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Influence Of Soil Type (Sandy And Loamy) Treated To Different Watering Volume On Growth And Yield Of Cucumber In A Green House Trial

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Abstract:** There is a need to quantify and understand the potentials of soils across the globe as it pertains to their agricultural potentials. With increasing global pressure on land resources, marginal soils such as sandy soils are taken into production or cultivated more intensely by farmers in Africa generally and particularly in Nigeria. Observing that water and soil are the two most important factors for plant growth, the main objective of the study was to evaluate influence of two soil types and watering volumes on growth development and yield of cucumber during 2016 cropping season. A green house trial conducted at the Kogi State University, Anyigba, Kogi State, Nigeria, evaluates the influence of soil type (loamy and sandy soils) treated to different watering volumes on growth development and yield of cucumber in a factorial experiment. Parameters evaluated include: days to seedling emergence, vine length, leaf number, leaf area as well as fruit characters (fruit number, length and fruit weight harvested / plant). Days to seedling emergence did not differ significantly among soil types, so also the growth parameters investigated (vine length, leaf numbers, leaf area); an indication that sandy soil could perform comparatively as loamy soil in respect of these parameters. However, interplay of watering regimes on the studied soils showed significant influence on fruit characters (length, number and weight) but not on days to 50% flowering. Though cucumber seedlings emerged earlier and grew rapidly in sandy soil, however without significant differences, higher cucumber yields were obtained in loamy soils compared with sandy sails, thus recommended for the growing of cucumber. For optimum yield in sandy and loamy soils, application of 3 litres of irrigation water per week gave the best results, compared with application of 4 litres of water, where the latter must have inhibited adequate root growth due to induced flooding. Thus application of 3 litres of irrigation water per week to cucumber sown into sandy or loamy soil is recommended, compared with 4 litres of water.

***Keywords:** Days to seedling emergence, vine length, leaf number, leaf area, days to flowering and fruit characters*

I. INTRODUCTION

A large percentage of Nigeria's (at least 65 per cent) rural populace are into agricultural production drawing their livelihood from the enterprise either as primary crop producers or as adding values to the chain of food production, or engage in agro input enterprises (Oyewole, 2019). The mode of production is basically subsistence, employing simple hand tools such as hoes and cutlasses in land cultivation and crop management. Any form of mechanization is most often completely absent. Increases in food supplies increasingly require productivity growth either through the intensification of cultivation / maximization of land use and its resources in food production or increasing land brought under production.

Generally farmers in Africa and Nigeria in particular, do not have many choices in their efforts to feed the over 3 billion people in the continent. Besides the fact that they are doing a job not too many people are willing to do, they are also contending with numerous factors that often hold back crop yields, principally among these is the soil. With growing population coupled with urbanization taking up agricultural lands; overwhelmed by the better purchasing powers of land developers, African farmers have to make do with whatever land they can get. Caged between land developers and herdsmen their choice of where they crop is highly restricted.

Large part of the earth surface is arid, characterized as too dry for conventional rain fed agriculture (Creswell and Martin, 1998), yet millions of people live in such regions. If the current trend in population increase continues, there will soon be millions more people living in such arid environments. These people must eat, and the wisest course for them is to produce their own food on a soil that may not support healthy plant life.

Water and soil are the two most important factors for plant growth. The main objective of the study was to evaluate influence of two soil types and watering volumes on growth and yield of cucumber in green house.

With increasing global pressure on land resources, marginal soils such as sandy soils are taken into production or cultivated more intensely. There is a need to quantify and understand the potentials of sandy soils across the globe in comparison with other soil types, such as the loamy soil.

Soils of the arid tropics are highly variable. Because of the low rainfall and consequently reduced plant growth, organic material is produced slowly in such soils; also due to low rainfall, it may be broken down slowly as well. The amount of organic material in such soils, and thus the potential fertility, is likely to be high in semi-arid zones and low in desert soils.

Generally, loam refers to soils having relatively even mixtures of different grades of sand, silt and clay according to the USDA textural classification triangle. It has somewhat gritty feel, but is fairly smooth and slightly flexible. This has been described adequately by Ezeaku (2011).

Sandy soils are characterized by less than 18% clay and more than 68% sand. It is estimated that sandy soils cover approximately 900 million ha worldwide particularly in arid or semi-arid regions.

Sandy soils – as a group of soils – have received limited research attention, particularly with regards to crop cultivation, seeing that it is assumed to be nutritionally poor. With increasing population, the choice of soil available to farmers for crop cultivation is increasingly reducing, thus the approximately 900 million ha of sandy soil worldwide may offer farmers readily needed cropping land.

Besides being restricted in the cultivation of crops sandy soils is often not the best choice for farmers engaged in crop production. However, when constrain by limited fertile farm land, farmers employ this often low fertility soil in extensive agricultural production, though often limiting their utilization to certain crops.

Water is becoming an economic scarce resource in many areas of the world, especially in the arid ad semi-arid regions. Availability of adequate soil moisture levels at critical stages of plant growth not only optimizes the metabolic process in plant cells but also increases the effectiveness of the mineral nutrients applied to the crop.

II. MATERIALS AND METHODS

The experiment, a 2*3 Factorial with four replications was sited at the green house of the Department of Crop Production, Kogi State University Anyigba, Kogi state. The trial consisted of a variety of cucumber (*Marketmore*) sown into a 10 kg soil / bucket of either sandy or loamy soil and treated to three levels of volumes of irrigation water (2, 3 and 4 litres / week).

Within the 11 weeks that the experiment lasted, the crop received 22, 33 and 44 litres of irrigation water, respectively for 2, 3 and 4 litres weekly treatment. Each bucket of 10 kg soil was also treated to well decompose cow dung (see Table 1) two weeks before seed sowing at the rate of 2kg cow dung / 10 kg of soil. Before sowing, seed viability was tested using the floatation method, which indicated over 80% germination for the seed stock. Seeds that sunk in water were sown two seeds / bucket to a depth of 2 cm, which was later, thinned down to a seedling / bucket.

For the trial, samples of loamy soil were obtained from the Kogi State University Anyigba Animal Production Farm, while sandy soils were sampled from Ogane-aji river site in Anyigba, Dekina Local Government Area of Kogi State.

Composite samples of both loamy and sandy soils were subjected to physical and chemical analysis (Table 2) in accordance with prescribed procedures (Bouyounces, 1962; Nelson and Sommers, 1982; Aliyu, 2013). For loamy soil, sand constitutes 23%, while silt and clay constitutes 50% and 27%, respectively. Organic carbon and organic matters were 52.70 and 1.24%, respectively and soil P^H 6.5. For sandy soil, sand constitutes 92.0%, silt and clay 4.40% and 3.60%, respectively, while organic carbon and organic matter was 16.70 and 0.10%, respectively. For sandy soil P^H was 7.80, while available P and %total N, were 4.02 ppm and 3.55%, respectively.

Data collected include: days to seedling emergence, number of leaves per plant, leaf area per plant and vine length per plant; with all the growth parameters collected two weekly. Parameter on days to flowering was determined, as well number of fruits per plant, average fruit length and average fruit weight.

Data collected were subjected to analysis of variance (ANOVA) and treatment found to be statistically significant at 5% probability were separated using Least Significant Difference (LSD) (Snedecor, and Cochran, 1967).

III. RESULTS AND DISCUSSION

INFLUENCE OF SANDY AND LOAMY SOILS TREATED TO DIFFERENT WATERING REGIMES ON SEEDLING EMERGENCE AND VINE LENGTH

Establishment of adequate crop stand is a prerequisite for a successful crop and this depends on seedling emergence (Oyewole *et al*., 2001; Oyewole *et al*., 2005). Thus any treatment (soil type, watering volume or their interactions) applied to seeds which may affect crop emergence may be expected to impact on crop population at establishment, all things being equal.

Days to seedling emergence did not respond significantly ($p \geq 0.05$) to soil type, volume of water applied / week as well their interactions; an indication that sandy soil will perform comparatively well as loamy soil in respect to seedling emergence (Table 3). While it took approximately 9 days on average for seedlings sown into loamy soils to emerge, it took approximately 8 days on the average for those sown into sandy soils to emerge from the soil.

Property	Composition
P^H	7.30
% Organic matter	50.34
% Nitrogen	1.46
% Phosphorus	1.74
% Potassium	1.01
Magnesium	6.75 mg/kg
Sodium	2.30 mg/kg
Calcium	123.00mg/kg

Table 1: Analysis of Cow Dung Sample

Soil Properties	Soil type	
	Loamy	Sandy
% Sand	23.00	92.00
% Silt	50.00	4.40
% Clay	27.00	3.60
Chemical properties		
P^H (H_2O)	6.50	7.80
% Organic carbon	52.70	16.70
% Organic matter	1.24	0.10
Available phosphorus (ppm)	8.60	4.02
% Total Nitrogen	5.45	3.55
Exchangeable bases		
Calcium (Cmol/kg)	4.42	3.00
Magnesium (Cmol/kg)	2.28	1.60
Potassium (Cmol/kg)	0.34	0.29
Sodium (Cmol/kg)	1.17	7.20
CEC	46.80	42.45

Table 2: Soil Characteristics

Treatment	**Days to Emergence**	**Vine length (cm)**			
		2 WAS	**4 WAS**	**6 WAS**	**Final vine length**
Soil type					
S_1	8.92	11.29	33.09	96.75	165.94
S_2	7.67	12.42	44.17	106.29	139.21
Significance LSD (0.05)	NS	NS	NS	NS	3.431*
Volume of water / week (lit/week)					
V_1	10.25	11.07	35.69	100.07	144.97
V_2	7.88	13.63	40.88	108.63	160.35
V_3	6.60	10.88	39.32	95.88	152.41
Significance LSD (0.05)	NS	NS	NS	NS	4.862*
Interactions					
S_1V_1	9.59	11.18	34.39	98.41	155.46
S_1V_2	8.40	12.46	36.99	102.69	163.15
S_1V_3	7.76	11.09	36.21	96.32	159.18
S_2V_1	8.96	11.75	39.93	103.18	142.09
S_2V_2	7.78	13.03	42.53	107.46	149.78
S_2V_3	7.14	11.65	41.75	101.09	145.81
Significance LSD (0.05)	NS	NS	NS	NS	12.586*

Keys: S_1= Loamy soil; S_2= Sand soil; V_1= 2 lit/week; V_2=3 lit/week; V_3=3 lit/week
*NS = Not Significance; * = Significance*

Table 3: Influence of sandy and loamy soils treated to different watering regimes on seedling emergence and vine length

Though water is critical to sprout initiation in prior dormant seeds, however volume of water applied / week to seeds in this experiment, did not produce any significant variations in seedling emergence; an indication that all seeds regardless of volume of water, received enough water to trigger seed sprouting.

Final vine length responded significantly ($p \leq 0.05$) to soil type, volume of water applied / week as well their interactions. Higher vine lengths were observed when seeds were sown into loamy soil compared with those sown into sandy soil. Application of 2 lit / week of water gave the least vine length (144.97 cm), while seedlings that received 3lit / week of irrigation gave the highest vine length (160.35 cm).

Treatment interactions show that application of 3 lit / week of irrigation water consistently gave the highest vine length both in loamy and sandy soils, with the least response obtained in 2 lit / week application of irrigation water on sandy soil. The capacity of loamy soil to retain more water than sandy soil, which must have resulted from the clay content (Table 2) in this soil, must have been responsible for its better performance in respect of vine length compared to sandy soil; observing that water plays critical roles in nutrient uptake, physiological processes in plant and subsequently plant growth.

INFLUENCE OF SANDY AND LOAMY SOILS TREATED TO DIFFERENT WATERING REGIMES ON LEAF NUMBER

Plant leaf plays crucial role in crop photosynthesis, any effect of imposed treatment on either leaf number or leaf area which may impact on photosynthesis should probably be expected to affect crop yield. However may not be that straight forward as the process of yield formation involves complex interplays of various yield-determining factors (Jamileh and Moghadam, 2015), besides leaf number and leaf area (Hay and Walker, 1989) with usually unpredictable outcomes. Such varying factors which may affact sink-source relation may moderate expectations away from basic principles.

Leaf number (Table 4) and leaf area (Table 5) did not respond significantly ($P \geq 0.05$) to soil type, water application / week as well their interactions; also an indication that sandy soil will perform comparatively as loamy soil in respect to leaf number and leaf area.

This observation on leaf area is expected; since the treatment had no significant effect on leaf number produced (Table 4), except if there can be variations in relation to either leaf length or leaf breadth. It has been observed that leaf area expansion depends on leaf turgor, temperature, and assimilating supply for growth; stating that drought-induced reduction in leaf area (Rucker *et al*., 1995) as a result of suppression of leaf expansion through reduction in photosynthesis. Such expected response may however be limited to drought situation (Rucker *et al*., 1995), or where the crop water thirst far exceeds irrigation delivered. The probable absence of such water deficit in this trial may have resulted in the observed non-significant influence of the treatment on leaf area.

INFLUENCE OF SANDY AND LOAMY SOILS TREATED TO DIFFERENT WATERING REGIMES ON DAYS TO 50% FLOWERING AND FRUIT CHARACTERS

No significant (p ≥0.05) effects of soil type, volume of water applied / week or their interactions were observed on days to 50% flowering. However, soil type significantly (p ≤ 0.05) influenced fruit length, number of harvested fruits and fruit weight, with better performances notice in crops sown into loamy soils as it relates to fruit length, number and fruit weight (Table 6).

Application of 3 lit of water / week gave the best performance for fruit length, fruit number and fruit weight. For soil type x watering regime interaction, the best responses were in the application of 3 lit of water / week on loamy soil as compared to other interactions.

IV. CONCLUSION

Higher cucumber yields were obtained in loamy soils compared with sandy sails, thus recommended for the growing of cucumber. For optimum yield in sandy and loamy soils, application of 3 litres of irrigation water per week gave the best results, compared with application of 4 litres of water, where the latter must have inhibited adequate root growth due to induced flooding. Thus application of 3 litres of irrigation water per week to cucumber sown into sandy or loamy soil is recommended, compared with 4 litres of water.

Treatment	leaf number			
	2 WAS	4 WAS	6 WAS	8 WAS
Soil type				
S_1	3.33	9.92	22.08	50.25
S_2	3.08	6.50	17.69	43.03
Significance	NS	NS	NS	NS
Volume of water / week (lit/week)				
V_1	2.13	6.00	16.63	39.25
V_2	4.63	10.00	21.50	50.50
V_3	2.88	8.63	22.75	50.17
Significance	NS	NS	NS	NS
Interactions				
S_1V_1	2.73	7.96	19.36	44.75
S_1V_2	3.98	8.25	21.79	50.38
S_1V_3	3.11	9.28	22.42	50.21
S_2V_1	2.61	6.25	17.16	41.14
S_2V_2	3.86	8.25	19.60	46.77
S_2V_3	2.98	7.57	20.22	46.60
Significance	NS	NS	NS	NS

Keys: S_1= Loamy soil; S_2= Sand soil; V_1= 2 lit/week; V_2=3 lit/week; V_3=3 lit/week

*NS = Not Significance; * = Significance*

Table 4: Influence of sandy and loamy soils treated to different watering regimes on leaf number

Treatment	leaf area (cm2)			
	2 WAS	4 WAS	6 WAS	8 WAS
Soil type				
S_1	32.22	105.35	160.67	155.63
S_2	39.52	92.54	140.67	133.71
Significance	NS	NS	NS	NS
Volume of water / week (lit/week)				
V_1	35.90	86.29	138.49	134.88
V_2	46.08	110.65	159.54	150.25
V_3	35.64	99.90	154.00	148.88
Significance	NS	NS	NS	NS
Interactions				
S_1V_1	34.06	95.82	149.58	145.26
S_1V_2	39.15	112.65	160.11	152.94
S_1V_3	33.93	102.63	157.34	152.26
S_2V_1	37.71	89.42	139.58	134.30
S_2V_2	42.80	101.60	150.11	141.98
S_2V_3	37.58	96.22	147.34	141.30
Significance	NS	NS	NS	NS

Keys: S_1= Loamy soil; S_2= Sand soil; V_1= 2 lit/week; V_2=3 lit/week; V_3=3 lit/week

*NS = Not Significance; * = Significance*

Table 5: Influence of sandy and loamy soils treated to different watering regimes on leaf area

Treatment	Days to 50% flowering	Fruit characters		
		Length (cm)	Number	Weight (kg)
Soil type				
S_1	48.50	10.24	5.66	`0.12
S_2	51.17	6.50	2.22	0.04
Significance	NS	0.880*	1.225*	0.015*
Volume of water / week (lit/week)				
V_1	53.25	7.12	3.00	0.04
V_2	47.75	8.88	4.25	0.05
V_3	48.50	9.13	4.63	0.10
Significance	NS	0.587*	0.812*	0.010*
Interactions				
S_1V_1	50.88	8.68	4.33	0.08
S_1V_2	48.13	9.56	4.96	0.09
S_1V_3	48.50	9.69	5.15	0.11
S_2V_1	52.21	6.81	2.61	0.04
S_2V_2	49.46	7.69	3.24	0.05
S_2V_3	49.84	7.82	3.43	0.03
Significance	NS	1.760*	2.450*	0.030*

Keys: S_1= Loamy soil; S_2= Sand soil; V_1= 2 lit/week; V_2=3 lit/week; V_3=3 lit/week

*NS = Not Significance; * = Significance*

Table 6: Influence of sandy and loamy soils treated to different watering regimes on days to 50% flowering and fruit characters

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