Original Research Article

Variation in Morphological Attributes and Soil Characteristics of Potential Horticultural Plants growing in the Wild.

Abstract

This study investigated the variations observed in morphology and soil characteristics potential ornamental plants and four (4) species: *Callichilia stenosepala* Stapf, *Clerodendrum splendens* G. Don, *Combretum bracteatum* Herb.Madr. ex Wall and *Combretum indicum* L. Defillips, were collected within University of Uyo Main Campus, Use Offot village in Uyo Local Government Area and Ifiayong Usuk Village in Uruan L.G.A. of Akwa Ibom State alongside soil samples from the location of the plants. The morphology of the plants species was extensively described and the soil sample succinctly analyzed using standard methods. The results of the physicochemical properties of the soil revealed that the pH of the soils was slightly acidic ranging from 6.31±0.07 to 6.75±0.05. Soils of *Callichila stenosepala* had the highest value of electrical conductivity, organic carbon, total nitrogen, calcium, magnesium and exchange acidity. *Clerodendrum splendens* soils sample had the highest amount of soil pH, bulk density, phosphorus, sodium, potassium and clay, *Combretum indicum* had the highest values of sand and silt particles in the soil while *Combretum bracteatum* had the least values in all parameters of the soil analyzed. It is concluded that these plants could be used as outdoor plants for walkway decoration due to their persistent and attractiveness of flowers and leaves, as well as good plant habit that bloom in all seasons. Ecological investigation has been initiated to provide insights into the soil determinants for these potential horticultural plants.

INTRODUCTION

Plants are found all over the world, even where humans don't live. Plants are an integral part of the ecosystem [1, 2]. Plants are essential for human and other living things to exist. They are useful asa foodstuff, medicine, and in many other industries [3, 4,]. It is important to determine the type of plants in various fields such as horticulture, botanical research, aromatic herbs, farming, and so on. Horticulture is a science, as well as, an art of production, utilization and improvement of horticultural crops, such as fruits and vegetables, spices and condiments, ornamental, plantation, medicinal and aromatic plants [1,2,3,5]. According to Hopkins [6,7,8], horticultural crops require intense care in planting, carrying out intercultural operations, manipulation of growth, harvesting, packaging, marketing, storage and processing. Crops involved in horticulture are vine, perennial bush and tree nuts, vegetables (including roots, tubers, shoots, stems, leaves), fruits, flowers of edible, aromatic and medicinal plants, cut flowers, potted ornamental plants, and bedding plants, trees and shrubs, turf and ornamental grasses. Horticulture can be divided into food horticulture and ornamental horticulture. Ornamental horticulture concerns the production and use of woody and herbaceous plants [9]; and is divided into floriculture and landscape.

Plants have played a major role in the sustaining and evolving of human existence, and achieving aesthetics is one of the most encouraging ways to save plant activity and provide a wider knowledge of the various species of plants available in the locality. Most wild plants were introduced for

nutrient or fiber production, or for ornamental purposes [10, 11]. Wild ornamental plants occur naturally in the field with highly ornamental features such as ornamental flowers, foliage and fruits [12, 13,14]. They play an important role in environmental planning of urban and rural areas for abatement of pollution, social and rural forestry, wasteland development, afforestation and landscaping of outdoor and indoor spaces [15]. Most of the present day flowers have come from the wild progenitor a few of which still exist in natural habitat [16]. The more attractive wild flowers have long been prized for the beauty and planted in the garden around man kinds dwelling places. These ornamental plants exercise a strong, positive influence on human behavior [16].

According to [14] on the identification of potential wild ornamental plants in the Convolvulaceae family, they identified 61 Plants belonging to 11 genera presented in electronic herbarium, the ornamental potentiality was highlightened due to its attractive habit and good looking flowers. The plants identified were known as climbers, the flowers of these species possessed various colours to attract people especially those who are interested in gardening. It can also be preferred as indoor as well as outdoor gardening. Most wild plants were introduced for nutrient or fiber production, or for ornamental purposes [10,]. In a similar study by the same authors, they also identified and documented 153 species from 112 genera and 48 families which have attractive plant growth habit and beautiful flowers. These species belonged to herbs, followed by creepers and climbers, shrubs, trees and epiphytes. Major families were Convolvulaceae followed by Fabaceae and Apocynaceae and among dominant genera including *Ipomoea, Jasminum, Indigofera, Euphorbia, Argyreia* and *Barleria* [17]. Umoh [17] reported in his work that Plants such as *Mimosa pudica, Clerodendrum splendens, Combretum racemosum* and *Centrosema pubescens* found in the University of Uyo main campus could be very useful as ornamentals due to their beautiful and persistent flowers and all-season flowering habit. Botanical investigation resulted in abundant diversity of wild ornamental plants in terms of taxa, habit and growth forms. A total of 356 species belonging to 246 genera and 105 families with potential aesthetic value were listed. On analysis and evaluation, prominent ornamental trait was found to be flowering and some with ornamental fruits and foliage.

The importance of plants as food, medicine, fibre, fuel, timber, and others often has been treated by many researchers, but the aesthetic dimension was not very analysed [9, 18, 19,]. In some studies, the ornamental use is indicated but explicitly relegated for a secondary position regarding its medicinal and food uses. In other words, ornamentals sometimes constitute a starting point to evaluate its food, medicinal, and/or toxic properties [20, 21]. Thus, certain plants have not yet harnessed its full potentials. This could possibly be due to the none domestication of most the wild species. Landscape planting plays an important role in urban and public open spaces [22]; and one of the elements targeted in landscape design is to establish a balanced interaction between humans and the nature and to reflect the natural environment in urban environments. Another element is to create an aesthetic, functional and ecologically sustainable landscape. However, urbanization leads to a higher number and proportion of alien species in plant communities [23, 24] and possible emergence of urban habitats with unique diversity. Since the soil in urban sites has differentiated when compared to the original conditions, local plants have evolved to tolerate these conditions and it is inaccurate to believe that native plants would automatically fit better when compared to the wild plants [25]. Furthermore, wild species could be preferred more since they could be more tolerant to common urban stressors such as compact and limited soil, are often fast-growing, and have showy flowers [26, 27]. Most of the plants used in public institutions, recreation areas, traffic islands, and especially in herbal gardens are wild plant species of foreign origin; and wild plant species may exhibit higher expansion potential when suitable growth conditions are present when compared to

domestic plants. This may affect the growth conditions of other plants in the environment by altering certain soil properties in expansion areas. Harmful effects of non-native species are now considered to be one of the greatest threats to biodiversity globally [28] and more that 40% of widespread invasive plant species include ornamental plants [29, 30]. Invariably, ornamental plant quality is associated with physical properties that determine the appearance of plants, and chemicals, including the adequate balance of nutrients, in order to achieve the standard of commercialization and consumption [31]. Therefore, information on physical and chemical conditions of soil is essential for proper adoption and management of horticultural species within the area. This research aimed at the identification and documentation of some potential ornamental plants growing in the wild while providing diagnostic character description of each of these plants and also reveal the characteristics of soil supporting the survival of these potential ornamental plants for possible domestication.

MATERIALS AND METHODS

Study Area

This study was carried out in University of Uyo (UNIUYO) Main Campus, Use Offot village in Uyo Local Government Area and Ifiayong Usuk Village in Uruan L.G.A. all of which fall within Uyo metropolis of Akwa Ibom State (Longitude 7° $57^{'}$ $29^{''}$ E and latitude 4° $55^{'}$ $38^{''}$ N). The surrounding topography is undulating with sparsely distributed homesteads and the surrounding lands are cultivated. Akwa lbom State lies entirely on the coastal plain of south-eastern Nigeria, where no part constitutes an area of appreciably high relief. The climate is characterized by two seasons, namely, rainy season and the dry season. The rainy season begins about March-April and lasts until mid-November. The dry season begins in mid-November and ends in March. The total annual rainfall varies from 4000 mm along the coast to 2000 mm inland. Temperature values are relatively high in Akwa lbom State throughout the year, with the mean annual temperatures varying between about 26°C to 36°C. Akwa lbom State has relative humidities which vary between 75 % to 95 %, with the highest and lowest values in July and January respectively [32].

Plant collection and Identification

Specimens of four (4) potential ornamental plant species: *Callichilia stenosepala* Stapf, *Clerodendrum splendens* G. Don, *Combretum bracteatum* Herb.Madr. ex Wall and *Combretum indicum* L. Defillips, were collected within University of Uyo Main Campus, Use Offot village in Uyo Local Government Area and Ifiayong Usuk Village in Uruan L.G.A. of Akwa Ibom State using the methods of [33, 34].

Soil Sampling

Laboratory procedure for Soil Analysis

The soil sample from the location of the plants were collected at a depth of 0-15 centimeters with the aid of a soil auger and temporary preserved in a zipploc bag according to the methods of [54] and transferred to the Laboratory for analyses following the standard procedures outlined by the Association of Official Analytical Chemist (AOAC) [35].

Statistical analysis

Data on variation in soil characteristics were obtained in triplicates for each location. The entire dataset were arranged based on location and was subjected to one way analysis of variance (ANOVA). Significant means were separated using Duncan multiple range test. The results were presented as mean ± standard deviation and the probability level was set at $P<0.05$. Both Descriptive and inferential statistics were carried out using Statistical Package for Social Science (SPSS) Version 20 (IBM Corporation, Armonk USA)

RESULTS

Four wild plants which hold potentials in horticulture were collected and identified. The list is summarized in Table 1.

Table 1: Common names of Potential Horticultural Plants and their Location.

S/N	Botanical Name	Family	Common Name	Location	Coordinates
1	*Calichillia stenosepala* Stapf.	Apocynaceae	Not available	Uniuyo, Nwaniba	Long: 7:58:38.9300 Lat: 5:2:14.6899
2	*Clerodendrum Splendens* G. Don	Lamiaceae	Glory-bower	Uniuyo, Nwaniba	Long: 7:58:39.9500 Lat: 5:2:14.6868
3	*Combretum bracteatum* Herb.Madr. ex Wall.	Combretaceae	Palmwine of the sun-bird	Ring-road 3	Long: 7:57:57.9500 Lat: 4:59:56.2200
4	*Combretum indicum* L. Defillips	Combretaceae	Ragoon Creeper	Ekamba Nsukara	Long: 7:58:47.9623 Lat: 5:3:16.3210

Morphological Features of *Callichilia stenosepala* (Stapf)

Stem Features: It is an erect shrub with no hairs present at the stem and absence of fluid. The shape of the stem is cylindrical and it has a mild foul smell.

Leaf Features: The apex of the leaf is acute with an elliptic shape, arcuate venation, rounded base and the margin was observed to be entire. The leaf arrangement is opposite and the length measures between 9.4 cm – 1.0 cm and the breadth 5.1 cm – 6.5 cm. The petiole is greenish and very short. It measures 0.7cm. The leaf has a smooth texture.

Floral Features

Bracts: The bract is conjoined with the down part of the flower. The bract measures at 0.3 cm – 0.5 cm.

Calyx: It is about five and they are fused together at the base of the flower and attached to the corolla.

Corolla: The texture of the corolla is very smooth. The corolla is an open petal fused towards the base and forming a petal tube. The corolla is in salver form, having a cylindrical elongated tube. The flower has a butter-like scent.

Androecium: The filament is attached to the walls of the petal tube. It is about five with a triangular shaped head.

Gynoecium: It has a single gynoecium which is attached to the base of the calyx.

Fig 1: Pictorial Representation of ***Callichilia stenosepala*** (Stapf)

Morphological Features of *Clerodendrum splendens* G. Don

Stem Features: It is a scrambling shrub slightly hairy with short brown hairs. These short hairs are mostly found on the young stem. When stem is broken, there is absence of exudate. A clear cut made through the stem shows the shape of the stem to be angular and there are nodes observed to be scattered all over the stem. The stem is also observed to be scented.

Leaf Features: The leaves are arranged in an opposite direction with arcuate venation, elliptic shape and acuminate apex. The base of the leaf is rounded and the margin was observed to be entire. When measured, the length of the leaf was between 10.3 cm – 14.5 cm and the breadth of the leaf ranged from 6.0 cm – 9.0 cm. The petiole is deep green in colour while in some it is brown and it ranges from 0.8 cm – 1.3 cm.

Floral Features

Bracts: Possess some scanty bracteoles, they are slightly visible due to its scanty nature. The bracts are slender. It measures around 0.2 cm – 0.5 cm. It is slightly maroon and green in color.

Calyx: It is quite tiny when attached to the flower but when it matures to a fruit, it becomes broader and when fruits ripens, the calyx changes color from maroon and green to black and it gently wilts off. It measures 0.6 cm – 0.8 cm. The calyx is five in number and conjoined down to the part of the plant.

Corolla: It is open and fused towards the base of the flower. The corolla is in salverform. It has a cylindrical elongated tube. The corolla is five in number; and in dissecting the elongated tube of the corolla there was presence of transparent fluid.

Androecium: It is carefully buried into the tube of the corolla and it spreads across the upper region of the corolla. The androecium is 4 in number, and it measures between 1.9 cm –21 cm.

Gynoecium: It is not attached to the walls of the elongated corolla. The gynoecium has a light green color at the low region, a maroon color at the middle part and the top it has a green color, measuring between 3.5 cm – 3.8 cm. The gynoecium can be easily pulled out from the flower. The flower of this plant matures to a fruit. The young fruit is scented and completely greenish. The length of the fruit measure between 0.4 cm – 0.7 cm, while the breadth is between 0.8 cm – 1.1 cm. When the fruit is squashed there is presence of transparent liquid. The fruit is shaped into a four compartment.

Figure 2: Pictorial Representation of ***Clerodendrum splendens*** G. Don

Morphological Features of *Combretum bracteatum* Herb.Madr. ex Wall.

Stem Features: *Combretum bracteatum* is a semi-deciduous and scandent shrub of up to 7–10 m high, with a rounded crown, branched and often with twisted trunks. Bark on younger stem is whitish and hairy; stems have prominently thickened nodes, smooth and flaking; small twigs are reddish and drooping. When the stem was broken, it was noticed to have presence of transparent fluid. The shape of the stem is cylindrical, it had a mild foul smell and no hair was found.

Leaf Features: The leaves have an arcuate venation, elliptic shape with an opposite leaf arrangement. The apex of the leaf is accuminate and the margin is entire. It has an acute base and

the length of the leaves measures between 7.6 cm – 15.0 cm while the breadth measures between 3.0 cm – 6.3 cm. The petiole is green in color with presence of short hairs, it was also observed that some have brownish colour.

Floral Features

Bract: The bract is attached to each axis of the flower. Some of the bract is colored and is attached to each flower. It measures between 1.6 cm - 13.4 cm and the breadth is between 0.5 cm - 6.2 cm. Note: The inflorescence is panicle.

Calyx: The calyx appears as a petalloid, taking the shape of the petal. It has a peach color. It is about five calyx joined together at the base of the flower and separated approaching the tip of the corolla. It measures within 1.6 cm - 2.1 cm. The calyx is tubular and the surface is dry with whitish hair.

Corolla: In the corolla, there is presence of short white hairs and it is attached to the walls of the calyx measuring between 0.7 cm - 1.0 cm and the breadth is 0.3 cm.

Androecium: They are attached to the walls of sepal and the stamen are about 11 some could be 8 - 10. It measures between 1.8 cm - 2.1 cm.

Gynoecium: It is firmly attached to the ovary and it measures between 3.0 cm - 3.2 cm. In the ovary there is presence of short white hairs on the axis of the inflorescence.

Fig 3: Pictorial Representation of ***Combretum bracteatum*** **Herb.Madr. ex Wall.**

Morphological Features of *Combretum indicum* L. Defillips

Stem Features: It is a scandent shrub. It possesses short white hairs at the younger part of the stem. This is visible when viewed under a microscope. There is no fluid present in the stem**.** The shape of the stem is cylindrical**.** The stem has a foul smell when it is broken.

Leaf Features: It has an arcuate venation with alternate leaf arrangements. The texture of the leaf is rough. The apex of the leaf is accuminate and the* margin is entire. It has an acute base and the length of the leaves measures between 6.3 cm - 9.7 cm while the breadth measures between 3.8 cm - 5.0 cm. The petiole is green in color with presence of short hairs; it was also observed to have some been brownish.

Floral Features

Bract: It is present in this species and it measures within 1.0 cm-1.2 cm.

Calyx: The calyx is joined to the base.

Corolla: The corolla is not fused together; the younger ones are observed to be whitish in color while the matured ones are pink. It has short white hairs with a velvety texture. The corolla is five in number and it measures between 1.0 cm-1.5 cm.

Androecium: The stamen is about 10-15 attached to the walls of the corolla.

Gynoecium: It is only one present and it is attached to the wall of the calyx.

Fig 4: Pictorial Representation of ***Combretum indicum*** L. Defillips

Table .2: Physicochemical properties of the soils

	Calichillia stenosepala	*Clereodendrum. Splendens*	*Combretum bracteatum*	*Combretum indicum*
pH	6.31±0.07[a]	6.75±0.05[a]	6.48±0.06[a]	6.57±0.09[a]
E. Conductivity (ds/m)	18.2±4.10[b]	11.0±1.86[a]	10.6±0.63[a]	14.30±0.45[a]
Organic Carbon (%)	5.28±0.80[a]	4.98±0.51[a]	4.82±0.47[a]	4.72±0.78[a]
Total Nitrogen (%)	4.86±0.52[a]	4.22±0.60[a]	3.68±0.72[a]	4.41±0.60[a]
Bulk Density (g/cm^3)	1.26±0.07[a]	1.88±0.004[a]	1.32±0.06[a]	1.63±0.04[a]
Avail. Phosphorus (mg/kg)	0.88±0.001[a]	2.08±0.003[a]	2.04±0.41[a]	1.02±0.36[a]
Calcium (mg/kg)	164.00±10.20[b]	20.00±4.61[a]	31.00±3.62[c]	34.00±2.36[c]
Magnesium (mg/kg)	74.36±6.21[b]	9.96±1.08[a]	23.60±4.00[c]	13.6±1.05[a]
Sodium (mg/kg)	9.20±1.13[b]	18.4±4.09[a]	11.8±2.14[b]	10.5±1.98[b]
Potassium (mg/kg)	16.82±2.03[b]	32.18±7.02[a]	13.70±0.42[b]	24.10±3.62[c]
Exchange Acidity(mg/kg)	2.88±0.07[a]	1.98±0.01[a]	2.00±0.05[a]	2.05±0.40[a]
Sand (%)	48.00±5.01[b]	55.00±3.05[a]	53±8.02[a]	62.00±7.10[c]
Silt (%)	20.00±3.60[b]	11.00±1.60[a]	16.00±2.41[c]	23±4.30[b]
Clay (%)	32.00±5.00[a]	34.00±6.10[a]	31.00±7.20[a]	15.00±3.10[b]
Textural class	Silt,clay loam	Clay	Loam	Sandy loam

± Standard error Means with different superscript along the same row are significantly different (p = 0.05)

The physicochemical properties of the soil supporting the growth of the studied species are presented in Table 2. The pH of the soils was slightly acidic ranging from 6.31±0.07 to 6.75±0.05. Soils of *Calichillia stenosepala* had the highest values for electrical conductivity (18.2±4.10 ds/m), organic carbon (5.28±0.80 %), total nitrogen (4.86±0.52 %), calcium (164.00±10.20 mg/kg), magnesium (74.36±6.21 mg/kg) and exchange acidity (2.88±0.07 mg/kg). Soils of *Clereodendrum splendens* had the highest values for bulk density (1.88±0.004 g/cm^3), available phosphorus (2.08±0.003 mg/kg), sodium (18.40 ±4.09 mg/kg), potassium (32.18±7.02 mg/kg) and clay (34.00±6.10 %) while soils of *Combretum indicum* had the highest values for sand (62.00±7.10%) and silt (23.00±4.30 %). On the other hand, soils of *Calichillia stenosepala* had the least values for bulk density (1.26±0.07 g/cm^3), available phosphorus (0.88±0.001 mg/kg), sodium (9.20±1.13 mg/kg) and sand (48.00±5.01%), that of *Combretum indicum* had the least values for organic carbon (4.72±0.78 %) and clay (15.00±3.10 %), that of *Combretum bracteatum* had the least values for total nitrogen (3.68±0.72 %) and potassium

(13.70±0.42 mg/kg) while soils of *Clereodendrum splendens* had least values for electrical conductivity (11.00±1.86 ds/m) and silt (11.00±1.60 %).

DISCUSSION

In this study, the present observation on ornamental potentiality was categorized based on their persistent and attractiveness of flowers and leaves; scent, as well as good plant habits which was identified to be shrubs. These morphological features were also high lightened in [13,17, 36]. Umoh [17] also revealed that *Combretum* species on investigation possessed unique ornamental features that makes it suitable for shades and landscape use. Ornamental plants are grown usually for the purpose of beauty for their fascinating foliage, flowers and their pleasant smell [37]. However, these plants do not just have aesthetic values but several medicinal benefits such as: the leaves of *Clerodendrum splendens* are used in the form of poultice to treat burns and wounds; *Combretum indicum* is used in stopping diarrhea, treatment of parasitic skin infections, use for pain relief, and treatment of rheumatism [38], hence can be cultivated at home to serve both ornamental and medicinal purposes.

Soil properties especially nutrients are known to influence primary productivity and plant species richness. The presence and availability of nutrients may define a species' potential to survive in a given area. Productivity generally increases with increasing nutrient availability and, as such, nutrients and rate of nutrient supply are commonly used as proxies for estimating productivity [39, 40]. This is quite evidenced in this study as variations were observed in the soil properties where the four plant species are found. This variation relates to the fact that plant species adapt differently to changes in topographic, anthropogenic and edaphic factors in their environment [41] also different species growing together under similar environmental conditions varied in their response and adaptability to nutrients limits [42].

Furthermore, this may entail that woody species vary in their soil nutrient return and also exert great influence on soil nutrient compositions. This had been documented by several scholars in previous studies [43, 44, 45]. [46] reported that changes in soil biotic and abiotic conditions created by plants cause legacy effects in the soil that does not only affect the performance of co-occurring plants of the same and other species, but also the offspring of these species. In this way, soil conditions that were altered by a plant can affect the establishment, growth, performance or reproduction of the later arriving plants.

CONCLUSION

Plant quality is associated with the physical and chemical conditions of the soil. In this research work, the properties of the soil samples revealed that these four species could thrive in varied to moderate conditions; coupled with the several morphological diagnoses, it is concluded that environmental aesthetics can be achieved by a proper use of these plants in the locality as outdoor plants for walkway decoration. The flowers of these plant species possess a colourful display and the plants bloom in all season hence making it visually appealing when introduced into front yards and can also aid a proper relaxation due to its stem arrangement as a shrub and the leaves spread across to provide shade.

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