

## Influence of Different Growth Media on the Morphometric Characters of *Sansevieria liberica*

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### Abstract

The performance of *Sansevieria liberica* was determined on different growth media in the nursery. The growth media used include topsoil (TS), sandy soil (SS), rice husk (RH), topsoil plus rice husk (TS+RH), sandy soil plus rice husk (SS+RH), topsoil plus sandy soil (TS+SS) and top soil plus rice husk plus sandy soil (TS+SS+RH). The media were prepared in ratio 1:1 and their effect was observed on the height, stem girth, root length, root number and leaf number after six weeks of planting. The proximate and anti-nutritional analysis of the plant as well as the pH and mineral composition of the growth media were determined. The (TS+SS) medium showed the highest performance as regard plant height, stem girth, root length, root number and leaf number as it was significantly ( $p < 0.05$ ) different from other media. (TS+SS) growth medium had the highest pH value of 5.88 and the *S. liberica* grown on it recorded higher value of the mineral contents than those grown on other media. There was strong correlation between the performance of the plant and the pH value of the growth media as reflected by the linear regression analysis. Plant grown on RH recorded highest value of the anti-nutritional component tested. Thus, the rate at which *S. liberica* from different growth media contain the anti-nutritional components can be arranged as RH>SS+RH>TS+RH>TS+SS. Base on the result obtained, the growth of *S. liberica* can be enhanced using topsoil with sandy soil as growth media.

**Keywords:** Growth media; Soil pH; Rice husk; Mineral composition; Sandy soil; Topsoil

### Introduction

Botanicals play vital and integral role in the wellbeing of heterotrophs as their social, cultural, economic and environmental importance cannot be over emphasized. In both urban and rural settings, botanicals ranging from horticultural to agricultural to timber species have shown significant impact on the survival of humans and their livestock because of some benefits such as source of living, control of erosion, landscape enhancement, provision of recreational and cultural facilities, watershed protection, supply of fruits and seeds and fuel-woods derivable from them [1]. In addition, before the discovery of many nowadays synthetic drugs and insecticides in the early 1930s, the extracts of the botanicals have been the major means of healing and major weapon in farmer's armory [2-4].

In recent years, the use of plants and plant products are gaining more attention because of the perils associated with many synthetic drugs and chemicals. Many diseases, fungi, bacteria and even insects and other pests have developed resistances to many popular synthetic drugs and pesticides [5,6]. For example, many malaria drugs are no longer effective as before Basco and Ringwald [5]. Also, the residue effects of these synthetic chemicals and drugs on both human and environmental health have become major factors encumbering their widespread use. Therefore, because of the public awareness of the downsides of these synthetic drugs, fungicides, bactericides and insecticides, researches have been shifted toward the use of herbal cure and plant base pesticides as a new boulevard of disease, infection and pest control to outwit these associated cons [1,7,8]. Moreso, that the parts of different plant species are believed to contain myriads of secondary metabolites that could be useful as drug sources, natural fungicides, bactericides, insecticides, natural food flavourings and colouring agents and natural fragrances [2,3,9,10]. Thus these have increased the demand for plants and plant products.

Hitherto, despite the importance of the botanicals to human existence, this weighty natural endowment has been facing a lot

of challenges thwarting their growth and large scale production. Deforestation due to urbanization, climate change and insect infestation as well as low attention from government and individual towards the production of this imperative natural gift are the major factors exacerbating their large scale production especially in the developing countries where there is high rate of deforestation than afforestation [2,11,12]. However, despite the low production of botanicals in many parts of the world including Nigeria, the demand for their use has increased incessantly over the years probably because of the public knowledge of their importance. Hence, this has led to competition between different companies and individual that depends on plants as their major source of raw materials as well as their source of living. Therefore, to increase the production of these valuable resources become an important subject.

To increase the yield of this natural endowment, different strategies are being employed. Manipulation of growth media is one of the strategies introduced to increase yield of ornamental plants and botanicals in general because the quality and quantity of growth media is directly proportional to the performance of the plant. James and Michael [13] as well as Bhardwaj [14] opined that growth media have direct effects on the functional rooting system and that for a plant to perform well, the growth media used must be able to reduce water content and yet retain sufficient water to reduce watering frequency, must be able to sufficiently anchor or support the plant and

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must be able to serve as reservoir for nutrients necessary for growth [15]. *Sansevieria liberica* is an ornamental plant with high medicinal values. It is used for the treatment of colic, cold and fever, diarrhea, rheumatism, microbial infections, snake bite, gonorrhoea, convulsion, eczema, menorrhagia, sexual weakness, sedative abdominal pains, hypertension, conjunctivitis, asthma and hemorrhoids [16-19]. Considering the importance associated with this pertinent ornamental plant, this research investigated the growth of *Sansevieria liberica* on different growth media in order to recommend best growth media that could enhance large production of the plant.

## Materials and Methods

### Study location

The experiment was conducted at the green house of the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure, Ondo State (Lat. 5°N and 15°E). The location is characterized by two peaks of rainfall that occur in the month of June and September/October with annual mean temperature of 27°C. The dry season is usually witnessed of Akure between November and March, while the rainy season ranged from April to October.

### Collection of plant

*Sansevieria liberica* root was obtained from a healthy root stock of the plant in an open field in the Royal Garden, Akure, Ondo State, Nigeria. The root was uprooted early in the morning (6-7 AM) and was carefully packed in a polythene bag before being transferred to the study location. The roots were planted on different growth media on that same morning (7:30-8:30 am) and watering of the plant was done ones in three days. Planting was immediately carried out that same morning, after planting watering was continuously carried out till the end of the experiment.

### Preparation of growth media and experimental procedure

The growth media used in this study include topsoil (TS), sandy soil (SS), rice husk (RH), topsoil plus rice husk (TS+RH), sandy soil plus rice husk (SS+RH), topsoil plus sandy soil (TS+SS) and top soil plus rice husk plus sandy soil (TS+SS+RH). These media were prepared in ratio 1:1. The topsoil used was collected from Reliable Horticultural Garden, Akure while the sandy soil used was collected from Wisdom Garden, Igem, FUTA South gate, Akure. The rice husk used was obtained from a milling company in Ogbese, Ondo State. The media were thoroughly mixed on a dry concrete surface and were filled into polythene pots of diameter 11.4 cm and length 20 cm. The root of *S. liberica* of about 2 cm was planted horizontally on each medium. The experiment was arranged in a complete randomized design and each treatment was replicated four times. The plant height, stem girth, number of leaves, number of roots and root length was observed six weeks after plant.

### Proximate and mineral content analysis

The moisture content, ash content, fat content, crude protein content and crude fibre content of plant from different growth media was carried out using the method described by AOAC [20]. The minerals analyzed in different plant from different growth media include K, Na, Ca, Mg and phosphorus. These minerals were analyzed as described by AOAC [20].

### Determination of growth media pH

Five grams of sieved air-dried soil was weighed into a 250 ml

beaker, 35 ml of the extracting solution was added to the soil, shaken and allowed to react under 30 min and then filtered. 10 ml of the filtered was pipetted into a 50 ml standard flask, 16 ml of Murphy and Riley solution was added and then made up to level with distilled water. Standard solutions of different concentration of phosphorus were prepared from KHPO<sub>4</sub> solution and their respective absorbent readings were obtained from the photometer.

### Determination of phytochemical component of plant from different growth media

The phytochemicals present in each of the plant of *S. liberica* was analyzed using the method of Sofowora [21] as described by Ileke [22]. The phytochemicals analyzed include Alkaloids, Cardiac glycosides, Phenol, Phytate, Flavonoid and Saponins.

### Statistical analysis

All data were subjected to one-way analysis of variance and means were separated using New Duncan's Multiple Range Test. Also, linear regression analysis was carried out to check the correlations between growth media pH and the morphometric characters of the plant. SPSS version 17 was used for the analysis.

## Results

### Effect of different growth media on morphometric characters of *S. liberica*

Height, stem girth, root length, root number and leaf number of *S. liberica* grown on different media were presented in Table 1. These morphometric characters varied with the type of growth media used. Growth was observed in plant grown on all the media except those planted TS+RH, SS+RH and TS+SS+RH. *S. liberica* planted on TS+SS recorded the highest height, stem girth, root length, root number and leaf number of 5.07 cm, 0.74 cm, 6.40 cm, 37.45 and 6.62 respectively. The effect of TS+SS as a growth medium for *S. liberica* was significantly ( $p < 0.05$ ) different from other growth media.

### pH and mineral composition of the different growth media used for the growth of *S. liberica*

Table 2 presented the pH and mineral composition of the different growth media used for the growth of *S. liberica*. Variation existed in the pH and mineral component of the growth media. The pH of all the media was on the acidic region of the pH scale. However, growth medium TS+SS recorded the highest pH of 5.88 and its effect was significantly ( $p < 0.05$ ) different from other media except TS and SS which recorded 5.42 and 5.12 respectively. The lowest pH value of 2.26 was recorded in growth medium TS+SS+RH. Regardless of the growth media, potassium recorded the highest proportion of the mineral composition of the growth media. However, TS+SS recorded the highest value of 475.00, 187.00, 3.70, 34.80 and 6.09 mmol/kg of potassium, sodium, calcium, magnesium and phosphorus respectively. The amount of mineral compositions of TS+SS was significantly ( $p < 0.05$ ) different from all other growth media. The order at which the growth media varied in their pH and mineral composition can be arranged thus TS+SS > TS > SS > RH > TS+RH > SS+RH > TS+SS+RH.

### Correlation between growth media pH and morphometric characters of *S. liberica*

The correlation between the growth pH and morphometric characters of *S. liberica* was presented in Table 3. There is great correlation between the pH and the morphometric characters of *S.*

Growth media	Measurement in cm			Root number	Number of leaf
	Plant height	Stem girth	Root length		
TS	2.86 ± 0.14 <sup>c</sup>	0.37 ± 0.01 <sup>c</sup>	5.67 ± 0.22 <sup>cd</sup>	32.00 ± 0.00 <sup>d</sup>	5.41 ± 0.01 <sup>b</sup>
SS	4.32 ± 0.18 <sup>d</sup>	0.53 ± 0.01 <sup>d</sup>	4.12 ± 0.28 <sup>bc</sup>	27.24 ± 0.22 <sup>c</sup>	5.37 ± 0.11 <sup>b</sup>
RH	1.04 ± 0.12 <sup>b</sup>	0.16 ± 0.02 <sup>b</sup>	3.41 ± 0.24 <sup>b</sup>	15.28 ± 0.14 <sup>b</sup>	3.21 ± 0.12 <sup>b</sup>
TS+RH	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>
SS+RH	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>
TS+SS	5.07 ± 0.16 <sup>d</sup>	0.74 ± 0.02 <sup>e</sup>	6.40 ± 0.22 <sup>d</sup>	37.45 ± 0.2 <sup>e</sup>	6.62 ± 0.02 <sup>c</sup>
TS+SS+RH	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>	0.00 ± 0.00 <sup>a</sup>

Each value is mean ± standard error of four replicates. Values followed by the same letters are not significantly ( $p > 0.05$ ) different from each other using New Duncan's Multiple Range Test.

Table 1: Effect of different growth media on morphometric character of *S. liberica*.

Growth media	pH	Values in mmol/kg				
		Potassium	Sodium	Calcium	Magnesium	Phosphorus
TS	5.42 ± 0.01 <sup>c</sup>	398.00 ± 0.11 <sup>b</sup>	124.00 ± 0.13 <sup>c</sup>	2.94 ± 0.23 <sup>b</sup>	22.00 ± 0.11 <sup>c</sup>	3.15 ± 0.15 <sup>b</sup>
SS	5.12 ± 0.01 <sup>c</sup>	346.00 ± 0.12 <sup>c</sup>	119.00 ± 0.11 <sup>bc</sup>	2.80 ± 0.14 <sup>b</sup>	24.50 ± 0.20 <sup>c</sup>	3.08 ± 0.11 <sup>b</sup>
RH	3.60 ± 0.02 <sup>ab</sup>	286.00 ± 0.09 <sup>b</sup>	108.00 ± 0.11 <sup>b</sup>	1.80 ± 0.14 <sup>a</sup>	12.00 ± 0.16 <sup>b</sup>	1.86 ± 0.10 <sup>b</sup>
TS+RH	2.44 ± 0.01 <sup>a</sup>	145.00 ± 0.11 <sup>a</sup>	66.00 ± 0.11 <sup>a</sup>	1.12 ± 0.16 <sup>a</sup>	5.90 ± 0.10 <sup>a</sup>	0.27 ± 0.12 <sup>a</sup>
SS+RH	2.63 ± 0.01 <sup>a</sup>	138.00 ± 0.07 <sup>a</sup>	63.00 ± 0.08 <sup>a</sup>	1.10 ± 0.07 <sup>a</sup>	7.70 ± 0.14 <sup>a</sup>	0.13 ± 0.08 <sup>a</sup>
TS+SS	5.88 ± 0.02 <sup>c</sup>	475.00 ± 0.10 <sup>d</sup>	187.00 ± 0.10 <sup>d</sup>	3.70 ± 0.09 <sup>c</sup>	34.80 ± 0.23 <sup>d</sup>	6.09 ± 0.08 <sup>c</sup>
TS+SS+RH	2.26 ± 0.01 <sup>a</sup>	136.00 ± 0.12 <sup>a</sup>	57.00 ± 0.12 <sup>a</sup>	0.89 ± 0.12 <sup>a</sup>	5.30 ± 0.12 <sup>a</sup>	0.16 ± 0.10 <sup>a</sup>

Each value is mean ± standard error of four replicates. Values followed by the same letters are not significantly ( $p > 0.05$ ) different from each other using New Duncan's Multiple Range Test.

Table 2: pH and mineral composition of the different growth media used for the growth of *S. liberica*.

*liberica* as reflected by their R value which is tending towards 1. The R<sup>2</sup> value showed that only 78.3, 76.7, 79.7, 98.1 and 98.6% of the plant height, stem girth, root length, root number and leaf number can be explained by the pH value respectively. The R<sup>2</sup> reflected high correlation as the values are large. However, the correlation between pH and plant height, pH and stem girth as well as pH and root length was not significant at  $p < 0.05$ . Moreover, the correlation between pH and root length as well as correlation between pH and leaf number is significant at  $p < 0.01$  and  $p < 0.05$  respectively.

### Proximate and anti-nutritional component of *S. liberica* grown from different growth media

Figures 1 and 2 presented the proximate composition and the anti-nutritional composition of the plant respectively. There were no proximate and anti-nutritional components recorded for plant grown on TS+RH, SS+RH and TS+SS+RH. *S. liberica* on TS+SS recorded the highest value of 53.21, 2.15, 15.24, 0.28, 23.23 and 14.28% of moisture content, ash, crude fibre, fat, protein and carbohydrate respectively. The order at which the *S. liberica* from different growth media contain the proximate and anti-nutritional composition can be arranged as TS+SS > TS+SS > RH > TS+RH = SS+RH = TS+SS+RH. The rate at which the anti-nutritional components present in *S. liberica* varied with the type of growth media used. Plant grown on TS+SS recorded the lowest proportion of alkaloid, cardiac glycoside, phytate, flavonoid and saponins. Thus, the rate at which *S. liberica* from different growth media contain the anti-nutritional components can be arranged as RH > SS+RH > TS+RH > TS+SS.

### Discussion

Botanicals have been the closest companions of human as more than 90% of human's life depend on them. In fact, abundance of different species of botanicals is directly proportional to the wellbeing of humans and animals. However, the high demand for this weighty gift of nature from different quarters has been the major obstacle to its abundance especially in developing countries where less attention is given to afforestation. Also, the advancement in technology has contributed immensely to the climate change which has direct effect on soil composition [23,24]. Since soil is the major growth medium for plants, there is need for investigating the growth medium that will enhance the performance of different species of plant as this could increase their abundance.

The result obtained showed that the performance of *S. liberica* varied with the type of growth media used. However, no growth was observed on *S. liberica* planted on TS+RH, SS+RH and TS+SS+RH. The highest height, stem girth, root length, root number and leaf number was observed in the plant planted on TS+SS growth medium. The inability of the plant planted on TS+RH, SS+RH and TS+SS+RH could be due to the RH admixture with the soil because it has been noted that rice husk when added to the soil have some negative effect on growth of plants as suggested by Moyin-Jesu [25]. Also, rice husk has been noted to contain high amount of ash and this could result in the shift of bacteria that helps in decomposition of materials in the soil [26]. However, the works of Jeon et al. [27] and Milla et al. [28] as well as Badar and Qureshi [29] revealed that rice husk could be a very good soil substitute when used in a carbonized form. In addition, the low or

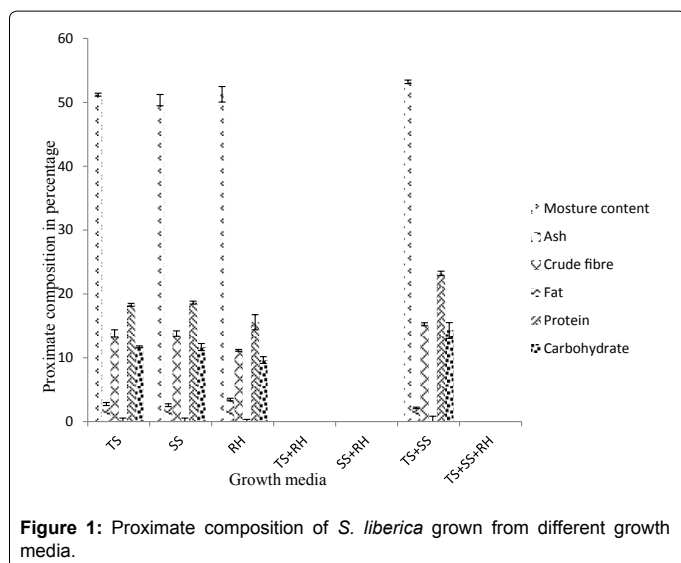


Figure 1: Proximate composition of *S. liberica* grown from different growth media.

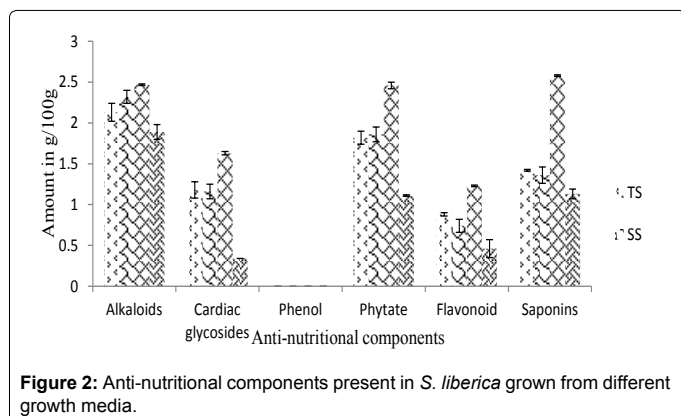


Figure 2: Anti-nutritional components present in *S. liberica* grown from different growth media.

Parameters	R	R <sup>2</sup>	K ± S.E	R <sub>c</sub> ± S.E	R <sub>e</sub>	Sig.
Plant height	0.885	0.783	-4.65 ± 3.01	1.59 ± 0.59	-4.65+1.59(pH)	0.115
Stem girth	0.876	0.767	-0.64 ± 0.43	0.22 ± 0.09	-0.64+0.22(pH)	0.124
Root length	0.893	0.797	-1.32 ± 2.25	1.24 ± 0.44	-1.32+1.24(pH)	0.107
Root number	0.990	0.981	-19.43 ± 4.75	9.47 ± 0.94	-19.43+9.47(pH)	0.01
Leaf number	0.986	0.972	-1.94 ± 0.86	1.42 ± 0.17	-1.94+1.42(pH)	0.014

K=Constant; R<sub>c</sub>=Regression coefficient; R<sub>e</sub>=Regression equation.

Table 3: Correlation between growth media pH and morphometric characters of *S. liberica*.

no growth of *S. liberica* on RH, SS+RH and TS+RH could be due to the low nitrogen content of the rice husk as reported by Kumar et al. [30] which estimated the nitrogen content of rice husk to be less than 0.24% compared to its ash content (about 29%).

Furthermore, the result obtained showed that TS+SS recorded the highest pH value while the TS+SS+RH recorded the lowest pH value. The high pH value noted in TS+RH, SS+RH and TS+SS+RH may due to the RH used as supplement. PH is an important factor in determining the availability of mineral elements in the soil [31]. Moyin-Jesu and Adekayode [32] opined that soil pH can either positively or negatively affect plant growth. The result obtained showed that the growth media with low pH recorded low growth of *S. liberica* compared to those that have higher values of pH. The low phosphorus and other macronutrients in TS+SS+RH, TS+RH and SS+RH as well as RH could be due to the low pH present in them (Webb, Loneragan and Moyi-Jesu) and

(Londo et al.; Zeng et al.) [25,31,33,34] reported that macronutrients are affected by the increase or decrease in pH of soil. These authors reported that at low pH plants take up little amount of nitrogen because the microbial conversion of NH<sub>4</sub><sup>+</sup> to nitrate (nitrification) will be slow. In the same vein, the amount of phosphorus in the soil is pH dependent because at high pH more phosphorus is available to the plant in the soil [32]. Therefore, the low root length and root number observed on *S. liberica* grown on RH could be due to low pH in the medium. The result obtained on root performance of *S. liberica* acquiesced with the findings of Haller and Sutton [35] as well as Conde et al. [36]. The low number of RH, TS, SS compared to TS+SS could be due to the effect of the pH on the macronutrient of the media which in turn affected the height of the plant. This agreed with the work of Moyin-Jesu and Ayodele [32]. However, the regression analysis of the result of this work revealed that there is strong correlation between the pH of the growth media and root number as well as the leaf number. Therefore, the low height, root length and stem girth recorded on *S. liberica* grown on RH could be attributed to the low number of the leaf (source) and the root (sink). This agreed with the work of Moyin-Jesu and Adekayode [32]. Also, the result of this work agreed with the findings of Valipour [37] in which regression analysis was used to compare mass transfer-based models to determine the best model under different weather conditions. Igbal et al. [38] reported that the nutritional and anti-nutritional components of plants are affected by the pH of their media. They opined that low pH reduces both nutritional and anti-nutritional components of plant and vice versa. Therefore, the low pH recorded in RH medium could be responsible for the low anti-nutritional component present in the *S. liberica* grown on it.

## Conclusion

The result of the work showed that the use of RH as supplement for the growth of *S. liberica* on TS and SS in the nursery may not yield good result. Considering the necessity for the rapid production of this pertinent ornamental plant, the mixture of TS and SS could be the best growth medium for *S. liberica* in the nursery and could be recommended for farmers.

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