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Evaluation of Seed Propagation and Early Growth Rates of Ocimum Gratissimum (Shrubby Basil) as Affected by Different Growth Media

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ABSTRACT

Variations in seedling emergence and morphological indices of *Ocimum gratissimum* (shrubby basil/scent leaf) seedlings in three soil types were evaluated sequel to the fact that some people believe that it is difficult to propagate it from its seeds and thereby relying on this plant that develop through dispersal despite its multiple benefits. This plant is shrubby and often utilized for culinary and other numerous medicinal purposes. The study was carried out in the Screen House of the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba - Akoko, Ondo State, Nigeria. Viable seeds of *Ocimum gratissimum* were obtained from Akungba – Akoko and the different soil types (washed river sand, sandy soil and sandy loam) used were procured from the University premises and analyzed by employing standard laboratory procedures. The experimental design used was a completely randomized design consisting of 3 treatments and 5 replicates. Analyzed soil samples (treatments) showed that sandy loam had the highest nutrient status and washed river sand was the lowest especially with regard to organic matter, %Nitrogen and available Phosphorus. The study lasted for 13 weeks and data obtained were analyzed using SPSS software package (version 20.0). Results indicated that seedling emergence commenced at the 4th day after sowing in all the treatments but washed river sand had the highest SE percentage (7th day after sowing) with significant difference (at P≤0.05). Conversely, sandy loam had the highest values in all the morphological growth indices (significant at P≤0.05) owing to its higher nutrient status. Thus, sandy loam was recommended for large scale production of the seedlings of this plant for its culinary and numerous medicinal uses.

Keywords: Evaluation, seed propagation, *Ocimum gratissimum,* growth media, morphological growth indices.

INTRODUCTION

Ocimum gratissimum is found in the family Labiatae, shrubby and indigenous to tropical areas of the world especially India and West Africa. It thrives naturally in the savannah and coastal areas in Nigeria but not cultivated in Nigeria as opposed to other places such as Nepal, Bengal, Chittagong and Deccan (Nadkarni, 1999). Owing to the peculiar scent/smell of its leaves (due to its volatile oils), it is commonly called scent leaf, 'Aruntantan' or 'Efirin-nla' in the southern part of Nigeria (Yoruba), 'Ahuji' by the Igbos, 'Daidoya' by the Hausas in northern Nigeria (Effraim *et al.,*2003) and 'Elah Elaa' in Urhobo (Eboh and Ekundina, 2012). It is also called African basil or shrubby basil and commonly used in traditional medical practice for treatments

of ailments such as mental illness (Abdulrahman, 1992), epilepsy and diarrhea (Sofowora,1993), pneumonia, cough, and conjunctivitis (Correa, 1932; Onajobi, 1986). The leaves of the plant are used (in culinary context) in salads, soups, pastas, vinegar (as preservative or a dilute solution of acetic acid) and jellies in different parts of the globe.

STUDY OBJECTIVES

The objectives of this study are to assess the seedling emergence rates/percentages and variations in the morphological parameters of *Ocimum gratissimum* under different soil types.

MATERIALS AND METHOD

The Study Area

This research work was conducted in the Screen Souse of Plant Science and Biotechnology Department, Faculty of Science, Adekunle Ajasin University, Ondo State, Nigeria (Latitude 7 28'N,Longitude 50 44'E). The climate (outside the screen house) comprises two seasons (wet and dry seasons), the highest average maximum temperatures are between March and April, temperatures fall from May to August while the lowest minimum temperatures are recorded in December and January, Invariably, the low temperature in December is often associated with dry harmattan (parching dust-bearing land wind) and cold owing to the wind which blows across the Sahara desert (Odjugo, 2010).

Materials Employed and Procedure

Mature seeds of *Ocimum gratissimum* were procured from the University premises in Akungba –Akoko and subsequently air dried. Three different soil samples (washed river sand, sandy soil, sandy loam) were sourced from the University premises and their physicochemical properties were carried out in order to know their textural classes and nutrient statuses by employing standard laboratory procedures. The experimental design employed was a completely randomized design (CRD) consisting of three treatments and five replicates owing to the homogenous environmental condition in screen house. Proper drainage was ensured in the polythene bags used by perforating them at the bottom (to pave way for adequate aeration and prevent flooding/water logging). Each of the soil samples was thoroughly sieved prior to filling into the polythene bags (2.5kg soil) and the soil condition was maintained at field capacity by means of adequate watering. Other tending operations apart from watering (such as weeding, thinning) were ensured throughout the period of the study.

Seedling emergence rates/percentages and morphological parameters (plant height, leaf count, collar girth, number of branches and the leaf area) were evaluated. The data obtained were subjected to statistical analysis of variance and least significant difference (LSD) was calculated where significant differences were observed. The seedling emergence rates were taken based on the number of days the seedlings emerged after sowing from different treatments. In case of seedling emergence percentage, it was calculated by dividing the actual number of seedlings that emerged by the total number of seeds sown per treatment multiplied by 100. The height of each seedling was measured weekly by the use of ruler graduated in centimeters from a ground level to the base of the apical bud. The number of branches and leaf count per seedling were taken (by counting physically) weekly and recorded appropriately. The collar girth of the seedlings was measured by tying thread round the basal region of the seedlings' stem (2cm from ground level) and placing/stretching the thread on a ruler and finally taking the values

while the leaf area was measured by multiplying the length and breadth (mean of the breadth at 3 points on each leaf). The values were taken and carefully recorded.

RESULTS AND DISCUSSION

Analysis of Soil Samples

The result from the analyzed soil samples indicated that sandy loam had the highest organic matter (OM) of 3.65%, this was followed by sandy soil (2.5%) and the lowest was washed river sand with 1.08%. The pH in the sandy loam was the highest (6.91), followed by washed river sand (6.65) and the lowest value was in sandy soil (5.80). The total nitrogen (i.e. %N) also varied in the soil samples used of which sandy loam had the highest value (3.90%) followed by sandy soil (2.05%) and the lowest value was (0.12%) in washed river sand. The values of other parameters such as the available phosphorus, the exchangeable bases, exchangeable acidity and effective cation exchange capacity (ECEC) are as shown in Table 1 below.

Table 1: Pre-sowing soil physicochemical analyses of the three growth media

PARAMETERS	Values: SS	Values: WRS	Values: SL
PH	6.65	5.80	6.91
OM(%)	2.54	1.08	3.65
TN(%)	3.10	0.12	3.90
Av. P(ppm)	32.58	23.24	39.58
K(mg/kg)	8.30	5.70	5.20
Ca(mg/kg)	9.60	8.30	13.50
Mg(cmol/kg)	1.26	1.26	1.39
Cu(cmol/kg)	0.72	2.33	1.98
Na(mg/kg	4.20	3.60	8.70
Zn(mg/kg)	2.04	0.55	0.69
Mn(mg/kg)	3.64	2.81	1.74
EA(cmol/kg)	1.66	0.42	0.52
ECEC(cmol/kg)	23.62	29.97	33.72
Sand	70.07	85.08	61.10
Silt	18.03	8.02	18.70
Clay	11.90	6.90	20.20
Textural Class	SS	WRS	SL

Legend: SS=Sandy Soil, WRS=Washed River Sand, SL=Sandy Loam, TN=Total Nitrogen, OM= Organic Matter, EA=Exchangeable Acidity, ECEC=Effective Cation Exchange Capacity.

Seedling Emergence Rates/Percentages and Morphological Parameters

Seedling emergence (SE) commenced on the 4th day after sowing (DAS) in all the treatments. The highest SE percentage was recorded in washed river sand (45.67%) while the lowest SE percentage was in sandy loam (30.34%) at the 7th DAS. Significant differences ($P< 0.05$) were observed in seedling emergence percentages of *Ocimum gratissimum* from the three different soil types/treatments (Table 2a, Plate 1: *Ocimum gratissimum* seedlings).



Plate 1: *Ocimum gratissimum* seedlings

Table 2a: Mean values of seedling emergence rates, percentages and some morphological parameters of *Ocimum gratissimum*

TRT	SER4	SEP4	SER7	SEP7	PH WK1	NL WK1	PH WK3	NLWK3
SS	5.46±0.92^{b}	27.3±4.61^{b}	9.67±2.05^{a}	45.67±6.84^{a}	0.93±0.13^{a}	2.00±0.00^{a}	1.49±0.24^{a}	4.93±0.58^{a}
WRS	5.99±0.41^{b}	27.99±3.39^{b}	9.13±1.37^{a}	48.34±10.25^{a}	0.76±0.07^{a}	2.00±0.00^{a}	1.77±0.15^{a}	5.20±0.49^{a}
SL	2.67±0.35^{a}	13.33±1.75^{a}	6.07±0.63^{a}	30.34±3.14^{a}	1.38±0.34^{b}	1.87±0.13^{a}	4.39±0.49^{b}	6.67±0.63^{a}

Means with similar superscripts connotes non- significant difference and those with dissimilar superscripts imply significant difference: TRT: Treatment, SER4: Seed emergence rate at day 4, SEP4: Seed emergence percentage at day 4, SER7: Seed emergence rate at day 7, SEP7: Seed emergence percentage at day 7, PHWK1: Plant height week 1, NLWK1: Number of leaves at week 2, PHWk3: Plant height week 3, NLWk3: Number of leaves at week 3

Table 2b: Mean values of some morphological parameters of *Ocimum gratissimum*

TRT	NBWk3	CGWk3	PHWk5	NLWk5	NBWk5	CGWk5	LAWk5	PHWk7
SS	2.93±0.58[a]	0.53±0.05[a]	3.26±0.23[a]	8.80±0.84[ab]	6.93±0.70[ab]	0.68±0.05[a]	1.18±0.23[a]	4.42±0.53[a]
WRS	3.20±0.49[a]	0.51±0.04[a]	3.03±0.41[a]	6.60±0.65[a]	5.53±0.44[a]	0.62±0.03[a]	1.08±0.24[a]	3.94±0.55[a]
SL	4.40±0.86[a]	0.63±0.03[a]	8.53±0.45[b]	12.07±1.84[b]	9.74±1.62[b]	0.91±0.04[b]	2.23±0.57[a]	11.09±0.62[b]

TRT: Treatment, NBWk3: Number of branches at week 3, CGWk3: Collar girth at week 3, PHWk5: Plant height week 5, NLWk5: Number of leaves at week 5, NBWk5: Number of branches at week 5, CGWk5: Collar girth at week 5, LAWk5: Leaf Area at week 5, PHWk7: Plant height week 7

Table 2c: Mean values of some morphological parameters of *Ocimum gratissimum*

TRT	NLWk7	NBWk7	CGWk7	LAWk7	PHWk9	NLWk9	NBWk9	CGWk9
SS	8.47±1.24[a]	6.93±0.95[a]	0.57±0.03[a]	3.51±0.96[a]	4.97±0.56[a]	9.93±1.18[a]	8.33±1.32[a]	0.68±0.06[a]
WRS	7.00±0.84[a]	5.80±0.70[a]	0.61±0.06[a]	2.40±0.73[a]	4.43±0.62[a]	8.60±0.93[a]	7.00±0.65[a]	0.62±0.05[a]
SL	13.07±1.81[b]	11.07±1.76[b]	2.48±1.57[a]	15.42±2.57[b]	12.76±0.72[b]	14.67±1.56[b]	12.27±1.32[b]	1.05±0.03[b]

TRT: Treatment, NLWk7: Number of leaf at week 5, NBWk7: Number of branches at week 7, CGWk7: Collar girth at week 7, LAWk7: Leaf Area at week 7, PHWk9: Plant height week 9, NLWk9: Number of leaves at week 9, NBWk9: Number of branches at week 9, CGWk9: Collar girth at week 9.

Table 2d: Mean values of some morphological parameters of *Ocimum gratissimum*

TRT	LAWk9	PHWk11	NLWk11	NBWk11	CGWk11	LAWk11	PHWk13	NLWk13
SS	7.04±1.48[a]	7.01±0.79[a]	11.93±1.33[a]	10.73±1.19[a]	0.85±0.04[a]	10.49±1.51[a]	9.28±0.94[a]	14.13±0.91[a]
WRS	5.25±1.48[a]	6.63±0.64[a]	10.40±0.73[a]	8.93±0.69[a]	0.75±0.04[a]	8.89±1.51[a]	8.72±0.71[a]	12.93±0.66[a]
SL	30.10±2.83[b]	16.60±0.27[b]	17.73±1.62[b]	15.13±1.48[b]	1.37±0.05[b]	41.48±3.34[b]	22.00±0.79[b]	21.33±1.99[b]

TRT: Treatment, LAWk9: Leaf Area at week 9, PH11Wk: Plant height week 11, NLWk11: Number of leaves at week 11, NBWk11: Number of branches at week 11, CGWk11: Collar girth at week 11, LAWk11: Leaf Area at week 11, PHWk13: Plant height week 13, NLWk13: Number of leaves at week 13.

Table 2e: Mean values of some morphological parameters of *Ocimum gratissimum* seedlings

TRT	NBWk13	CGWk13	LAWk13
SS	11.60±0.74[a]	1.15±0.04[a]	14.74±2.29[a]
WRS	10.80±0.75[a]	1.07±0.04[a]	13.28±0.74[a]
SL	18.80±1.87[b]	1.65±0.04[b]	45.24±4.54[b]

TRT: Treatment, NBWk13: Number of branches at week 13, CGWk13: Collar girth at week 13, LAWk13: Leaf Area at week 13.

Table 3a: Mean square values of *Ocimum gratissimum* from the three treatments (growth media)

Source of variation	DF	SER4	SPR4	SER7	SPR7	PHWk1	NLWk1	PHWk3
Treatment	2	15.998	342.229	18.871*	471.782*	1.056	0.029	12.836
Error	12	1.901	59.711	10.778	269.450	0.224	0.030	.534
Total	14							

***: Significant at P≤ 0.05; SER4: Seedling emergence rate at day 4, SPR4: Seedling emergence percentage at day 4, SER7: Seedling emergence rate at day 7, SPR7: Seedling emergence percentage at day 7, PHWk1: Plant height at week 1, NLWk1: Number of leaves at week 2, PHWk3: Plant height at week 3**

Table 3b: Mean square values of *Ocimum gratissimum* from the three treatments (growth media)

Source of variation	DF	NLWk3	NBWk3	CGWk3	PHWk5	NLWk5	NBWk5	CGWk5
Treatment	2	4.360*	3.049*	0.022*	48.356	37.871	22.941	0.119
Error	12	1.629	2.195	0.009	0.708	7.562	5.539	0.009
Total	14							

***: Significant at P≤ 0.05; NLWk3: Number of leaves at week 3, NBWk3: Number of branches at week 3, CGWk3: Collar girth atweek 3, PHWk5: Plant height week 5, NLWk5: Number of leaves at week 5, NBWk5: Number of branches at week 5, CGWk5: Collar girth at week 5**

Table 3c: Mean square values of *Ocimum gratissimum* from the three treatments (growth media)

Source of variation	DF	LAWk5	PHWk7	NLWk7	NBWk7	CGWk7	LAWk7	PHWk9
Treatment	2	2.029*	79.986*	50.063	38.449	5.925*	260.345	108.745
Error	12	0.733	1.619	9.184	7.495	4.098	13.401	2.018
Total	14							

***: Significant at P≤ 0.05; LAWk5: Leaf Area at week 5, PHWk7: Plant height week 7, NLWk7: Number of leaves at week 5, NBWk7: Number of branches at week 7, CGWk7: Collar girth at week 7, LAWk7: Leaf Area at week 7, PHWk9: Plant height week 9.**

Table 3d: Mean square values of *Ocimum gratissimum* from the three treatments (growth media)

Source of variation	DF	NLWk9	NBWk9	CGWk9	LAWk9	PHWk11	NLWk11	NBWk11
Treatment	2	50.867	37.515	0.274	960.675	159.468	74.831	50.831
Error	12	7.849	6.508	0.012	20.697	1.835	8.227	6.802
Total	14							

NLWk9: Number of leaves at week 9, NBWk9: Number of branches at week 9, CGWk9: Collar girth at week 9, LAWk9: Leaf Area at week 9, PHWk11: Plant height week 11, NLWk11: Number of leaves at week 11, NBWk11: Number of branches at week 11.

Table 3e: Mean square values of *Ocimum gratissimum* from the three treatments (growth media)

Source of variation	DF	CGWk11	LAWk11	PHWk13	NLWk13	NBWk13	CGWk13	LAWk13
Treatment	2	0.563	1687.132	282.059	103.232	97.067	0.500	1628.811
Error	12	0.011	26.223	3.365	8.703	7.661	0.008	43.937
Total	14							

CGWk11: Collar girth at week 11, LAWk11: Leaf Area at week 11, PHWk13: Plant height week 13, NLWk13: Number of leaves at week 13, NBWk13: Number of branches at week 13, CGWk13: Collar girth at week 13, LAWk13: Leaf Area at week 13

The highest seedling emergence percentage of 27.30 was recorded in washed river sand and the lowest was in sandy loam (13.33%) at the 4th day after sowing at significant level ((P<0.05) but at the 7th day after sowing (DAS) 48.34% was observed in washed river sand, 45.67% in sandy soil while the lowest value (30.34%) was obtained in sandy loam and the differences among the treatment means were not significant (Table 2a). The mean plant height values (weeks 3 - 13) were significantly different ((P<0.05) with highest mean value from the

seedlings in sandy loam (22.00cm) while the lowest value was obtained from seedlings in washed river sand (8.72cm). This trend was maintained with regard to the number of leaves and other morphological indices such as number of branches, collar girth and leaf area from weeks 3 – 13 in all the treatments (Tables 2b - e).

Significant differences observed in the seedling emergence percentages among the different treatments could be attributed to variations in the textural classes of the soil samples especially in terms of $P^{H,}$ porosity and water holding capacity. Results from the physicochemical soil analyses of the three growth media (sandy soil, washed river sand and sandy loam), indicated that sandy loam had the highest nutrient status. This was probably responsible for the differential growth rates/values in the morphological growth parameters of the seedlings from the different treatments with seedlings from sandy loam having highest values (Kareem, 2018). For instance, owing to the higher nutrient status in sandy loam more branches were recorded as opposed to the poor nutrient of washed river sand which brought about few leaves/branches. More so, photosynthesis is an anabolic process, thus bringing about larger surface area of leaves for photosynthetic activities with optimum productivity in certain treatment e.g. sandy loam (Kareem and Adegoke 2015). It is interesting to note that in most cases, values from seedlings in sandy soil were not reasonably higher than those from washed river sand, thus the two were not significantly different. The significant differences observed were mainly between sandy soil and sandy loam or between sandy loam and washed river sand. This phenomenon is not unconnected with the fact the nutrient status in sandy loam is known to be profoundly higher than that of either washed river sand or sandy soil while those (nutrient statuses) in sandy soil and washed river sand are always similar (due to their physicochemical properties). The process of thorough washing which river sand undergoes (since it is most cases employed as 'the control' among treatments on studies bordering on nutrient status) drastically reduces its nutrient status (which cannot reasonably support plants'/corps' growth, development and productivity/yield). Another perspective is that the free living brady rhizobium bacteria that are involved in nitrogen fixation are present in sandy soil and sandy loam, though those in sandy loam are higher in terms of quantity and rate of activity.

CONCLUSION

This study indicated that *Ocimum gratissimum* seedlings in sandy loam had the best performance among all treatments in terms of all the morphological growth parameters. As earlier mentioned the nutrient status of the sandy loam was the highest and that of washed river sand was the lowest (lower than that of the sandy soil), thus confirming that *Ocimum gratissimum* seedlings cannot be productively produced (from seeds) in sandy soil or washed river sand since their nutrient statuses of these growth media are always very low.

RECOMMENDATIONS

Based on the results from this study, I hereby make the following recommendations:

a. Any of the soil types could be used for raising the seedlings of *Ocimum gratissimum* prior to transplanting.
b. Transplanting of *Ocimum gratissimum* should be done two weeks after seedling emergence.
c. For optimal growth of *Ocimum gratissimum* seedlings, sandy loam should be employed.

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