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EFFECTS OF FOUR GROWTH MEDIA ON VEGETATIVE GROWTH OF WATERMELON (*Citrullus lanatus* Thunb, Matsum and Nakai) IN ASABA, SOUTHERN NIGERIA

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Abstract
The study was conducted to evaluate the effect of four growth media (topsoil, clay soil, river sand, and sawdust) on the vegetative growth of watermelon. Plants were grown in containers with a basal application of pig manure at the rate of 30 tonnes/hectare in the Teaching and Research Farm of the Faculty of Agriculture, Delta State University, Asaba Campus. It was shown that there were significant differences between the growth media at different weeks of planting, number of leaves, and length of the vine. The topsoil performed better compared to other growth media and the values were significantly higher in the length of vines (111.3cm) in the fifth week after planting; It also performed better in leaves number at second, third, fourth, and fifth weeks after planting, Topsoil produced the highest numbers of leaves (24) at the fifth week. The clay soil was next to topsoil with 97.3cm recorded as the length of vine and 17 leaves number in the fifth week, while River sand recorded 75.3cm vine length, 16 leaves number in the fifth week. Sawdust displayed the least performance with 37.1cm vines length with 9 leaves number. The result of this finding showed that the topsoil is well suitable for the production of watermelon but can be improved by soil tillage, use of plant residues, and fertilizer application.
Keywords: Production, Suitable, Improved, Topsoil

Introduction

Watermelon is an edible fruit vegetable eaten fresh and as a component of salad (Peet, 1995). Its pods are either large or small (5–18kg), with shapes varying from round to elliptical, depending on the variety. The large red-fleshed, seeded watermelons make up the bulk of those sold commercially (Titilayo *et al.,* 2014). It belongs to the family of Cucurbitaceae which is made up of other members like muskmelon, winter squash, pumpkin, and cucumber. Crops in this family are mainly vine crops with spreading growth habits (Peet, 1995).

Watermelon pod is made up of 90% water content, a good source of vitamin C and vitamin A. It also provides a significant amount of vitamin B6 and vitamin B1 with minerals like potassium and magnesium (Charles, 2005). According to Peet (2005), the plant is an aggressive vining annual crop that prefers a temperature greater than 21^{o}C. Sugar content and sweetness are the critical factors in determining the quality of many cultivars; the watermelons have a large variety of uses from fresh salads and desserts to pies, vegetable entries, snack food, and ornamental decorations. It is also grown as a cover crop (Athens, 1988).

When cultivated, it requires a high level of water intake during the first phase of its development (Charles, 2005) therefore water supply is important throughout its growth, but critical at flowering and fruit development. It is cultivated mostly in northern Nigeria due to the crop's warm loving nature; As a result, watermelon production in southern Nigeria is seasonal. Excess water affects the crop during its last developmental stage. Excess rain, under rain-fed farming, dilute the fruit sugar content and further excessive water absorption leads to the fruit spoilage by cracking, thus reducing edible and marketable yields significantly. The crop demand in southern Nigeria is high, and is not met due to nutrient depletion and high rainfall in some parts of the year (April – October) hence the study was carried out to assess the best media for growing watermelon under rain fed conditions in Asaba, southern Nigeria.

Materials and Method

Brief Description of the Experimental Site

The experiment was carried out at the Teaching and Research Farm of the Faculty of Agriculture, Delta State University, Asaba Campus. Asaba is located at Latitude 6^0 14'N and Longitude 6^0 49'E. It lies in the tropical rainforest zone and it is characterized by a rainy season between April and October with an annual rainfall of 1500mm to 1,849mm, and relative humidity of 69 -89% per annum. The mean temperature is 23°C with a maximum temperature of 37°C. The mean monthly soil temperature at 100cm depth is 28.3°C; the mean relative humidity is 77.2% and monthly sunshine of 70 Psi (4.8bars) (Federal Ministry of Aviation Meteorological Station Asaba, 2018).

Planting Materials

The plant was propagated using a watermelon variety called sugar baby, a hybrid collected from Delta State Agricultural Procurement Agency, Ibusa. A potted experiment using 25kg poultry feed bags as the experimental pots were carried out. A total number of 144 bags were used and each bag carried a specified planting media and was shared into 4 plots replicated 3 times, while 3 other plots served as control. Topsoil, Clay soil, River sand, and Sawdust were the planting media that served as the treatments. An equal amount of organic manure was applied to the planting media. Pig manure was applied at 0.5kg per bag. A spacing of (1m x 1m) with 12 pots per plot covering a land area of $12m^2$ resulting in a total land area of $300m^2$ was used for the experiment. Clearing of land, preparation of pots/containers, treatment of seeds with fungicides, planting, and weeding were done at the appropriate time. A spacing of (1m x 1m) with 12 pots per plot covering a land area of $12m^2$ resulting in a total land area of $300m^2$ was used for the experiment. Clearing of land, preparation of pots/containers, treatment of seeds with fungicides, planting, and weeding were done at the appropriate time. The growth media used for the study were air-dried and sieved through a 2mm sieve and was taken to the laboratory for analysis. The hydrometer method was used to determine particle size distribution (Juo, 1979). Soil reaction was determined using 1:2 soil/water ratio by use of a glass electrode pH-meter, organic carbon was determined using the Walkley and Black (1945) method, and total nitrogen was determined using the micro-kjeldahl digestion method, available phosphorus was determined by Bray 1 method. The exchangeable cations were extracted with IN NH_4OAC method (pH of 7) and Ca^{++} and mg^{++} were determined by the Ethylenediaminetetraacetic acid titration method, while K^+ and Na^+ were determined with a flame photometer. Exchangeable H+ and AI^{++} were determined by leaching the growth media with IN KCl and titrating the aliquots with 0.01m NaOH. Cation exchange capacity (CEC) was determined using neutral NH_4- acetate displacement method using the procedure of IITA (1982). Percent base saturation (%BS) was calculated as the sum of exchangeable cations divided by CEC.

Data collection and statistical analysis

Simple statistics were used, and the data collected from the experiment were subjected to Statistical analysis of variance (ANOVA), with means showing significant differences separated using least significant differences (LSD) at $P<0.05$ (SAS, 2012).

Results and Discussion

The result of the pre-planting chemical analysis of growth media used for the studies as determined by common procedures (table 1) shows that the topsoil (0.15cm) was sandy loam in texture, and the clay media was predominantly clay (97.6%). The river sand was predominantly sand with 94.6% sand content and was very sharp to feel (FAO, 2017). The sawdust was characterized by un-decomposed organic materials. The result shows that the topsoil was acidic (5.7), clay soil was slightly alkaline (7.5) and the river sand was very acidic (4.8). The organic carbon content for the topsoil was medium (23gkg^{-1}), while clay soil (13gkg^{-1}), river sand (13gkg^{-1}), and sawdust (15gkg^{-1}) were low.

Table 1: Pre-planting Chemical Analysis of Four Growth Media

Soil Variables		**Growth**	**Media**	
	Topsoil	**Clay soil**	**River sand**	**Sawdust**
Particle Size: Distribution (%)				
sand	86			
silt	6	24	54	
clay	8	97.6	-	
Soil pH (H_2O)	5.7	7.5	4.8	
Organic Carbon(gkg^{-1})	23	5.0	13.0	15.0
Total N (gkg^{-1})	1.50	1.20	0.06	0.08
Avail P. (gkg^{-1})	7.0	8.30	3.0	0.02
Exch. Cations (Cmolkg				
Ca^{+2}	5.2	6.7	0.4	0.05
K	1.5	1.8	0.5	0.05
Mg	0.2	0.35	0.10	0.03
Na	0.02	0.03	0.02	0.101
Exch. Acidity				
H^+	1.32	0.04	0.12	
Al^{+++}	0.96	0.02	0.03	
CEC	15.42	17.36	5.30	
BS%	44.9	51.2	19.3	

The medium status of organic carbon of topsoil could be a result of litter falls and subsequent organic matter decomposition (Hazalton and Murphy, 2007). Total nitrogen content in the topsoil was 1.5gkg^{-1} and was attributed to decomposed leaf litter. The total nitrogen content was low (1.20gkg^{-}1) for the clay soil media, and very low (0.06gkg^{-}1) for river sand and sawdust was still in un-decomposed form. The available phosphorus status was generally low for topsoil (7.0mgkg^{-}1) low for river sand (3.0mgkg^{-}1), sawdust (2.0mgkg^{-}1) and moderate for clay soil (8.3mgkg^{-}1) respectively.

The exchangeable cations were moderate in topsoil and clay soil medium and low in river sand and sawdust. The Cation exchange capacity (CEC) was moderate in topsoil and clay soil medium, 15.42 cmolkg^{-1} and 17.35 cmolkg^{-1}. The percentage base saturation which is the sum of all exchangeable cations over cation exchange capacity multiplied by 100 and also an index of soil fertility shows that topsoil and clay soil values of 44.9%BS and 51.25%BS were seemingly better media in the experiment.

The results obtained from various growth media (table 2) influenced the number of leaves produced by watermelon (*Citrullus lanatus*). In the 2nd week after planting; topsoil, river sand, and clay soil had the same number of leaves (3.5) while sawdust produced the least leaves number (1.7). There were slight variations in the 3rd and 4th weeks after planting.

Table 2 Effect of Different Growth Media on Number of Leaves of Watermelon

Growth medium	Weeks after planting			
	2	**3**	**4**	**5**
Top soil	3.5	6.7	14.0	24.0
Clay soil	3.5	6.8	12.0	17.3
River sand	3.5	6.3	9.7	16.0
Sawdust	1.7	4.5	6.0	9.0
LSD (0.05%)	**1.1**	**1.0**	**2.2**	**4.8**

At the 3rd week after planting topsoil had the highest leaves number (14.0), followed by clay soil, (12.0) river sand, (9.6) while sawdust still maintained the least having 6.0 leaves number. It was observed that in the 5th week after planting, topsoil had the highest leaves number (9). Topsoil significantly did better than the other growth media, while both clay soil and river sand had no significant difference, both were significantly different from sawdust. This finding agreed with Nahusenay *et al.,* (2014) who reported that there were distinctions in properties of soil such as TN, OM, and CEC with topographic positions in several areas in southern Nigeria.
From table 3, vines length gradually increased from the 2nd week after planting to the 5th week after planting. It was also observed that topsoil produced the highest vines length from the 2nd to the 5th week after planting.

Table 3. Effect of Different Growth Media on the Length of Vines (Cm) of Watermelon

Growth Medium	Weeks after Planting			
	2	**3**	**4**	**5**
Top soil	7.0	49.2	75.8.0	111.3
Clay soil	5.9	36.1	66.2	97.3
River sand	4.7	25.0	48.7	75.3
Sawdust	3.8	11.3	16.2	37.1
LSD (0.05%)	**19**	**16.0**	**12.2**	**16.8**

This could be attributed to nutrient availability, temperature; soil/plant water relationship. This agreed with Smith, (2006) and Yoshimura *et al.,* (2008), who reported that temperature, high organic matter, and well-drained soil were best in watermelon production. In the 2nd week after planting topsoil had 7.0cm as the length of vines, clay soil (5.9cm) rivers sand, (4.7cm) while sawdust had 3.8cm as the least. There was a steady increase in the 3rd week in the length of vines, topsoil had 49.2cm, clay soil, 35.1cm, river sand, 25.0cm while sawdust had 11.3cm. The clay soils performing better compared to river sand could be attributed to the ability of clay to have a greater affinity for water, nutrient retention, and the ability to warm up slowly compared to sandy soil. This finding is in agreement with Yoshimura *et al.* (2008) who reported a similar trend in watermelon production. In the 4th week after planting topsoil had 75.8cm while sawdust had 16.2cm and in the 5th week after planting, topsoil still grew better than the other growth media recording 111.3cm as the length of vines followed by clay soil with 97.3cm, river sand. 75.3cm while sawdust still had the least vines length of 37.1cm. The general observation on sawdust having the least effect on the length of the vine was that the sawdust was in its un-decomposed form and this also attributed to low performance in watermelon production**.**

There was also a significant difference between river sand and clay soil. These could be attributed to the different processes of soil formation and organic materials which contributed to the differences in nutrient status which influenced the growth of watermelon. This is in agreement with Botha (2005), who reported that watermelon can grow in any type of soil, but does best when it is grown on well-drained sandy loam with good moisture retention capacity and high organic matter. The various nutrient levels of each media played a major role in the production of watermelon (FFD, 2012). Topsoil and clay soil, which had more nutrients, had a significant difference over the other two media used. Topsoil was the best media for watermelon cultivation. This is in agreement with Harzeton and m Murphy (2007) who attributed an increase in fertility to soils with the ability to retain water and organic matter.

Watermelon production was also influenced by temperature due to off-season production and continuous heavy rain falls, which directly influenced fruiting and the gradual decay of fruit after development due to high humidity during the experiment. The findings agreed with Athens (1988) who opined that watermelon thrives in fertile sandy soils containing organic matter having a pH of 6.0 – 6.5. It was obvious that topsoil organic matter status was better than that of the other growth media.

Conclusion and Recommendations

Different growth media on the production of watermelon influenced the growth in terms of leaves and vines number. There were great significant differences between the four growth media used in growing watermelon (topsoil, clay soil, river sand, and sawdust). Sawdust as a growth media was not favourable to the crop. Though there were slight differences among growth media (topsoil, river soil, and clay soil), topsoil turned out to be the best media for cultivating watermelon under rain-fed conditions because it had the highest values, both in the leaves and vines number compared to both clay soil and river sand. It is therefore recommended that topsoil could be used in growing watermelon

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