ISSN:
Print - 2277 - 0755
Online - 2315 - 7453

Journal of Agricultural Science and Environment

THE INFLUENCE OF TYPE OF CUTTING AND GROWING MEDIUM ON GROWTH AND FLOWERING OF SCORPION ORCHID (*Arachnis maingayi)* Hook.f. Schltr

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ABSTRACT

Orchids are of importance primarily for their horticultural appeal and accounts for 8% of the world floricultural trade. Scorpion orchid (*Arachnis maingayi* Hook) is highly prized for its beautiful long lasting flowers, but it is under-exploited in many countries including Nigeria. There is the need to determine the best type of cutting and growing medium protocols for commercial production of this species. Seven homogenous growing media (sawdust, topsoil, charcoal, coconut husk, wood shavings, maize cobs and rice husk) and two types of cutting (apical and non-apical) were compared in a factorial experiment laid out in Completely Randomized Design with six replications at the Federal University of Agriculture, Abeokuta, Nigeria between 2010 and 2012. Data collected on plant height, number of leaves, leaf area, shoot dry weight, days to spiking, length and number of spike, size and number of florets were subjected to analysis of variance and Tukey's HSD at $p \leq 0.05$ to separate treatment means. Apical cuttings were significantly ($p \leq 0.05$) superior to non-apical cuttings in terms of all parameters assessed except floret diameter which was statistically similar. For growing medium, dry matter accumulation and spike yield were in the order of charcoal > rice husk > maize cob > topsoil > wood shavings > coconut husk. Apical cuttings planted in charcoal or rice husk gave the best results relative to other media. Thus, apical cutting is the best propagating technique and charcoal or rice husk is the best growing medium for scorpion orchid cultivation.

Keywords: monopodial orchid, propagating material, dry matter accumulation; flowering characteristics.

INTRODUCTION

The orchid family, Orchidaceae is one of the largest and most diverse families of plants (Dressler, 1981) and is outstanding in many ways among horticultural and floral crops. With over 700 genera and 25000-35000 species, orchids comprise one of the three largest groups of flowering plants in the world (Hoffman and Brown, 1992). The growth habits of orchids are either sympodial or monopodial (Arditti, 1994). Most of the orchids are perennial plants with simple leaves and usually displays varied growth patterns and complex flowers with a great diversity of colours, structures, scents and size (Stewart, 1981). In Nigeria, about 20 genera

of terrestrial orchids with more than 250 species and 30 genera of epiphytic orchids, the species numbering around 200 have been identified (Tang and Cribb, 1983).

Potting orchids is important in its cultivation and the type of potting medium used for growing orchids vary depending on whether it is an epiphyte or terrestrial orchids, structure, growth habit and method of potting. Orchids could tolerate a wide range of growing media with extremely good aeration and drainage. Often local conditions and availability of various constituents dictates the composition of the growing medium. However, many epiphytic orchids do not grow well and or die when planted in soil. Thus they require different growing media from other houseplants.

Commercial growers of orchids use different materials to formulate the growing medium which include charcoal, chopped coconut husks and fiber, Douglas fir back, expanded clay, expanded polystyrene, osmunda fiber, peat, perlite, pumice, redwood bark, rock wool, sphagnum moss, tree fern fiber, vermiculite, volcanic rock, and washed gravel (Slump, 2004; Wang, 2005). Among all of these materials, coconut husk, charcoal, sawdust, wood shavings, maize cobs, rice husk and other wastes from crops are locally available in Nigeria. However, their uses as media components for growing *Arachnis maigayi* orchids have not been extensively studied.

Production and importation of orchid cut flowers and potted plants have become one of the largest segments of floriculture industry worldwide (U.S. Department of Agriculture. 2006). The horticultural orchid trade is steadily increasing, particularly in Europe and United State of America (Ready, 2008), thus creating opportunity for African countries as a means of diversifying their agricultural production. Nigeria as the case for most Sub-Sahara African countries has varied agro climatic zones suitable for all year round harvest, fertile land, cheap labour, large local and international market. Proximity of Africa to Europe compared with South America and Asia and opportunity of trade concession offered by African Growth Act (AGA) in United State of America make it a highly profitable proposition to grow scorpion orchids in Nigeria. It is imperative to provide relevant information on best planting materials and growing medium for scorpion orchid cultivation among farmers to harness the economic opportunity created by its rising popularity in international floral trade. Thus the purpose of this study is to determine the best type of cutting and growing medium for optimum growth and flowering characteristics of scorpion orchid.

MATERIALS AND METHODS

The experiment was conducted at the Nursery of Department of Horticulture, Federal University of Agriculture, Abeokuta (7° 15' N, 3° 25'E) Ogun state, Nigeria, from 2010 to 2012. The experiment consisted of two factors; types of cutting (apical and non-apical cuttings) and seven homogeneous growth media (sawdust, topsoil, charcoal, coconut husk, wood shavings, maize cobs and rice husk). Each of the 14 treatment combinations was replicated six times and arranged in a Completely Randomized Design (CRD). There were 84 plastic pots arranged in six rows, 20 cm apart and 50 cm buffers were used to separate different replicates.

Topsoil was collected with a shovel to a depth of 10 cm from the surface under the forest area (rainforest transition ecology of

south west Nigeria) of the University of Agriculture, Abeokuta. Rice husk, wood shavings and sawdust were obtained from rice and saw mills respectively within Abeokuta City, while maize cobs was collected from maize shellers at Olodo market, Olodo, Ogun State. Charcoal dust and coconut husk were collected from charcoal selling point at Odo-Ona and Institute for Agricultural Research and Training (IAR&T), Ibadan, Oyo State, Nigeria. Rice husk, sawdust, wood shavings, maize cobs and coconut husk were allowed to partially decompose by applying water under prevailing weather condition for thirty days before usage. All media were used as collected from the sources, except for topsoil that was sieved using 2 mm sieve and was not amended with any nutrient source.

Chemical analysis of the growing medium was evaluated using the following standard procedures. Total nitrogen was determined using Kjedhal method of digestion and adapted auto analyzer calorimeter method (Technicon, 1979). Organic carbon was determined by modified Walkley Black colorimetric method (Hearnes, 1984). Elemental analysis (Na and K, Ca and Mg) were determined by subjecting filtrate from 1 N ammonium acetate extraction method (Black, 1965) to a flame photometer and Atomic Absorption Spectrometer (AAS), respectively. Available phosphorus was determined using Bray-1 P extractant and determined calorimetrically by the molybdenum blue procedure (Bray and Kurtz, 1945). Cu, Fe, Zn and Mn were extracted in 0.1 N HCl and determined by AAS. Apical (with apex) and non-apical (without apex) cuttings of herbaceous shoots of scorpion orchid were soaked in 0.23 % fungicide solution of Dithane M-45 (Ethylene dithiocarbamate 80% by Rahm and Hass Co, Philadelphia, PA19106) for five minutes before planting to prevent fungus infection. Cuttings with 25 to 30 cm long and a girth of 2 to 3cm were selected and planted upright with respect to polarity. They were set in 7-litre plastic planting pots filled to the 5-litre mark with the different potting media. Observations on plant height (cm), number of leaves, leaf area (cm^2), dry shoot weight (g), days to spiking, spike length (cm), number of flower, flower size (cm) and inflorescence yield (number of inflorescence per plant) were recorded. Leaf area was determined using leaf area estimation regression equation $Y = -1.7733 + 0.098X - 0.004X^2 + 0.00000239X^3$ where X is the leaf length x breadth (Olosunde, 2013). Data collected on each parameter were subjected to Analysis of Variance (ANOVA) and treatment means separated using Tukey's HSD ($P \leq 0.05$) via SAS Computer software (1999 package).

RESULTS

The physicochemical properties of the growing media various slightly varied (Table 1). Bulk density and total porosity ranged from 0.12 to 1.24 g/dm^3 and 49 to 92%, respectively. Topsoil had the lowest N, P, Ca, Mg, Zn, Fe and C compared to other media.

The type of cutting significantly ($p \leq 0.05$) influenced growth and flowering characteristics of scorpion orchid. Plants raised from apical cuttings were significantly superior in terms of height, number of leaves and leaf area across the sampling periods, irrespective of the growing medium (Figure 1). Plants grown from apical cuttings were significantly ($p \leq 0.05$) taller with higher number of broader leaves than those from non-apical cuttings at 12, 24 and 36 weeks after planting (WAP).

Table 1: Physicochemical properties of the growing media before planting

Growing media	N %	P mg/kg	K %	Ca mg/kg	Mg mg/kg	Cu mg/kg	Mn mg/kg	Zn mg/kg	Fe mg/kg	C %	Bulk Density g/dm3	Total Porosity %
Coconut husk	0.65	0.54	0.09	3300.0	472.50	0.08	146.0	16.2	2224	24.86	0.60	60
Sawdust	1.06	0.75	0.07	6050.0	1260.0	0.04	26.0	12.6	1239	33.01	0.12	92
Wood savings	1.07	0.46	0.06	825.0	930.0	0.05	363.0	42.0	4009	21.12	0.29	81
Charcoal	0.90	0.29	0.06	6050	1937.5	Nd	49.0	21.2	1489	16.31	0.35	77
Maize cob	0.41	0.37	0.14	3875.0	827.5	0.11	102.0	42.7	2203	31.20	0.15	49
Rice husk	1.02	0.36	0.2	333.0	1295.0	0.14	38.0	62.9	346	35.34	0.15	90
Topsoil	0.05	0.19	0.16	382	890	0.22	14.19	1.44	18.38	0.32	1.24	53

Nd = Not detected

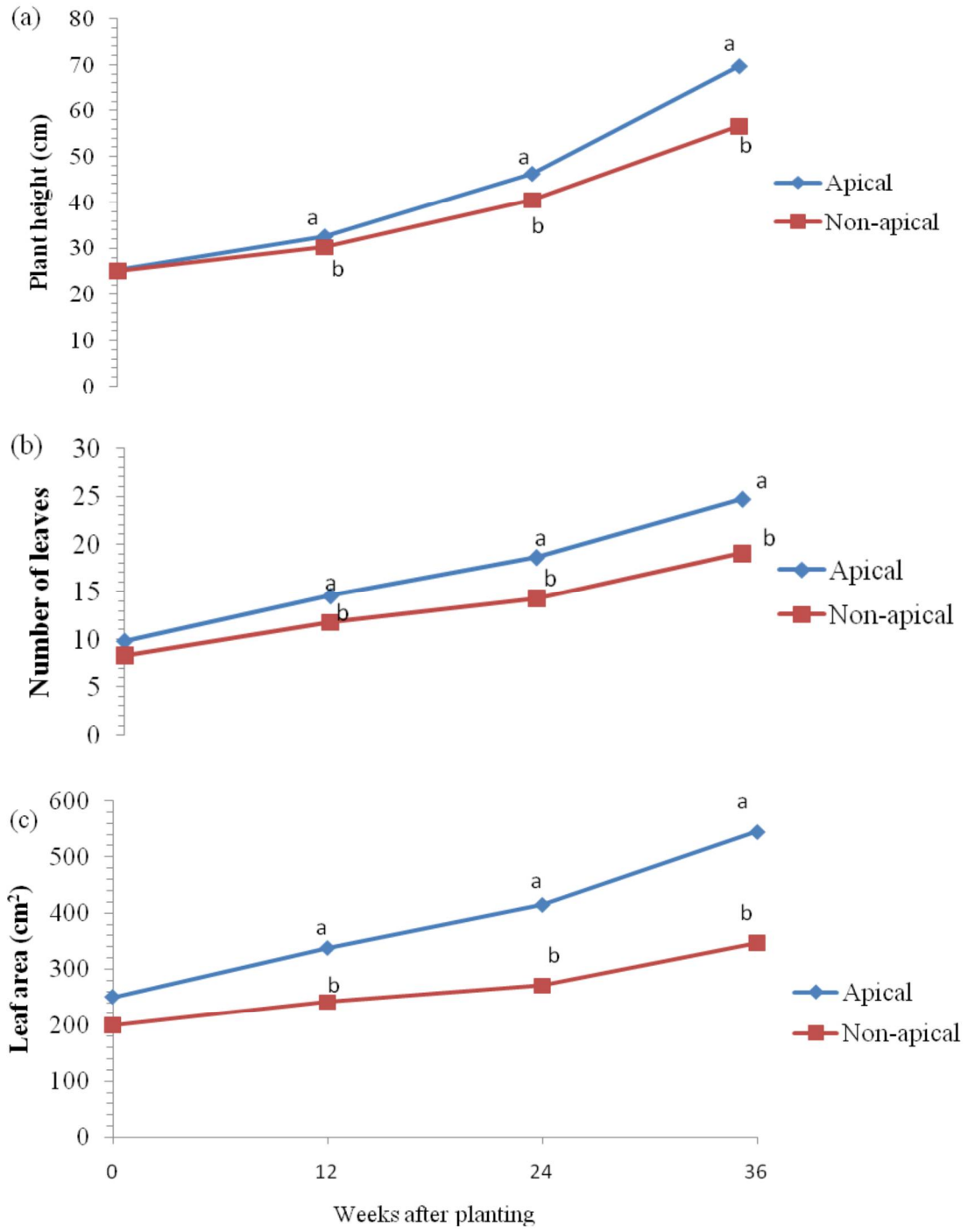

Figure 1: Height (a), leaf area (b) and number of leaves (c) of scorpion orchid as influenced by type of cutting (Mean of 2011 and 2012 trials)

Significant differences existed among scorpion orchid planted on rice husk, charcoal, topsoil, wood shavings, coconut husk, maize cob and sawdust medium with respect to growth and flowering characteristics. Plants grown on either rice husk or charcoal medium were tallest (73 and 67 cm), had the highest number of leaves (25 and 26 leaves /plant) and broadest leaf area (553 and 541 cm^2), respectively, than those grown on other media at 36 WAP (Table 2). The least number of leaves were produced by scorpion orchid planted in sawdust and wood shavings media (20 and 18 leaves / plant), respectively. Plants grown on rice husk or charcoal had significantly broader leaf area while those in wood shavings had the least (275 cm^2).

Plants grown from apical cuttings had greater dry shoot weight compared to those grown from non-apical cutting (Figure 2). Results presented in Table 3 showed that highest dry shoot weight was obtained in scorpion orchid planted on charcoal (14 g) or rice husk (13 g) compared to those grown on other media.

Flowering characteristics and inflorescence yield of scorpion orchid were significantly affected by the type of cutting, irrespective of the growing medium (Figure 2 & 3). Scorpion orchid grown from apical cuttings produced in a relatively shorter period higher number of longer spikes and bigger florets than those from non-apical cuttings.

Table 2: Effects of growing medium height, number of leaves and leaf area of scorpion orchid (Mean of 2011 and 2012 trials)

Growing media	Height (cm)			Number of leaves/plant			Leaf area (cm2)		
	12*	24*	36*	12*	24*	36*	12*	24*	36*
Charcoal	31.8ab	44.0a	66.9ab	13.4ab	17.0ab	25.7a	337.6a	406.0a	540.5a
Top soil	32.2ab	43.8a	61.8bc	15.0a	17.3ab	22.6ab	298.7a	326.4ab	427.8ab
Rice husk	31.0ab	45.1a	72.5a	13.2b	17.6a	24.8a	300.4a	384.6a	553.0a
Sawdust	33.6a	44.0a	59.7bc	13.0b	15.5ab	19.6bc	290.9a	345.4ab	423.7ab
Coconut husk	30.1b	41.3a	60.6bc	12.9b	16.3ab	21.6abc	296.2a	346.4ab	442.0ab
Maize cob	30.2b	43.6a	64.3abc	12.1b	17.7ab	21.5abc	270.1a	343.6ab	461.7ab
Wood shavings	31.3ab	42.0a	56.7b	12.9b	15.1b	17.8c	233.5a	248.3b	274.6b

*= Weeks After Planting

Means followed by the same lower-case letters in each column did not differ statistically using Tukey's HSD at the 5 % level of probability.

Table 3: Dry matter accumulation and flowering characteristics of scorpion orchid grown in different growing media (Mean of 2011 and 2012 trials)

Growing media	Shoot dry weight (g)	Days to spiking	Spike length (cm)	Number of florets/ spike	Flower size (cm)	Number of spikes/plant
Charcoal	13.81a	373.7a	47.21a	7.33a	8.24ab	2.92a
Top soil	9.42bc	403.4a	36.89c	5.67a	8.16ab	1.92ab
Rice husk	12.75ab	377.3a	49.79a	7.33a	8.53a	2.42ab
Sawdust	7.69c	390.1a	41.58b	6.58a	8.06ab	1.83ab
Coconut husk	9.14bc	440.8a	36.26c	5.58a	7.75b	1.33b
Maize cob	9.89bc	397.5a	46.08a	7.25a	8.25ab	2.25ab
Wood shavings	9.11bc	333.3a	42.92b	6.33a	8.11ab	1.58ab

Means followed by the same lower-case letters in each column did not differ statistically using Tukey's HSD at the 5 % level of probability.

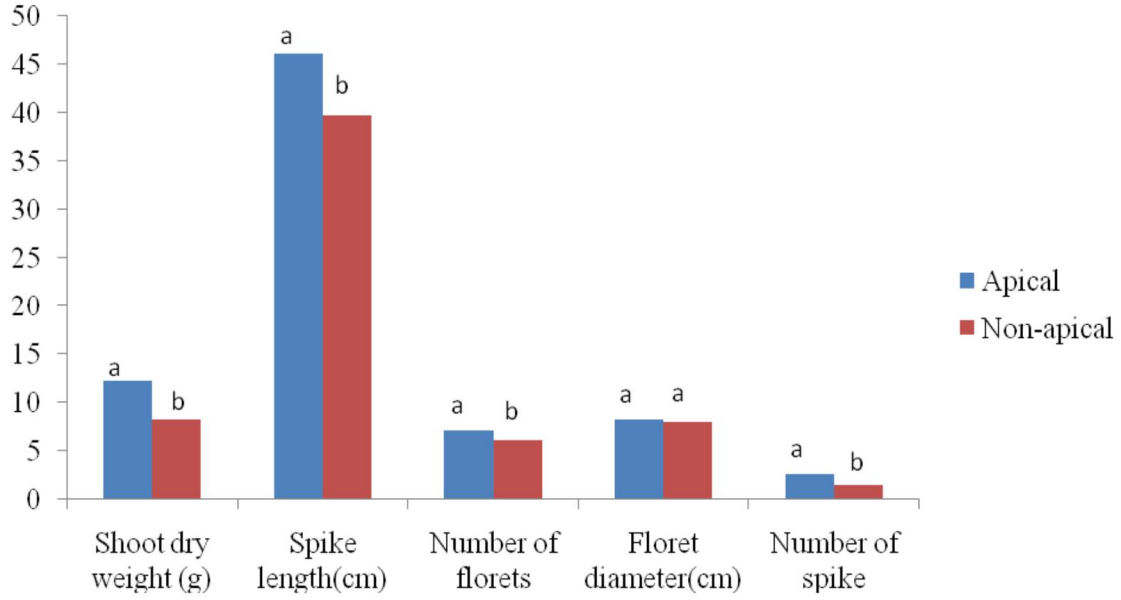

Figure 2: Dry matter accumulation and flowering characteristics of scorpion orchid as influenced by type of cutting (Mean of 2011 and 2012 trials)

Growing medium significantly ($p \leq 0.05$) affected shoot dry weight, spike length, number of florets per spike, size of floret and spike yield of scorpion orchid, irrespective of type of cuttings planted (Table 3). However, effect of the various growing media on days to spiking was not significant. Plants in charcoal, rice husk and maize cob produced longer spike compared to those in wood shavings, sawdust, topsoil and coconut husk. It was observed that it took scorpion orchid planted in maize cob, rice husk and charcoal relatively shorter period to produce many longer spikes with higher number of bigger florets than those in other media. Scorpion orchid planted in sawdust, wood shavings and coconut husk media took longer period to produce fewer spikes.

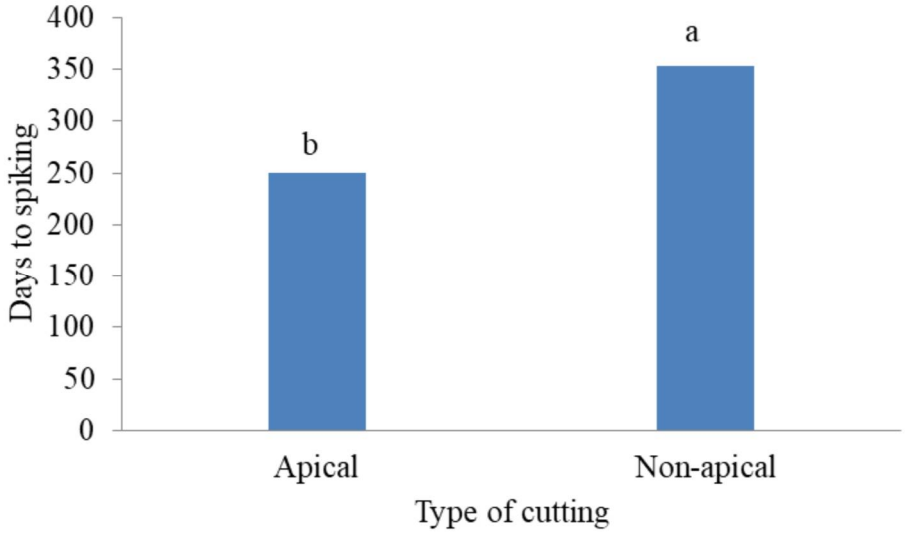

Figure 3: Effect of type of cutting on days to spiking of scorpion orchid (Mean of 2011 and 2012 trials)

DISCUSSION

Base materials for formulating potting media are significant determinants of its physicochemical properties (Sahin *et al*., 2005; Bayeri and Mbah, 2006). Thus, the variability in the growing medium in this study probably explained the marked differences in their nutrient concentration, porosity and water holding capacity which consequently affected the growth and flowering characteristics of scorpion orchids. Although the physicochemical properties of all the media were not too different, plant responses significantly varied suggesting that some specific attributes of each medium might have far reaching effect on growth and flowering performance as observed in this study. Better growth and flowering of scorpion orchid planted in charcoal or rice husk could probably be attributed to good air circulation for roots, slow or good resistance to degradation, availability of higher Mg and adsorption. Magnesium is crucial for optimum growth of tropical orchids under full sun as deficiencies in nitrogen, potassium and phosphorus rarely occur (Naik *et al*., 2009).

This study indicated that significant differences existed between apical and non-apical cuttings of scorpion orchid suggesting apical cuttings as better propagation material for its optimum growth, spiking and flowering. The influence of cutting position was found to significantly affected the rooting and subsequent growth of *Cercis siliquastrum* (Karam and Gebre, 2004) and *Gonystylus bancanus* (Nor Aini *et al*., 2010). Similarly, Olosunde *et al*., (2012) reported a higher number of rooted cuttings with superior rooting characteristics in apical cuttings of *Arachnis maingayi* compared to non-apical. The differences in the growth and flowering performance of cuttings made from varying positions of the shoot could be linked to the anatomical differences and perhaps effect of auxin translocation from the apex, rather than positional effect.

However, since getting good and healthy planting materials is a constraint to orchid production, non-apical cuttings could be used as propagating material for commercial production of scorpion orchid and other monopodial orchids like *Vanda, Dendrobium, Phalaenopsis*. This study however discovered that, non-apical cuttings are useful propagation material and could be planted just like apical cuttings to establish orchid fields after upgrading for three months. Previous studies recommended the use of apical cuttings with two aerial roots for immediate planting and that non-apical cutting be left to re grow before cuttings could be made from them. This may be due to differences in period required for bud to break and subsequent development of new shoot by non-apical cuttings. However, ability of non-apical cuttings to develop spikes and florets suggests that it could be used as an alternative planting material when grown in the nursery for three months where apical cutting is scarce or unavailable.

Finding from this study corroborated earlier studies which identified a desirable media for orchids as one that retains an adequate amount of moisture, nutrients and does not create barriers to root entry (Blanchard and Runkle, 2008). Additional desirable characteristics of orchid media was reported to include; low cost, high uniformity, abundant availability, devoid of pathogens, pests and weeds and no or slow degradation (van der Knaap *et al*., 2005; Wang *et al*., 2007). Among all the media assessed in this study, rice husk and charcoal satisfy most of these conditions. Though maize cob as found out in this study was a good potting medium for scorpion orchid cultivation, it is not stable as it degraded quickly. Growing media also varied in their ability to allow easy penetration of roots of scorpion orchid, which may have affected roots functions of nutrients and water absorption with attendant effects on growth and development. The ability of the plant root not to find space in which to grow or to force it way into the growing medium is often limit plant growth.

CONCLUSION

Apical cutting is a better propagating material for commercial production of scorpion orchid. Non-apical cutting could also be used as alternative planting material where it is difficult to source sufficient quantity of apical cuttings. Rice husk and charcoal are better growing media for scorpion orchid cultivation. Planting of apical cutting in rice husk or charcoal dust is recommended for optimum growth and flowering of scorpion orchid.

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(Manuscript received: 10th June, 2016; accepted: 28th December, 2018).