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Rooting, growth and sustainability of yellow Ficus (*Ficus retusa* 'Nitida') as affected by growth media under nursery conditions

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ABSTRACT

A greater percentage of yellow ficus (*Ficus retusa* 'Nitida') seedlings die out at the nursery production stage as they can be stressed easily. Rooting time is slow (30-60 DAP) and any disturbance in the root system could be fatal. Some die without any reason. Therefore, this study was conducted to evaluate the rooting, growth and sustainability of yellow ficus in varying growth media to determine the efficient growth media for its propagation. A cutting of yellow ficus each with eight (8) nodes was planted per black polythene nursery bag each filled with different growth media. The growth media utilised were: topsoil alone, sawdust alone, topsoil + cow dung (4:1), topsoil + poultry manure (4:1), cow dung + sawdust (1:4), sawdust + poultry manure + topsoil (1:1:3) and sawdust + cow dung + topsoil (1:1:3). The experimental design was Completely Randomized Design (CRD) with three replications. Significantly ($P<0.05$) highest vegetative and root length was produced by plants grown on a mixture of sawdust, cow dung and topsoil (1:1:3). Root length of *Ficus retusa* 'Nitida' was best supported by the medium topsoil alone (16.43, 12.16) > sawdust alone (15.18, 12.78) > sawdust + cow dung + topsoil (1:1:3) (8.35, 6.80) > topsoil + cow dung (4:1), (8.79, 4.71) > topsoil + poultry manure (4:1) (5.24., 4.65) > cow dung + sawdust (1:4) (3.00, 3.36) at both plantings. The growth medium Sawdust + cow dung + topsoil (1:1:3) significantly (at $P<0.05$) affected the number of leaves produced, root length and branch girth of yellow ficus. It supported the highest number of leaves produced. More branches were encouraged by the medium sawdust + cow dung + topsoil (1:1:3) (0.14, 0.15) (at both plantings) > topsoil alone (0.12, 0.13); > topsoil + cow dung (4:1) (0.11, 0.12) > topsoil + poultry manure (4:1) (0.11, 0.10). Significant growth media influences on the number of branches and branch lengths of this plant were observed. Sawdust + cow dung + topsoil (1:1:3) medium most favorably supported establishment and sustenance of yellow ficus plants.

Keywords: Ficus, Potting media, response, seedlings, sustenance, vegetative growth.

INTRODUCTION

Ficus plants are mostly ornamental trees, shrubs or vines several of which are desirable interior foliage plants. They are made up of different species and cultivars. Over 70 species of *Ficus* are found naturally in West Africa, and a few introduced ones, such as *Ficus retusa*. Fruits of some species of ficus are edible or used medicinally, and some possess ornamental value (Jianjun et al.,

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2000). These species are commonly used as food by local people, for example for fruits (*Ficus sur* Forskk, *Ficus sycomorus* L., *Ficus polita vahl*) or leafy vegetable (*Ficus. Sycomorus* L., *Ficus thonningii* Blume). Others are used for firewood (*Ficus thonningii* Blume, *Ficus ovata vahl*), fodder (*Ficus thonningii* Blume, *Ficus sycomorus* L.), latex (*Ficus platyphylla* Delile) or traditional medicines (leaves of *Ficus thonningii* Blume are used to treat malaria and yellow fever). In addition, *Ficus platyphylla* Delile, *Ficus retusa* L. and *Ficus lutea vahl.* are widely used to provide shade or as street trees (Danthu et al., 2002). Some of the species have multiple uses, such as *Ficus sycomorus* L., *Ficus thonningii* Blume, *Ficus platyphylla* Delile. Yellow ficus (formerly *Ficus microcarpa* L.f., now *Ficus nitida*) also known as *Ficus retusa* 'Nitida', the Cuban laurel fig belongs to the genus, Ficus (Henley et al., 2009).

Propagation by stem cuttings is the most commonly used method to propagate many woody ornamental plants (Erv and Blazich 2009). Propagation of ficus is done by three primary methods (layerage, cottage and tissue culture) while seeds may be used occasionally with certain species such as *Ficus vallischaude* (Urgessa, 2011). However, rooting time varies with the type of cutting material used, the species being rooted, and the environmental conditions. Yellow ficus is an attractive hedge plant of economic importance used in landscaping that is relatively hardy when fully established. However, it was observed that a greater percentage of the yellow ficus stem cuttings either do not root on time or die out in the course of propagation in the nursery. Ficus requires media with good container capacity and aeration, pH of 5.5-7.0, shade house with 60-70% shade required with a temperature 21-35ºC and relative humidity of 60-100%. Fertilizers with micronutrients are also good for ficus production and recommended (Conover et al., 1990) in its production. Growth media are materials similar to soil that physically support plants growth (Ekpo and Sita, 2010). They also determine the nutritional status of the potting media to sustain better growth (Gabriels et al., 1986). In nursery production industry, a variety of growing media are in use worldwide, especially in ornamental plant production (Muhabat et al., 2006). Yellow ficus is a slow rooting plant, about 30-60 days after planting (Leon, 2014). It requires organically rich, well-drained loamy soil amended with compost at planting to enhance its growth and survival (Marie, 2014). Providing fertilizer will help the plant to remain healthy and liquid fertilizer or a slow- release fertilizer should be used for ficus (Bennett, 2011). The phrase "One man's waste is another man's treasure" certainly applies to materials we find useful for various horticultural applications. Potential uses of composts and other organic materials in the horticultural industry are frequently evaluated **(**Sibley et al., 2012). Some of the more common organic by-products marketed to the green plant industry include animal wastes such as poultry litter, stable cleanings, and dairy solids. Ishtiaq et al. (1995b) noted that sand media and *Ficus* species have significant effect on number of leaves and number of branches of the cuttings. The percentage of rooting and quality of root can, in many ways be linked to the medium itself (Wojtusik et al., 1994; Olosunde, 2003). Choosing the most suitable growing media for the achievement of a successful plant production is very important in potted growth. With the challenges of slow rooting, requirements and recommendation for growth and survival of ficus, this study aims at determining the choice of growth media obtainable from available, accessible and affordable resources of organic materials and alternative products as substrate blending components suitable for propagation of ficus plants in the nursery. It also aims at determining the response of yellow ficus to these growth media with respect to the rooting, optimum growth and its sustainability under nursery conditions.

MATERIALS AND METHODS

The experiment was conducted at the screen house of the National Horticultural Research Institute (NIHORT), Ibadan, Oyo State, Nigeria (3^0 52'E and 7^0 25'N) between early season May to September, 2009 (first planting) and late season July to October, 2010 (second planting). Cuttings of yellow ficus (*F. retusa* 'Nitida') each with eight (8) nodes were planted in medium sized (10cm by 12cm) black polythene nursery bags filled with different growth media. A cutting was planted per nursery bag. The growth media compared were: topsoil alone, sawdust alone, topsoil + cow dung (4:1), topsoil + poultry manure (4:1), cow dung + sawdust (1:4), sawdust + poultry manure + topsoil (1:1:3) and sawdust + cow dung + topsoil (1:1:3). The experimental design was Completely Randomized Design (CRD) with three replications.

Mist propagation technique (Hartmann et al., 2002, Brown, 2011) was employed in the course of the experiment to enhance the rooting of the cuttings. An equal amount of water (450ml) was applied weekly to each plant throughout the course of the experiment. Nursery and other cultural practices were carried out. There was no insecticide application. Plants were uncovered after three (3) weeks. Data on number of leaves was at three weeks after plants were uncovered while number of branches and branch length was taken at ninth week after plants uncovering; and every forth night thereafter. Branch girth and root length data collection was at the termination of the experiment (13 weeks after planting). Data collected were subjected to analysis of variance (ANOVA) using SAS, 1999. The Duncan Multiple Range Test (DMRT) at 5% probability level was used to compare the treatment means (SAS 1999).

RESULTS

The topsoil utilised for this study was sandy loam in texture (% sand, silt and clay were 58.4, 29.6 and 12 respectively) with pH 7.7.

Rooting of yellow ficus as affected by growth media

Topsoil alone and sawdust alone gave comparable and significantly longer root length for both years (Table1). However, plants in the medium sawdust alone had more roots followed by those in topsoil alone; while plants in cow dung + sawdust (1:4) medium had the shortest root length for both years.

Number of branches of yellow ficus as affected by growth media

There were significant differences in the influence exerted by all the media on the number of branches of yellow ficus (Table 2) at the two planting years of this experiment. However, highest number of branches was observed on plants in the media topsoil + cow dung (4:1) and sawdust + cow dung + topsoil (1:1:3) at first and second planting respectively.

Branch length of yellow ficus as affected by growth media

There was significant difference in media influence on branch lengths of yellow ficus at first planting in 2009 (9-11 WAP), while in 2010 none occurred. However, the longest branch lengths was observed on plants at 11WAP, in the medium cow dung + sawdust (1:4) at first planting, though the media sawdust + cow dung + topsoil (1:1:3), sawdust + poultry manure + topsoil (1:1:3) and topsoil alone all performed comparably with it.

Branch Girth of yellow ficus as affected by growth media

There was significant difference in the growth media effects on the branch girth of the yellow ficus plants evaluated at 13WAP. The production of the strongest and most stout branches were greatly supported by sawdust + cow dung + topsoil (1:1:3) at both planting years (Table 4). However, plants in cow dung + sawdust (1:4) had the lowest branch girth at both years of study.

Leaves production of yellow ficus as affected by growth media

Sawdust + cow dung + topsoil (1:1:3) positively and significantly supported the highest production of leaves (Table 5) at the first and second planting. This was closely followed by topsoil alone and topsoil + cow dung (4:1), at first planting but sawdust + poultry manure + topsoil (1:1:3), topsoil + poultry manure (4:1) and topsoil alone respectively at the second planting. The medium topsoil alone, was not significantly different from the other media except sawdust + cow dung + topsoil (1:1:3) at 13 weeks after planting. Cow dung + sawdust (1:4) and topsoil + cow dung (4:1) performed least at first planting and second planting respectively (Table 5).

Table 1: Root length of yellow ficus as affected by growth media at13WAP.

Growth media	Root length (cm)	
	2009	2010
Sawdust+Cowdung+Topsoil	8.35^{ab}	6.80^{ab}
Topsoil + Poultry manure	5.24^{b}	4.65^{b}
Sawdust	15.18^{a}	12.78^{a}
Cow Dung + Sawdust	3.00^{b}	3.36^{ab}
Sawdust+Poultry manure+Topsoil	7.63^{ab}	8.17^{ab}
Topsoil + Cow Dung	8.79^{ab}	4.71^{b}
Topsoil	16.43^{a}	12.16^{a}

Table 2: Number of branches of yellow ficus as affected by growth media.

Growth media	Week after planting (WAP)		
2009	**NBR9**	**NBR11**	**NBR13**
Sawdust+Cowdung+Topsoil	4.13^{ab}	4.13^{ab}	3.93^{ab}
Topsoil + Poultry manure	3.87^{ab}	3.87^{ab}	3.60^{ab}
Sawdust	2.47^{ab}	2.47^{ab}	2.90^{ab}
Cow Dung + Sawdust	1.10^{b}	1.10^{b}	1.50^{b}
Sawdust + Poultry manure +Topsoil	2.07^{ab}	2.07^{ab}	2.67^{ab}
Topsoil + Cow Dung	4.87^{a}	4.87^{a}	5.67^{a}
Topsoil	4.40^{ab}	4.40^{ab}	4.67^{ab}
2010			
Sawdust+Cowdung+Topsoil	3.33^{a}	3.67^{a}	4.33^{a}
Topsoil + Poultry manure	2.33^{a}	2.67^{a}	3.67^{ab}
Sawdust	2.33^{a}	2.67^{a}	2.67^{b}
Cow Dung + Sawdust	2.33^{a}	2.33^{a}	3.33^{ab}
Sawdust + Poultry manure +Topsoil	2.67^{a}	3.00^{a}	3.00^{ab}
Topsoil + Cow Dung	2.00^{a}	3.00^{a}	4.00^{ab}
Topsoil	2.67^{a}	3.33^{a}	3.33^{ab}

Means with the same letters are not significantly different at P<0.05 along columns.

Table 3: Branch length of yellow ficus as affected by growth media.

Growth media	Week after planting (WAP)		
2009	**BL9**	**BL11**	**BL13**
Sawdust+Cowdung+Topsoil	4.26[a]	5.35[a]	6.72[a]
Topsoil +Poultry manure	3.52[a]	3.61[ab]	4.27[a]
Sawdust	1.61[b]	2.16[b]	4.23[a]
Cow Dung + Sawdust	4.21[a]	5.75[a]	5.05[a]
Sawdust + Poultry manure +Topsoil	3.90[a]	4.72[a]	5.63[a]
Topsoil + Cow Dung	3.26[a]	3.59[ab]	4.31[a]
Topsoil	4.17[a]	4.97[a]	6.39[a]
2010			
Sawdust+Cowdung+Topsoil	3.27[a]	3.35[a]	3.74[a]
Topsoil +Poultry manure	4.01[a]	4.03[a]	4.32[a]
Sawdust	3.65[a]	3.80[a]	4.58[a]
Cow Dung + Sawdust	2.85[a]	3.09[a]	2.53[a]
Sawdust + Poultry manure +Topsoil	2.91[a]	4.05[a]	4.50[a]
Topsoil + Cow Dung	1.77[a]	3.14[a]	2.86[a]
Topsoil	3.70[a]	4.08[a]	3.76[a]

Means with the same letters are not significantly different at P<0.05 along columns

Table 4: Branch girth of yellow ficus as affected by growth media at 13WAP.

Growth media	Branch girth (cm)	
	2009	**2010**
Sawdust+Cowdung+Topsoil	0.14[a]	0.15[a]
Topsoil + Poultry manure	0.11[a b]	0.10[a b]
Sawdust	0.11[a b]	0.09[a b]
Cow Dung + Sawdust	0.04[c]	0.04[b]
Sawdust+Poultry manure+Topsoil	0.07[bc]	0.09[a b]
Topsoil + Cow Dung	0.11[ab]	0.12[ab]
Topsoil	0.12[a]	0.13[ab]

Table 5: Number of leaves of yellow ficus as affected by growth media.

2009	NL3	NL5	NL7	NL9	NL11	NL13
Sawdust+Cowdung+Topsoil	3.40^{bc}	6.20^{a}	13.13^{a}	12.53^{a}	18.67^{c}	18.93^{a}
Topsoil + Poultry manure	4.87^{ab}	7.73^{a}	10.33^{ab}	10.87^{ab}	14.67^{ab}	14.13^{ab}
Sawdust	4.00^{abc}	6.60^{a}	5.60^{ab}	5.60^{bc}	8.27^{ab}	7.47^{b}
Cow Dung + Sawdust	1.40^{c}	4.20^{a}	4.70^{b}	3.60^{c}	5.50^{b}	5.40^{b}
Sawdust + Poultry manure +Topsoil	3.40^{bc}	6.80^{a}	7.33^{ab}	5.87^{bc}	9.00^{ab}	11.33^{ab}
Topsoil + Cow Dung	4.60^{abc}	9.87^{a}	11.47^{ab}	11.40^{ab}	15.07^{ab}	16.80^{a}
Topsoil	6.87^{a}	9.20^{a}	11.93^{ab}	11.13^{ab}	17.40^{a}	18.40^{a}
2010						
Sawdust+Cowdung+Topsoil	4.27^{ab}	4.57^{abc}	8.33^{a}	11.27^{a}	11.80^{a}	12.93^{a}
Topsoil + Poultry manure	5.20^{a}	6.13^{a}	6.73^{a}	8.47^{ab}	8.87^{ab}	9.73^{b}
Sawdust	3.57^{b}	2.07^{e}	5.87^{ab}	4.93^{bc}	4.93^{cd}	5.67^{c}
Cow Dung + Sawdust	4.17^{ab}	2.73^{ed}	6.37^{ab}	7.27^{abc}	7.67^{bcd}	9.27^{b}
Sawdust + Poultry manure +Topsoil	4.40^{ab}	5.13^{ab}	7.60^{a}	9.07^{ab}	8.80^{ab}	9.73^{b}
Topsoil + Cow Dung	3.67^{b}	3.00^{cde}	4.00^{b}	4.20^{c}	4.67^{d}	5.53^{c}
Topsoil	4.13^{ab}	4.30^{bcd}	7.87^{a}	8.73^{ab}	8.33^{abc}	8.20^{c}

Means with the same letters are not significantly different at P<0.05 along columns

DISCUSSION

In this study, rooting of yellow *ficus* was significantly supported by the media topsoil alone, followed by sawdust alone and vice- versa at second planting (Table 1). This may be as a result of good and friable topsoil as the soil was loamy, and aeration made possible by the sawdust. A soil with a large amount of fine particles (silt and clay) will have smaller pore diameters and a higher penetration resistance at a lower bulk density than a soil with a large amount of coarse particles Daddow and Warrington (1983). This suggests that the roots of the plant in this sawdust-containing (alone) medium did not have to exert too much pressure to overcome mechanical resistance and move particles as it grows. This made rooting easier and the roots longer. It was observed that all the media containing sawdust encouraged rooting and root elongation/length. This was also observed by Akinyele (2010) who investigated the effects of growth hormones, rooting media and leaf size on juvenile stem cuttings of *Buchholzia coriacea*. Engler. She found out that the use of sawdust as the rooting medium produced seedlings with significantly longer root length of 20.7 cm compared with plants in topsoil as the rooting medium which had 14.2 cm. Daddow and Warrington (1983) who reported that a silt soil has 19 percent macro pore space and a measured penetration resistance of 2.5 bars at a bulk density of 1.4 g cm-3. However, a coarser sandy loam had 28.9 percent macro pore space and a penetration resistance of 1.2 bars at the same bulk density. As a result of this relationship, coarse-textured soils will have lower root growth limiting power than the fine-textured soil mixtures. Therefore, it could be said that roots grow in soil through large soil pores and by moving soil particles aside when the roots penetrate pores that are smaller than the root tips. In a compacted soil, most soil pore diameters are substantially smaller than the diameters of growing roots. In this situation, root growth is essentially limited or even stopped because the roots cannot exert enough pressure to overcome the mechanical resistance and move soil particles. This restricted root penetration and elongation reduces the volume of soil that can be

exploited by a plant for essential nutrients and water. This can cause a reduction in total growth. This is not so in the sawdust-containing media as the sawdust is relatively light and easy to move aside by penetrating roots as they grow as observed in this study.

The medium Topsoil alone supported rooting but the medium sawdust + cow dung + topsoil (1:1:3) was comparable in supporting the best expression of all the growth parameters of yellow ficus evaluated in this study. This may be due to a favorable condition created by these medium; as a result of optimum moisture holding capacity enhanced by cow dung and sawdust providing good aeration. This was similarly reported by Urgessa (2011) who worked on seed germination of *Ficus vallischaude* L. He observed significant effects of nutrient media ($p<0.05$) used. Next to control (forest soil); cow dung and a mixture of forest soil, cow dung and sand (3:1:1) resulted in earlier germination of *Ficus vallischaude* L. seeds under laboratory conditions, whereas sand followed by forest soil and a mixture of forest soil, cow dung and sand (3:1:1) resulted in higher germination percentage.

Sawdust + cow dung + topsoil (1:1:3) significantly supported the highest production of leaves at the first and second planting of yellow ficus (Table 5). However, variation in leaves production in the results of both years could be as a result of difference in the planting seasons. Performance of plants in Sawdust + cow dung + topsoil (1:1:3) compared to others in the other growth media in this experiment may be due to the presence of a complementing source of nutrient (cow dung), good aeration made possible by both sawdust and cow dung as well cow dung retaining moisture in the growth media (Urgessa, 2011). Some of the other media that were close in performance in supporting leaves production and other plant characters evaluated as observed in the results had complementary source of nutrients. This was similarly reported by Younis et al. (2010) in the experiment conducted on Croton. Their results indicated that different manures in combination with soil exhibited better results. There was increase in number of leaf buds per plant in the croton plants and was evident after the application of organic residues which provided soil with high nutrients (N, P and K) concentration (Sims, 1990; Sikora and Szmidt, 2001; Riaz et al., 2008; Younis et al., 2008; Albiach et al., 2010). It is of note that organic fertilizer sources such as agricultural by-products, organic waste including dung of dairy cattle, poultry waste and animal litter can be used as main source of essential minerals needed to plants, yellow ficus inclusive (Bilderback, 1982; Riaz et al., 2008; Younis et al., 2008). The organic matter content of a growth medium is known to have a profound effect on its biological, chemical and physical properties (Kambooh, 1984). Hence, the presence of cow dung or poultry manure in the growth media for yellow ficus contributed immensely to its support in better leaves production which is an important agronomic character for a hedge plant.

The presence of sawdust in the medium supporting the highest leaves production in this study serve as aeration material which will not only support easier and early rooting but ensures the ready use of available nutrients in the medium to develop more leaves. It was observed that plants in the medium sawdust + cow dung + topsoil (1:1:3) had faster growth compared with the other growth media considering the growth parameters evaluated in this study. Similarly, Kebebew (2007) in his study on the germination responses of seeds of *Croton macrostachyus* Hocht. Ex Del sown in pots found out that growth media containing red soil, decomposed cow dung and sand in different ratios resulted in significantly ($P< 0.05$) better height growth of seedlings of *Croton macrostachyus* compared to the mixture containing red soil and decomposed cow dung in equal proportions. The results also indicated that the species seedlings grow fast and reach planting stage within 5-6 months if a soil mixture containing red soil,

decomposed cow dung, and sand in equal proportions are used.

Topsoil alone and sawdust + cow dung + topsoil (1:1:3) closely followed by topsoil + cow dung (4:1) and topsoil + poultry manure (4:1) all supported the production of the strongest and most stout branches at first planting (Table 4). However, sawdust + cowdung + topsoil (1:1:3) performed the best at second planting. This could be adduced to the fact that all these media contained complementary nutrients sources thereby supporting the size of the branches i.e. branch girths.

Poor performance of yellow ficus in terms of branch girths in the media cow dung + sawdust (1:4) at both plantings indicated the media's inability to support branch girths for a long time in the nursery (Table 4). Sawdust alone as a medium was found to support longer root lengths but not so good performance and sustained support for the yellow ficus plants in the nursery considering the growth parameters evaluated in this study. This suggests its inability to sustain the yellow ficus plants.

Despite non-significant influence of the media in their support for branches (at 13WAP) and branch lengths of yellow ficus in this experiment, it was observed that the media with a source of nutrient, cow dung or poultry manure with topsoil suggests a positive influence on the ficus plants thereby encouraging branching and better girth sizes.

Conclusion

In consideration of readily available nutrients resources and for good performance in the nursery production of yellow ficus, rooting was best with topsoil alone though sawdust alone encouraged longer roots. According to this study, Topsoil alone was comparable with sawdust + cow dung + topsoil (1:1:3) in support for rooting, survival, vegetative growth, establishment and sustenance of the plants for a good length of time before being sold by the commercial florist nursery men, as bonsai plant and or before transplanting to the field as hedge plants. Therefore, topsoil alone (loamy soil) supports rooting and growth of yellow ficus, however, an additional source of (cow dung or poultry manure) and material for improved aeration (sawdust) will support early and better rooting, establishment and sustenance of yellow ficus. Topsoil + cow dung (4:1) / topsoil + poultry manure (4:1) may be used in raising this ornamental plant as the performance of the plants in these media was fairly stable.

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