were observed among the treatments except between treatments A & B, C & D, C & E and D & E.

Table 8: Mean number of cucumber leaves based on treatments from weeks 2-8

Treatment	Week2	Week3	Week4	Week5	Week6	Week7	Week8
TS	5.00±0.00	6.00±0.00	7.40±0.24	10.6±0.40	15.6±0.68	15.8±0.58	16.0±0.55
TS + PD	3.00±1.22	6.00±2.45	8.60±3.52	12.0±4.99	16.0±6.58	16.6±6.79	15.0±6.19
SS	3.00±0.00	4.00±0.00	4.00±0.00	5.00±0.00	6.40±0.24	7.20±0.20	7.20±0.20
CS	4.00±0.00	4.00±0.00	4.00±0.00	5.40±0.24	7.20±0.37	7.80±0.37	8.00±0.32
RS	4.00±0.00	4.00±0.00	4.80±0.20	5.80±0.20	6.60±0.40	7.00±0.55	7.20±0.49

Note : T.s implies Top soil, P. d. implies Poultry droppings

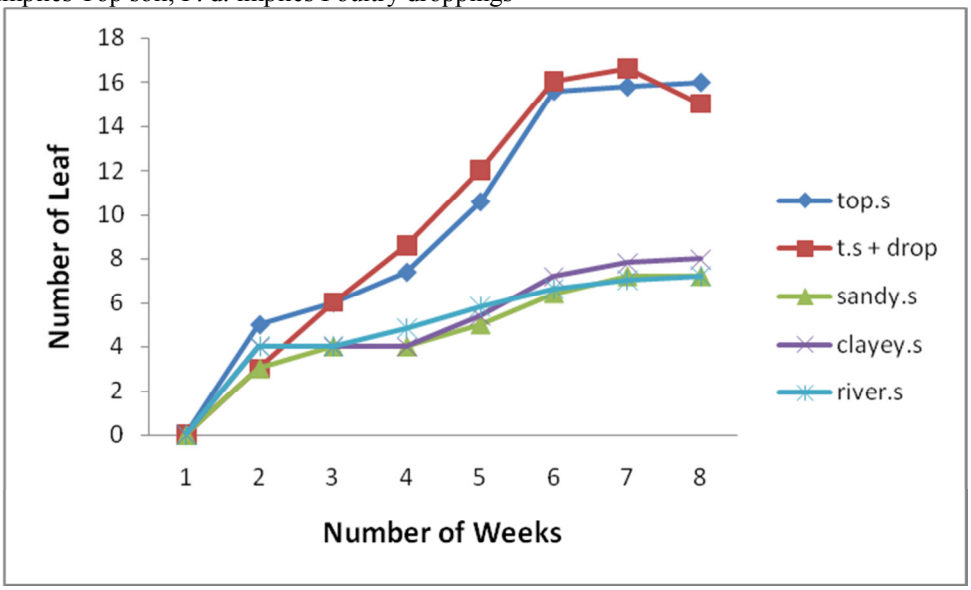

Fig.5: Mean number of leaves of cucumber based on treatment from weeks 1-8

Number of Flowers: The result obtained on number of flowers showed that the highest mean value (7.20) was got from seedlings sown in treatment B (top soil + poultry droppings) at weeks 4 - 6 after planting, but at the 8th week, top soil has the highest mean of 6.00, treatment B, D, C and E had 4.00, 3.00 and 3.00 respectively. ANOVA showed significant differences some of the various treatments at the 7th except among treatments C, D & E but at the 8th week it was only between treatment A and the remaining treatments but none among treatments B, C, D & E.

Table 9: Mean number of cucumber flowers based on treatments from weeks 4-8

Treatment	Week4	Week5	Week6	Week7	Week8
TS	0.00±0.00	2.40±0.68	5.60±0.75	7.40±0.51	6.00±0.55
TS+ PD	2.40±1.03	4.60±1.94	7.20±2.96	5.80±2.37	4.80±1.98
SS	0.00±0.00	0.00±0.00	1.40±0.60	2.60±0.24	3.00±0.32
CS	0.00±0.00	0.00±0.00	2.40±0.24	4.20±0.37	4.00±0.00
RS	0.00±0.00	0.00±0.00	1.60±0.51	2.60±0.40	3.00±0.45

*TS=Top Soil, TS/PD = Top Soil + Poultry Droppings, SS = Sandy Soil, CS = Clay Soil, RS=River Sand

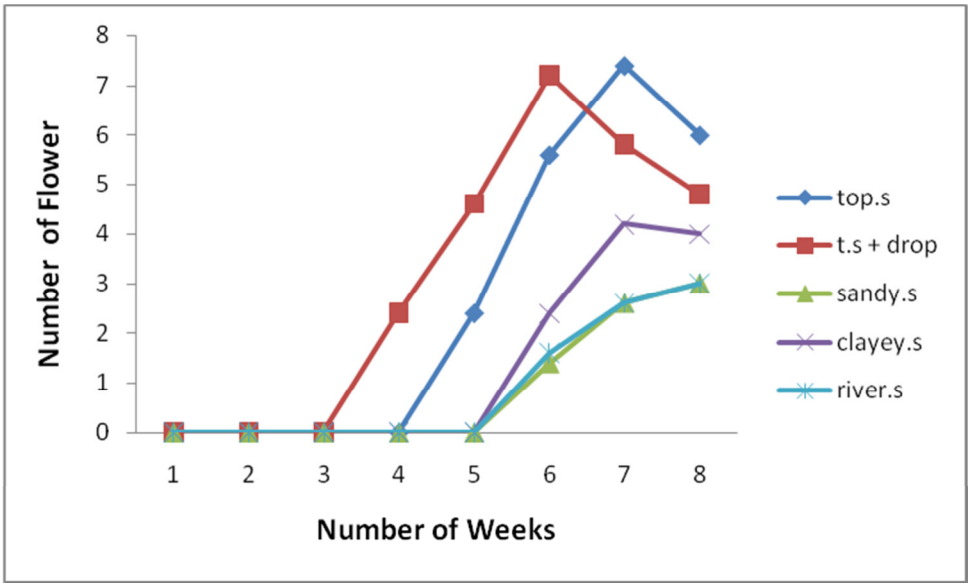

Fig.6: Mean number of flowers of cucumber based on treatment from weeks 1-8

Number of Fruits The highest mean value (3.0) obtained on number of fruits was from seedlings sown in treatment B (top soil mixed with poultry droppings) at the 8th week after planting, followed by top soil with 2.60, clayey soil with 1.20, river sand with 0.60 while at the 8th week, cucumber seeds sown in sandy soil were yet to fruit therefore had the mean value of 0.00. ANOVA indicated significant differences among the various treatments. ANOVA showed significant differences the various treatments at 1% probability level (P<0.01/P<0.05)P= 0.01)

Table 10: Mean Number of Cucumber Fruits Based on Treatments from Weeks 5-8

Treatment	Week5	Week6	Week7	Week8
Top soil	0.00±0.00	0.80±0.20	1.60±0.24	2.60±0.24
TS/PD	0.80±0.37	2.00±0.84	2.80±1.16	3.00±1.22
Sandy soil	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Clayey soil	0.00±0.00	0.00±0.00	0.60±0.24	1.20±0.20
River sand	0.00±0.00	0.00±0.00	0.20±0.20	0.60±0.24

*TS=Top Soil, TS/PD = Top Soil + Poultry Droppings, SS = Sandy Soil, CS = Clay Soil, RS=River Sand

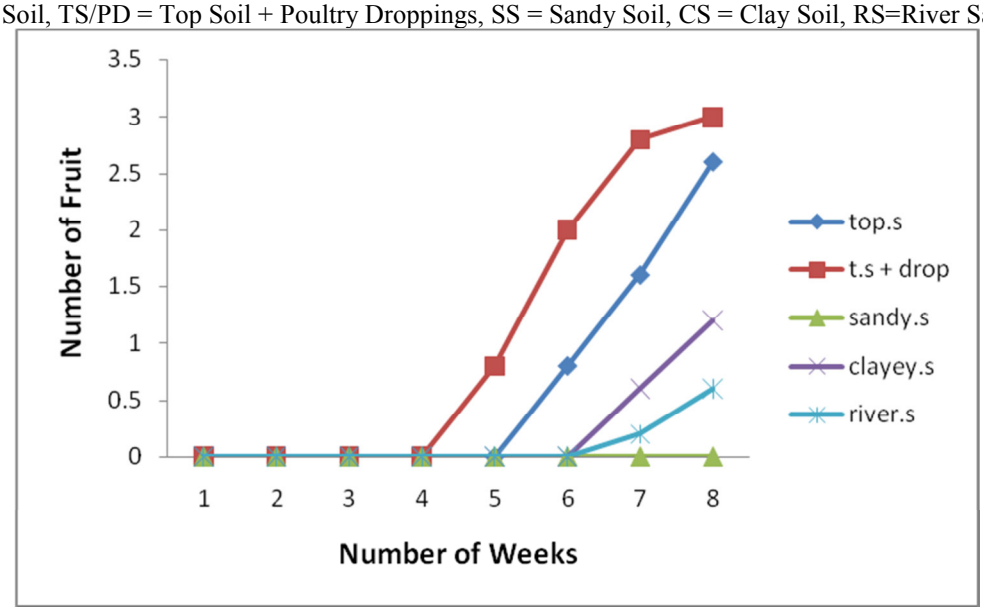

Fig.7 Mean number of fruits of cucumber based on treatment from weeks 1-8

Fresh Fruit Weight: Matured cucumber fruits (still green prior to turning yellow) were harvested at the 8th week, after which the total fresh weight of fruit was determined using the electric weighing balance in the departmental laboratory. From the table below it could be observed that only fruits obtained from treatment A (top soil) and treatment B (top soil + poultry droppings) were reasonable in size. Treatment B had the highest

mean value of 316.8 g, followed by treatment A with value of 88.9g and the lowest was treatment D (18.7g). Significant differences (from ANOVA) were observed among the various treatments at P=0.01

Table 11: Table showing the fresh fruit weight (g) of cucumber based on treatments at week 8

Treatments	Fruit Fresh Weight (g)
Top soil	88.9
Top soil+PD	316.8
Sandy soil	24.5
Clayey soil	18.7
River sand	23.4

*PD=Poultry Droppings

3.2 Discussion.

It is a known fact that all plants need nutrients from the soil to thrive well. Hence, the differences in nutrient levels of these soil types brought about different growth rates and yield of the cucumber plant (Kareem, 2015). This is probably (mainly) due to the high amount of organic matter, nitrogen and other necessary nutrients (e. g. available phosphorus, K, Mg, Ca) present in the top soil and poultry droppings which enhanced the growth of the plant. This agrees with the findings of Dauda *et. al*. (2008) who attributed increased growth rate and yield of water melon to the release of more nutrient elements from organic manures. It is also in harmony with the report of Kareem and Adegoke (2015) who indicated that rapid/more release essential elements NPK fertilizers brought about faster growth rate and yield of soya bean (*Glycine max*) sequel to nutrient absorption and higher photosynthetic activities.

Though, poultry droppings contributed to reasonable increase in the growth and yield of cucumber but a major constraint was also observed during the experiment which was the late or low seedlings' emergence of cucumber seeds. During the experiment, other growth media (soil types) had 100% germination while top soil + poultry droppings had only 50% seedlings' emergence, this was probably as a result of the scorching effect of the poultry droppings during the decomposition process which was exothermic. Probably, the heat released might have tampered with the viability of those seeds that did not germinate (the embryos of those un-germinated must have been adversely affected). The observed higher values in morphological growth and yield characters in treatment B (top soil + poultry droppings) were possibly not unconnected with release of nutrients after decomposition, mineralization and absorption (Kareem *et. al.,* 2014).

The poor growth of cucumber under other treatments (such as river sand, clayey soil and sandy soil) was as a result of low nutrient status of those media. It is also noteworthy to point out impact of the physical properties pertaining to the structure, texture, porosity, density and compactness of soil particles in some of the growth media. For instance, the density, compaction and water holding capacity of clay soil are higher than that of sandy soil and the level of porosity in river sand is higher than any of the growth media. The level/degree of compactness, porosity and water holding capacity could also have resulted to variations in germination in the soil prior to seedlings' emergence, morphological growth and yield characters of this *Cucumis sativus*.

4. 0 Conclusion

Incontrovertibly, the growth and yield parameters had been influenced by the different growth media employed but the use of top soil and poultry droppings mixture in ratio 2:1 respectively resulted to the most outstanding performance of cucumber in terms of growth and yield (compared to other growth media or soil types). Very importantly, a minimum of two weeks should be set aside for the decomposition and mineralization of the pulverized poultry droppings or any organic manure to be used prior to sowing or planting the cucumber seeds. This is to safeguard or prevent the seeds from the scorching effect of the decomposition process of the organic manure that is exothermic which eventually affects the viability of the seeds adversely and thereby resulting in low seedlings' emergence percentage. Tending operations such as regular watering (especially during dry season) and weeding should be ensured to increase or improve the growth and yield of cucumber plants.

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