FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 4 No. 3, September, 2020, pp 547 – 553
DOI: https://doi.org/10.33003/fjs-2020-0403-425

THE SOIL MOISTURE RETENTION PATTERN OF SOME SELECTED OF ORGANIC MEDIA UNDER A GREENHOUSE STRUCTURE

[1]Dare A., [2]Onwuegbunam N. E., [3]Maikano S., [1]Zakka E. J.

[1]Department of Agricultural and Bio-Environmental Eng. Tech. Federal College of Forestry Mechanization, Afaka – Kaduna State, Nigeria.
[2] Department of Basic Science and General Studies, Federal College of Forestry Mechanization, Afaka – Kaduna State, Nigeria
[3]Department of Forestry Technology, Federal College of Forestry Mechanization, Nigeria Afaka – Kaduna State, Nigeria.

*Corresponding Author's Email: dareakinrinshola@gmail.com

ABSTRACT
This research aimed to investigate the soil moisture retention of some selected organic media for growing cucumber plant. The experiment was conducted in a greenhouse structure and moisture content of each of the organic media was determined by a calibrated moisture meter, which was taken before and after the irrigation. The water application was uniform, using a drip irrigation kit for potted system with a capacity of 75cl storage each for the treatments. The pH values of each of the organic media used shows moderate alkalinity. The mean and sample variance of the moisture retention pattern for each of the media gave; saw dust (3.61, 0.073), maize husk (3.41, 0.044), rice husk (3.92, 0.034), eucalyptus leaves (3.27, 0.021), sawdust + soil (2.76, 0.0416), maize husk + soil (2.94, 0.153), rice husk + soil (3.88, 0.069), eucalyptus leaves + soil (2.76, 0.041), eucalyptus leaves + soil unsterilized (3.77, 0.074), and sandy loamy (23.345, 0.009). Moisture retention pattern of the selected media show high moisture retention in sandy loam while other media show a low moisture retention in approximately ratio 6:1, the sample variance shows small variance indicating how the data point spread out. It can be assumed that low retention could be as a result of the presence of fibre or coarse particles given room for large pore spaces that allows easy moisture drain from the organic media. It can also be deduced from the results that maize husk is least suitable for growing purposes because of unsteady moisture retention pattern.

Keywords: Moisture retention, organic media, pH, drip irrigation kit and greenhouse structure.

INTRODUCTION

Growing media have some roles such as providing aeration and water, permitting maximum root growth and supporting physically the plant. There are many differed materials that have been used for vegetable production. Throughout the world, the raw material used were based on their local availability (Sclimilewski, 2009). Such raw material can be inorganic or organic, but growing media are often formulated from a blend of different raw materials in order to achieve the correct balance of air and water holding capacity for plants to be grown as well as for the long term stability of the medium (Bilder Back *et al.,* 2005; Nair *et al.,* 2011). It is reported that a high percentage of inorganic growing media such as rock wool, sand per litter, vermiculite, pumice, clays, and other, are used in soils plant production, while only about 12 % uses organic growing media such as peat, bark, wood residues. (Leaf mould, saw dust, barks). Coir, bagasse, rice hulls and other (Bonnan, 1998). Accurate information of moisture retention of organic media would help to know how much moisture that can be retained in the media at a particular growing period and help to know how to schedule effective irrigation operation for maximum crop production.

METHODOLOGY

Description of the Experimental Site

The study was carried out at the experimental field of the Federal College of Forestry Mechanization, Afaka Igabi Local Government of Kaduna State, Nigeria. The experimental farm is located at latitude 10^0 37′ N and longitude 7^0 47′ E, and situated in the Northern guinea savannah ecological zone of Nigeria. The experiment was conducted inside a control environment structure so as to avoid rainfall interference during the period of the experiment. Plate 1 showed the front and side view of the greenhouse structure used for this experiment and the isometric projection of the structure (Figure 1).

Plate 1: Front view

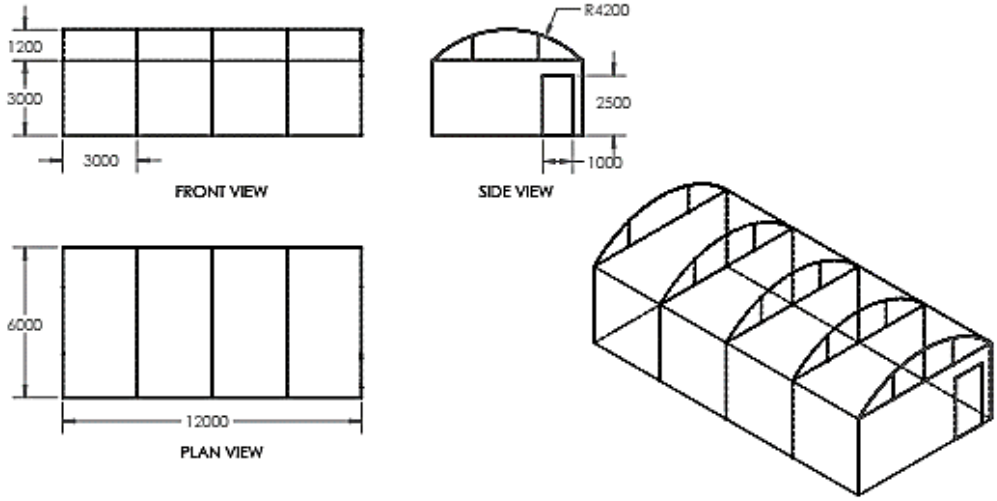

Figure 1: Isometric Projection of the Greenhouse Structure

Experiment Design and Layout

The experiment for moisture retention was carried out in a greenhouse structure for a period of 56 days. A gravity flow drip irrigation kit for potted plant as shown in (Plate 2) with the capacity of 75 cl storage which after each irrigation is refilled. The growing media were sawdust, rice husk, maize husk, eucalyptus leaves, sawdust mixed with sandy-loamy soil, rice husk mixed with sandy-loamy soil, maize husk mixed with sandy-loamy soil, eucalyptus leaves mixed with sandy-loamy soil, and sandy-loamy soil as the control of equal volume (4000 cm^3). The moisture content of each medium was measured before irrigation and one hour after irrigation, so as to determine the moisture retention capacity for each growing medium. The experimental layout was designed using the Randomized Complete Block Design (Figure 2) and Table 1 shows that The field experiment also consists of eleven (11) treatments which was replicated three times. The experiment was carried out in March to April, 2019. The water was applied using irrigation kits, with 75 cl per volume of water applied once in 2 days.

Plate 2: Gravity flow Drip Irrigation Kit

TI	**T4**	**T7**
T2	**T1**	**T9**
T3	**T10**	**T2**
T4	**T5**	**T10**
T5	**T9**	**T1**
T6	**T11**	**T9**
T7	**T2**	**T11**
T8	**T5**	**T3**
T9	**T7**	**T6**
T10	**T8**	**T4**
T11	**T6**	**T8**

Figure 2: Experimental layout

Table1: Description of the various planting media

Treatment	Treatment description
T1	Sawdust
T2	Maize husk
T3	Rice husk
T4	Eucalyptus sterilized
T5	Eucalyptus unsterilized
T6	Sandy loamy
T7	Sawdust soil
T8	Maize husk + soil
T9	Rice husk + soil
T10	Eucalyptus + soil
T11	Eucalyptus unsterilized + soil

Plate 3: Experimental layout

Moisture Content Determination

The media was crushed and equal volume of moisture was added to each of the organic medium. After which a moisture meter was used to determine the moisture content. The same media moisture content was also determined using gravimetric method. A linear regression analysis was carried out on both the values obtained from moisture meter and gravimetric method to generate the calibration equation (Table 2)

Table 2: Calibration equation**Treatment**	**Treatment description**	**Equation**
T1	Sawdust	Y = 0.977x + 2.538
T2	maize husk	Y = 0.958x + 3.016
T3	rice husk	Y= 0.765x + 3.400
T4	eucalyptus Sterilized	Y= 0.588x + 9.927
T5	eucalyptus unsterilized	Y= 0.373x + 13.76
T6	Sandy loamy	Y= 0.043x + 23.52
T7	Sawdust soil	Y= 2.505x + 21.36
T8	maize husk + soil	Y = 0.022x +26.20
T9	Rice husk + soil	Y = 0.596x +12.12
T10	Eucalyptus + soil	Y = 0.25x + 30.37
T11	Eucalyptus unsterilized + soil	Y = 0.199x + 29.95

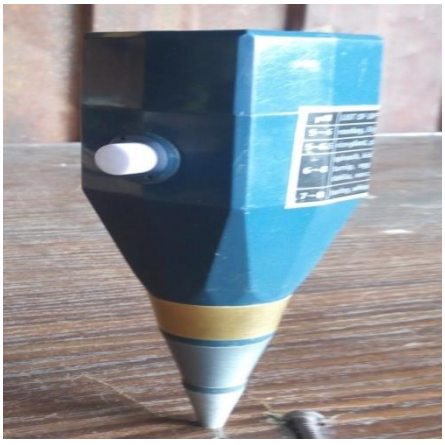

Plate 4: Soil moisture

RESULTS

Moisture Retention Pattern of the Media

The moisture retention of all the planting media was splitted into three categories for simple representation. The categories are sawdust, maize husk, rice husk and eucalyptus leaves; Sawdust + soil, Maize husk + soil, Rice husk + soil, Eucalyptus leaves + soil and Eucalyptus leaves + soil unsterilized and sandy loam soil.

Moisture Retention Pattern for Sawdust, Maize husk, Rice husk and Eucalyptus leaves

The rice husk shows a slightly higher moisture retention of approximate value of 4% while others shows approximately the same values 3% (sawdust, maize husk, and eucalyptus leaves). The standard deviation shows how their values deviate from the mean. Eucalyptus leaves shows the lowest sample variance indicating how well the moisture content was spread out within the medium, as all the details of the data obtained relating to this category of moisture retention

is shown in Table 3.

Table 3: Moisture retention pattern for sawdust, maize husk, rice husk and eucalyptus leaves

Days After Planting	**MR Saw Dust%**	**MR Maize Husk%**	**MR Rice Husk%**	**MR Eucalyptus%**
7	2.89	3.78	3.62	2.98
14	2.68	3.59	3.71	3.02
21	2.78	3.21	3.78	3.08
28	3.07	3.3	3.85	3.12
35	2.81	3.39	3.93	3.18
42	3.08	3.4	4.01	3.22
49	3.37	3.32	4.08	3.35
56	3.41	3.25	4.15	3.39
Mean	3.01125	3.405	3.89125	3.1675
Standard Deviation	0.271052841	0.191012341	0.184657018	0.14762404
Sample Variance	0.073469643	0.036485714	0.034098214	0.021792857

MR = Moisture Retention

Rice husk and eucalyptus leaves shows a steady increasing pattern of moisture retention, while sawdust and maize husk shows unsteady pattern of moisture retention as shown in figure 3.

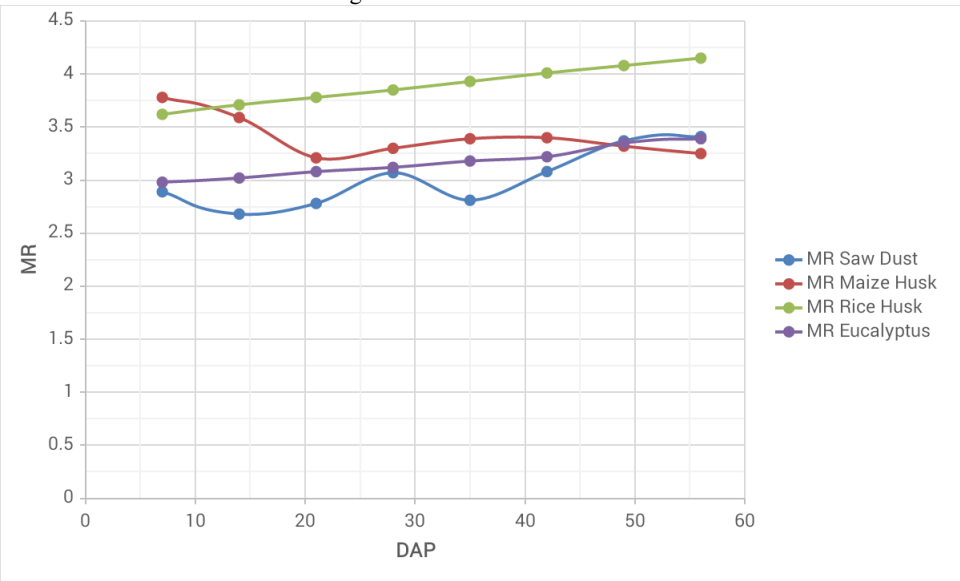

Figure 3: The graph of moisture retention against DAP for growing media; sawdust, maize husk, rice husk and eucalyptus leaves.

Moisture Retention Pattern for Sawdust + soil, Maize husk + soil, Rice husk + soil, Eucalyptus leaves + soil and Eucalyptus leaves + soil unsterilized

The rice husk + soil and Eucalyptus + soil unsterilized shows a slightly higher moisture retention at approximately 4% while others shows approximately the same values 3% (**Sawdust + soil, Maize husk + soil and Eucalyptus leaves + soil**). The standard deviation shows how their values deviate from the mean showing low values for all the media in this category. Eucalyptus leaves + soil shows the lowest sample variance indicating how well the moisture content was spread out within the medium, as all the details of the data obtained relating to this category of moisture retention is shown in Table 4.

Table 4: The descriptive statistics of the moisture retention pattern for Sawdust + soil, Maize husk + soil, Rice husk + soil, Eucalyptus leaves + soil and Eucalyptus leaves + soil unsterilized

Days After Planting	MR Saw Dust +soil%	MR Maize Husk +soil%	MR Rice Husk +soil%	MR Eucalyptus +soil%	MR Eucalyptus + soil (U)%
7	3.45	2.8	3.45	2.5	3.33
14	3.7	2.85	3.65	2.55	3.53
21	3.75	2.91	3.75	2.65	3.63
28	3.8	2.1	3.87	2.71	3.75
35	3.9	3.15	3.95	2.76	3.85
42	4.05	3.2	4.01	2.87	3.95
49	4.15	3.25	4.15	2.97	4.01
56	4.25	3.3	4.25	3.09	4.16
Mean	2.7625	2.945	3.885	2.7625	3.77625
Standard Deviation	0.204	0.391	0.263	0.204	0.272
Sample Variance	0.042	0.153	0.0695	0.0416	0.0741

Sawdust + soil, Rice husk + soil, Eucalyptus leaves + soil and Eucalyptus leaves + soil unsterilized shows a steady increasing pattern of moisture retention, while Maize husk + soil shows unsteady pattern of moisture retention as shown in Figure 4.

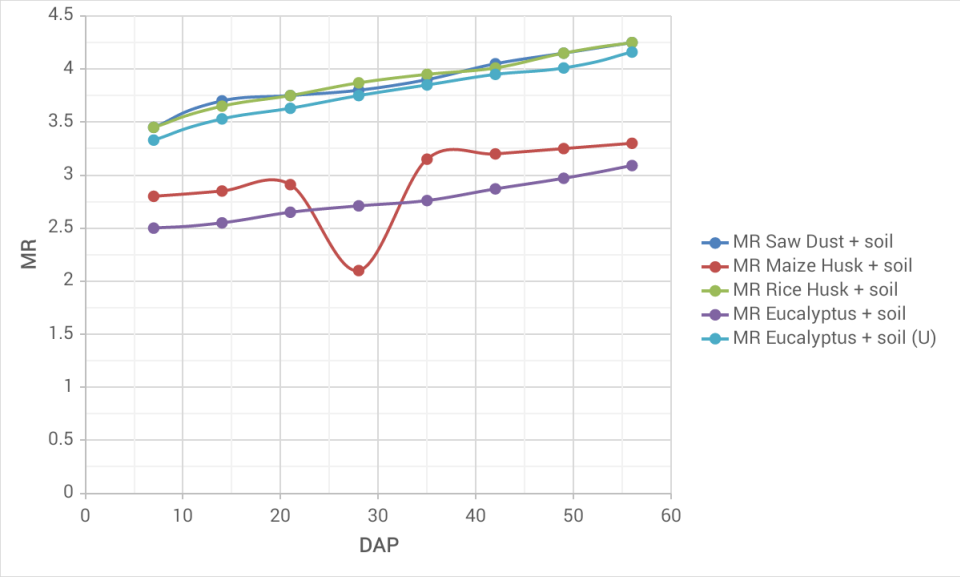

Figure 4: The graph of moisture retention against DAP for growing media; Sawdust + soil, Maize husk + soil, Rice husk + soil, Eucalyptus leaves + soil and Eucalyptus leaves + soil unsterilized.

Moisture Retention Pattern for Sandy Loamy Soil

The average moisture for the duration of the experiment was 23.34% which was higher than what was obtained from other organic media and it shows the lowest sample indicating how the moisture was spread within the soil, the details of this is shown in Table 5.

Table 5: The descriptive statistics of the moisture retention pattern for sandy loamy soil

Days After Planting	Sandy loam %
7	23.21
14	23.25
21	23.28
28	23.32
35	23.36
42	23.4
49	23.45
56	23.49
Mean	23.345
Standard Deviation	23.34
Sample Variance	0.009628571

The soil shows a steady pattern of moisture retention as shown graphically in figure 5.

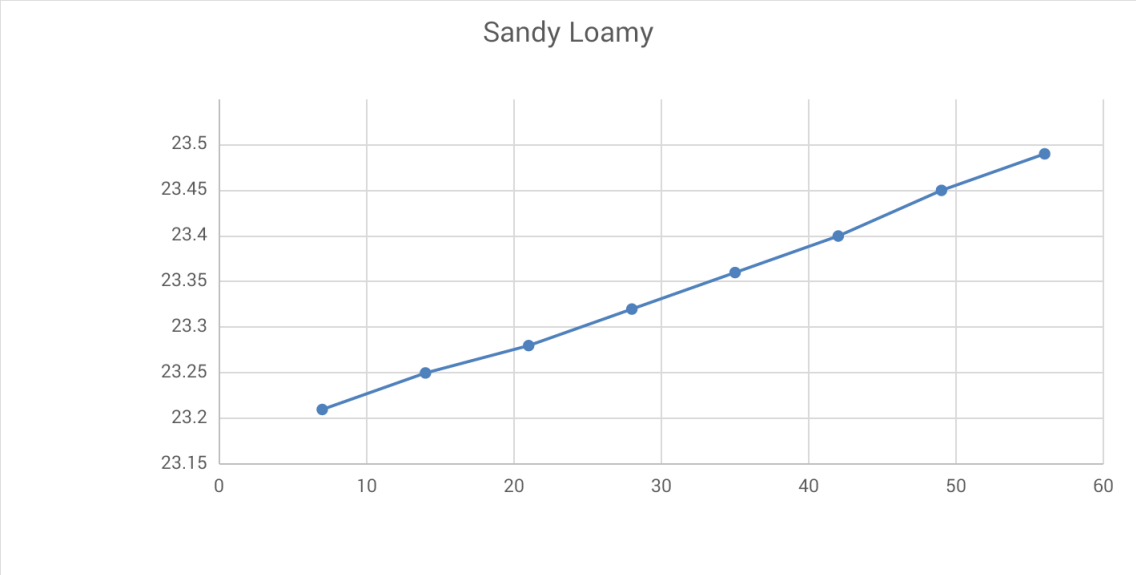

Figure 5: The graph of moisture retention against DAP for sandy loamy soil

DISCUSSION

In general, the organic media used in this experiment shows a low moisture retention capacity as compared to the soil used about ratio 1:6 approximately. The reason for this can be deduced from the fact that the organic media having coarse substances as part of the mixture thereby increasing pore spaces with the media, aiding easy drain of moisture from the media.

CONCLUSIONS

The moisture retention pattern of the selected media was obtained and some media shows steady pattern of moisture retention while some doesn't show unsteady moisture retention pattern. It can be inferred that the organic media that shows steady pattern of moisture content retention can be used for organic planting purposes as this would not be complicated for planning irrigation scheduling and not to have the plant grown on it to be stressed at any period of its growing season. So, from this study Maize husk and maize husk + soil doesn't exhibit a good organic medium for plant growth as it gave unsteady pattern of it retention since all these growing media was subjected to the same condition.

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