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Original Article

Stem cutting, rooting, and shoot growth potentials of some hedge plant species as influenced by number of nodes

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ABSTRACT

Root and shoot initiation, as well as seedling growth after planting a stem cutting, is critical for ensuring seedling establishment. This study was carried out at the Department of Horticulture Nursery, Federal University of Agriculture Abeokuta, Nigeria, to examine early rooting and shoot development of landscape hedge plants during propagation with respect to the number of nodes per cutting. Species used were *Duranta repense* Linn., *Duranta erecta* Linn.,Variegated *Duranta erecta* Linn., *Ficus retusa* Linn., *Ixora coccinea* Linn., *Acalypha inferno* Linn., *Acalypha wilkesiana* Mull. Arg., *Hamelia patense* Jacq., Boungainvillea glabra Wild., and *Alternanthra dentata* Scheygr. Stem cuttings of each of the ten species with 2, 3 and 5 nodes constituted the treatments arranged in Completely Randomized Design with three replicates. Time of root and shoot emergence, rooting percentage observed daily from one day after planting (DAP), number of leaves, seedling height, number of sprouted cuttings were measured weekly from 2 weeks after planting (WAP) and stem girth (at 15cm seedling height) 4 WAP. Fresh root and fresh shoot biomass were measured at 16 WAP. The result revealed that the number of nodes per cutting and the plant species had significant effects on the time to root, shoot initiation, cutting height, and number of leaves, stem girth, fresh root and shoot biomass. *Duranta* species performed best for all of

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parameters while *Bougainvillea glabra* produced the lowest shoot biomass. Days to shoot initiation was not significantly different ($p \leq 0.05$) across the number of nodes for all species, ranging between 8 and 10 days after planting (DAP). Time to root was also similar regardless of the number of nodes across species with all species rooting at a range of 14-28 DAP. All the species used in this study, except *Ficus retusa* can be classified as easy to propagate because of their early root formation and relatively fast shoot initiation, indicating their potential suitability for use as hedge plants.

Keywords: hedge species time of root, shoot initiation, propagation, rooting percentage and days after planting

INTRODUCTION

Hedge plants are important soft landscape elements in floriculture and the landscaping industry. Hedges are the initial elements of landscape design to form a shape. Due to their importance in landscaping, they are irreplaceable for this purpose. They provide aesthetically pleasing landscape features that can have positive benefits for psychological well-being (Mathews et al 2014). The commercial production of hedge plants as a plant nursery business requires good plant propagation skills and methods. A plant has many complex systems that keep it living and growing, including the shoot and root system. The shoot system of a plant includes the leaves, buds, flowering stems, flowering buds as well as the main stem. The shoot is the production center for a plant that gives rise to the stems, leaves and flowers. Therefore, the shoot system is functionally responsible for food production (photosynthesis) and reproduction (Moore et al 1995). One to three lateral buds are usually produced at each node. Stem cuttings are classified based on juvenility or maturity as either softwood, semi-hardwood or hardwood growth (Hartmann et al 2011, Simanjuntak and Wardani 2021). Softwood cuttings from the upper stem and semi-hardwoods can make better roots than those from basal hardwood stems. The basal stem has a thicker diameter in comparison to the upper stem (Soundy et al 2008, Simanjuntak and Wardani 2021). Kraiem et al (2010) stated that the establishment and growth rate of stem cuttings depend on branch age, stem segment position and stem diameter. Stem juvenility or maturity depends on branch age and stem segment position on the branch and it relates to endogenous hormones and nutrition in the stem tissue (Simanjuntak and Wardani 2021). While the upper stem cuttings usually have higher rates of auxin synthesis, less tissue differentiation and are more sensitive to dehydration, the basal stem cuttings have lower levels of endogenous auxin with a greater capacity to provide the necessary reserves of carbohydrate and nitrogen for the formation and growth of roots and shoots (Izadi et al 2016, Pigatto et al 2018, Simanjuntak and Wardani 2021). Identification of a plant species for use in the landscape is predicated on knowledge of the growth-related characteristics of the plant (FFA 2014). It is important for florists and gardeners to be provided with proper knowledge of the rooting and shoot formation of these hedge species to be able to economize on the use of their planting materials. The knowledge and skills of identification of plant organs, which must be used for plant propagation, is of paramount importance for horticulturalists in order to multiply their stocks as per requirements. The objective of this study was to examine the ease of propagation of some hedges and to determine the appropriate number of nodes per stem cutting for each respective species for early root and shoot development during propagation.

MATERIALS AND METHODS

The study was carried out from March to September 2020 at the Department of Horticulture nursery, Federal University of Agriculture Abeokuta, Ogun State, Nigeria. Ten hedge plant species (Figure 1) were used for the study: Green bush (*Duranta repens* Linn., soft wood), Yellow bush (*Duranta erecta* Linn., soft wood), Variegated Golden Duranta (*Duranta erecta* Linn., soft wood), Single ixora (*Ixora coccinea* Linn., semi hard wood), Paper Acalypha (*Acalypha inferno* Linn, soft wood), Copper leaf (*Acalypha wilkesiana* Mull.Arg., soft wood), Yellow ficus (*Ficus retusa* Linn., semi hard wood), Fire bush/Fireworks (*Hamelia patens* Jacq., soft wood), Wild Boungainvillea (*Boungainvillea glabra Wild.* semi-hardwood) and Little Ruby (*Alternanthera dentata Scheygr. soft wood*). The number of nodes per cutting: 2, 3 and 5 was the second factor. Thus, the experimental treatments were hedge plant species and number of nodes per cutting laid out in a Completely Randomized Design (CRD) with three replicates where each replicate contained 150 samples.

Transparent polyethylene pots of size 14.5x13cm were filled with forest top soil and arranged under shade, the soil was watered and stem cuttings of the ten species with 2 nodes, 3 nodes and 5 nodes were obtained from the erect branches of healthy plants already established in the landscape of Federal University of Agriculture, Alabata Road, Abeokuta (715'N, 325'E) Ogun State, South Western Nigeria, for about eleven years. The cuttings were made internodal at a 45° angle using sharp secateurs. Cutting were done at 7am in the morning and were placed in bucket filled with water. All cuttings were planted with an hour after the cuttings were taken after the leaves were remove. One node of each cutting was buried in the soil. Cuttings were raised under the erected 50% shade made of leaves. The nursery activities were watering and weeding.

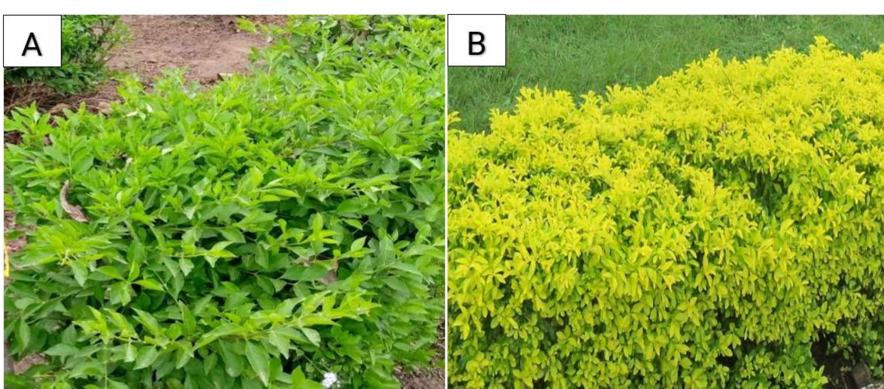

Figure 1. Hedge plant species used (a) *Duranta repens* (b) *Duranta erecta* (c) Variegated *Duranta erecta* (d) *Ixora coccinea* (e) *Acalypha inferno* (f) *Acalypha wilkesiana* (g) *Ficus retusa* (h) *Hamelia patens* (i) *Bougainvillea glabra* (j) *Alternanthera dentata*.

Figure 1. continued

Data Collection

The following parameters were measured: Time of root – observed daily from one day after planting (DAP) and rooting percentage (%) – as calculated by Anu and Radhakrishna (2013) using the formula:

$$Rooting(\%) = \frac{\text{Number of cuttings with root}}{\text{Number of cuttings planted}} x100$$

The number of leaves per seedling – counted weekly from 2 WAP; number of sprouts – counted weekly from 2 WAP weeks after planting; seedling height (cm) – measured weekly from 4 WAP from the soil level to the shoot apex of the plant, using a meter rule; stem girth (cm) – measured weekly from 4 WAP at 15cm seedling height, using a vernier caliper; root length (cm) – measured at 16 WAP using a meter rule and number of roots – counted at 16 WAP ; fresh shoot and root were recorded at 16 WAP using destructive sampling (the plants were removed from the planting bag, soil was washed off and the plant samples were air dried and weighed). Data were analyzed through Analysis of Variance Procedure using R Statistical Package and means were separated using Least Significant Difference, at 5 % probability level.

RESULTS

Time to Root, Number of Roots and Root Length as Influenced by the Number of Nodes and Species

The number of roots produced by cuttings with 2 nodes was approximately 6 roots at 4-12 DAP, while cuttings with 3 and 5 nodes had 8 and 9 roots respectively. The time of rooting was similar among cuttings with 2, 3 and 5 nodes at about 10 DAP. The primary root length of the seedlings raised from 2-node cuttings was on average 5cm , while those from cuttings with 3 and 5 nodes were 7 and 8cm respectively (Table 1). The species significantly differed ($p \leq 0.05$) in time to root as well as number and length of roots. The time of root varied between the plant species, *Acalypha inferno* and *Acalypha wilkesiana* rooted at 8 and 9 DAP, respectively. *Duranta repense and D. repense Golden* rooted at 7 DAP *while D. erecta* rooted at 5 DAP. Other species were in order of *Hamelia patens* < *Alternanthera dentata* < *Bougainvillea glabra* (wild) < *Single ixora*. The number of days to rooting for all species ranged from 5-17 DAP.

The numbers of roots across species at 14 DAP ranged from 5-12 per cutting. The number of roots per species was in the order of *Acalypha inferno* > *Acalypha wilkesiana* > *Duranta repense Golden* > *Hamelia patens* > *Single ixora* > *Alternanthera dentata Ruby* > *Duranta erecta* > *Duranta repense* > *Bougainvillea (wild)*. Root length ranged from 3-13cm per plant in order of *Hamelia patens* < *Duranta repense* < *Duranta erecta* < *Single ixora* < *Bougainvillea (wild)* < *Acalypha wilkesiana* < *Acalypha inferno* < *Duranta repenseGolden* < *Alternanthera dentata Ruby* (Table 2).

Table 1. Days to shoot initiation, number of roots, time to root and root length as affected by species.

Species	Node of First Shoot Emergence	Days to Shoot Initiation	Days to Root	Number of Roots at 16 WAP	Root Length (cm) at 16 WAP
Acalypha inferno	2	28	7.67	12.33	7.81
Acalypha wilkesiana	3	21	9.44	9.44	7.67
Duranta erecta	3	28	4.67	5.89	3.83
Duranta repense	3	21	7.00	5.67	3.32
Duranta repense Golden	3	28	7.00	8.33	8.42
Hamelia patens	2	30	7.33	7.33	3.10
Alternanthera dentata Ruby	3	14	8.56	6.22	13.09
Single ixora	3	28	17.44	6.67	5.27
Bougainvillea graba (wild)	3	35	12.67	4.78	6.86
LSD (≤0.05)	0.69	4.36	3.23	2.05	2.23

Table 2. Node of first shoot emergence, days to shoot initiation, number of roots, time to root and root length, as affected by number of nodes.

Number of Nodes	Node of first shoot Emergence	Days to Shoot initiation	Days to Root	Number of Roots at 16 WAP	Root Length at 16 WAP
2	2	25.89	10.00	5.78	5.01
3	2	25.89	8.89	7.83	6.94
5	4	25.89	8.37	8.52	7.64
LDS (≤0.05)	0.3976	NS	NS	1.186	1.29

Shoot Emergence, days to Shoot Initiation as Influenced by Number of Nodes and Species

Cuttings with 2 and 3 nodes had their first shoot from the second node counting from the base while cuttings with 5 nodes emerged theirs from the fourth node. Days to shoot initiation was not significantly different ($p≤0.05$) between cuttings with different numbers of nodes. Cuttings with 2, 3 and 5 nodes sprouted 26 days after planting (DAP) (Table 1). Plant species significantly differed ($p≤0.05$) in days to shoot emergence and initiation. Days to shoot initiation ranged from 14-35 DAP (Table 2). *Alternanthera dentata Ruby, Acalypha* species (*Acalypha inferno and wilkesiana*) produced their first shoot 14 DAP while shoots of *Duranta erecta and Acalypha wilkesiana* emerged at 21 DAP . *Acalypha inferno, Duranta erecta, Duranta repense and Single ixora* produced their first shoot at 28 DAP. The longest time for first shoot emergence was recorded at 30 and 35 DAP for *Hamelia patens and Bougainvillea graba* respectively (Table 2). Days to shoot initiation were thus in order of *Alternanthera dentata Ruby*> *Duranta repense* > *Acalypha wilkesiana* > *Acalypha inferno* > *Duranta repense Golden* > *Duranta erecta* > *Single ixora* > *Hamelia patens* > *Bougainvillea graba* (Table 2).

Cutting Height as Influenced by Number of Nodes per Cutting and Species

Seedling height was significantly affected ($p \leq 0.05$) by the number of nodes per cutting (Figure 1a). Stem cuttings with 5 nodes gave the highest cutting height among the species followed by cuttings with 3 nodes. Cutting height among the species significantly differed ($p \leq 0.05$) at all sampling times (Figure 1b). *Alternanthera dentata* seedlings were significantly taller than other species throughout the sampling period, followed by *Acalypha inferno*, *Duranta erecta*, *Duranta repense*, *Duranta repense golden*, *Single ixora*, *Bougainvillea graba* and *Hamelia patens* in that order. *Hamelia patens* had the shortest cuttings throughout the sampling period (Figure 1b). At 16 WAP, cutting height ranged between 5-15cm across species.

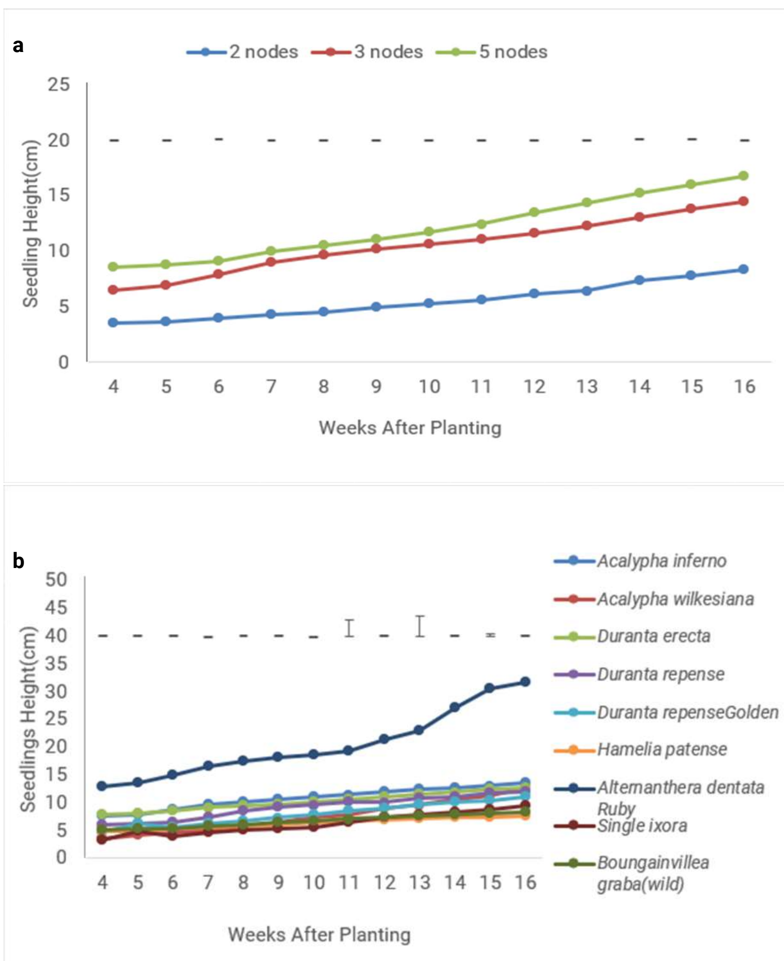

Figure 1. Cutting Height as Affected by (a) Number of nodes per cutting (b) Hedge plant species

Number of Leaves as Influenced by Number of Nodes per Cutting and Species

The number of leaves per cutting raised from cuttings with 3 and 5 nodes was significantly higher than those from cuttings with 2 nodes (Figure 2a) throughout the period of observation. Figure 2b shows the number of leaves as affected by species. There were significant differences ($p \leq 0.05$) in the number of leaves per cutting among the species. *Alternanthera dentata* showed a significantly higher number of leaves than every other species throughout the period of observation. This was followed by *Duranta erecta*. The least in leaf production was *Boungainvillea glabra* (wild). *Acalypha wilkesiana* had a high number of leaves at the early stage but this remained the same from 6-11 WAP and then started increasing from 12 through 16 WAP.

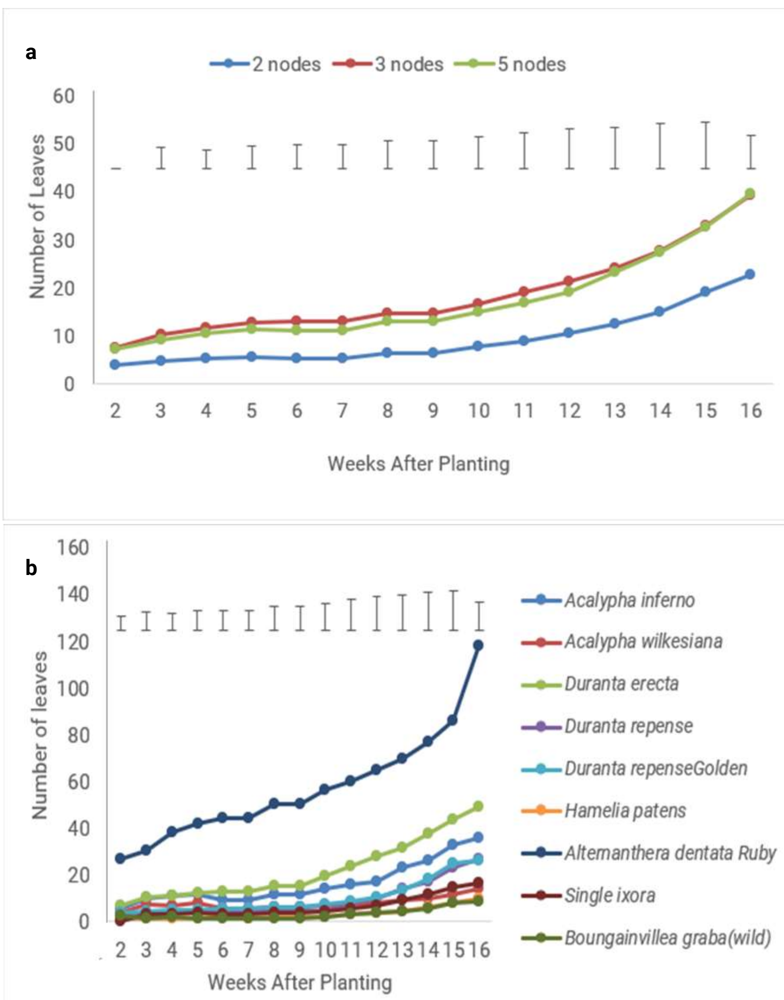

Figure 2. Number of leaves as influenced by (a) Number of nodes per cutting (b) Species

Stem Girth (cm) as Influenced by the Number of Nodes per Cutting and Species

Stem girth at 4 WAP was significantly affected ($p \leq 0.05$) by the number of nodes per cutting. The stem girth of plants from cuttings with 5 and 3 nodes was significantly higher than those with 2 nodes from 4-11 WAP (Figure 3a). Stem girth was also significantly ($p \leq 0.05$) affected by hedge plant species. Stem girth of *Acalypha wilkesiana* and *Alternanthera dentata* was significantly wider than the other species. The stem girth of *Acalypha wilkesiana* was higher than all other species from 11-16 WAP. All other species had low value of stem girth compared to *Acalypha wilkesiana* and *Alternanthera dentata* throughout the observation period. *Duranata repense* showed the smallest stem girth throughout the observation period (Figure 3b).

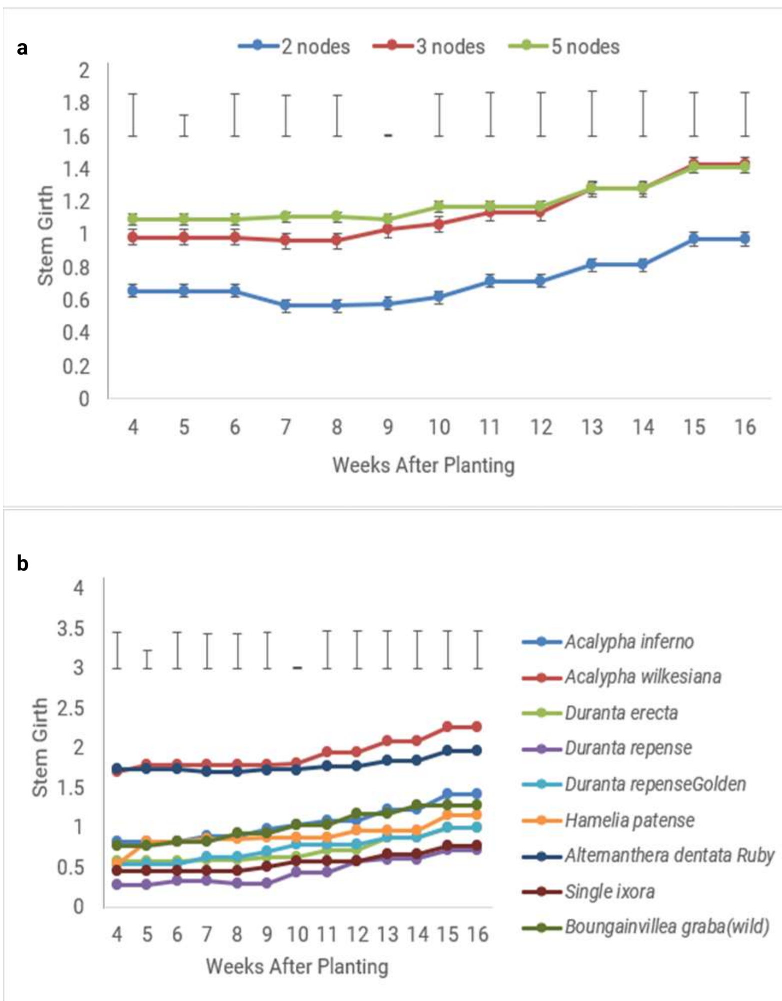

Figure 3. Stem Girth (cm) as affected by (a) Number of nodes per cutting (b) Hedge species

Fresh Root and Shoot Biomass as Influenced by Number of Nodes and Hedge Species

Fresh root biomass was significantly affected ($p \leq 0.05$) by the number of nodes per cutting. Cuttings with 5 nodes had the highest fresh root biomass followed by those with 3 nodes while the least was recorded from cuttings with 2 nodes (Table 3). Likewise, cutting fresh shoot biomass was significantly affected ($p \leq 0.05$) by the number of nodes per cutting (Table 3). The fresh shoot biomass of the cuttings with 3 and 5 nodes was significantly higher than that of 2 nodes throughout the experimental period. Fresh shoot biomass based on the number of nodes per cutting was in the order of 5 nodes cutting >3 nodes cutting >2 nodes cutting. The fresh shoot biomass ranged from 2.74g to 5.39g across the period of observation.

Table 3. Root and Shoot Biomass (g) at 16 WAP as influenced by number of nodes

Number of Nodes	Root Biomass	Shoot Biomass
2	2.93	2.74
3	3.38	3.27
5	4.4	5.39
LDS (≤0.05)	1.38	2.58

Hedge plant species were significantly different ($p \leq 0.05$) in cutting fresh shoot biomass (Table 4) in the order of *Alternanthera dentata* > *Acalypha wilkesiana*> *Duranta repense* > *Single ixora* > *Duranta repenseGolden*> *Hamelia patens* > *Duranta erecta*> *Acalypha inferno* > *Bougainvillea*. While fresh Shoot biomass of the hedge species were in order of *Alternanthera dentata* > *Single ixora* > *Acalypha wilkesiana*> *Duranta erecta*> *Acalypha inferno* > *Duranta repense Golden*> *Duranta repense*> *Bougainvillea*> *Hamelia patens*. Hedge plant species with 2 and 3 nodes both had equal shoot biomass at the time of observation. *Alternanthera dentata* showed the highest shoot biomass at all the times observed. This was followed by the remaining species except *Hamelia patens* which showed the lowest shoot biomass. There was no significant difference in the shoot biomass of *Acalyha inferno, Acalypha Wilkesiana, Duranta erecta, Duranta repense, Duranta repense Golden, Single ixora and Bougainvillea graba*.

Table 4. Root and Shoot Biomass (g) at 16 WAP as influenced by hedge species

Species	Root biomass	Shoot biomass
Acalypha inferno	1.48	2.31
Acalypha wilkesiana	3.46	3.7
Duranta erecta	1.52	2.39
Duranta repense	3.3	1.96
Duranta repense Golden	1.81	2.15
Hamelia patens	1.63	1.7
Alternanthera dentata Ruby	16.75	12.72
Single ixora	1.86	5.31
Bougainvillea graba (wild)	0.31	1.95
LSD (≤0.05)	3.74	3.74

Cutting Height as Affected by Interaction of Number of Nodes per Cutting and Hedge Plant Species

The interaction of number of nodes per cutting and hedge plant species was significant ($p \leq 0.05$) (Table 5). Hedge plant species height with 2 nodes per cutting were in the order of *Alternanthera dentata Ruby > Acalypha wilkesiana > Acalypha inferno > Duranta repense Golden > Single ixora > Duranta repense > Duranta erecta > Hamelia patens> Bougainvillea glabra* (wild). The height of cuttings with 3 nodes were in the order of *Alternanthera dentata Ruby > Acalypha inferno > Duranta erecta > Hamelia patens> Bougainvillea graba (wild) > Single ixora > Duranta repense Golden > Acalypha wilkesiana* from 4-16 WAP (Table 5). Cuttings with 5 nodes had Alternanthera *dentata Ruby* as the tallest followed by *Duranta erecta > Bougainvillea graba (wild) > Hamelia patens > Duranta repense Golden> Acalypha inferno > Duranta repense > Single ixora > Acalypha wilkesiana* from 4-16 WAP (Table 5).

Table 5. Interaction of number of nodes per cutting and hedge species on cutting height (cm)

Species	Weeks After Planting											
	4			8			12			16		
	Number of Nodes											
	2	3	5	2	3	5	2	3	5	2	3	5
Acalypha inferno	3.5	11.0	8.4	4.7	14.4	10.9	6.4	16.6	12.8	8.0	18.1	14.6
Acalypha wilkesiana	4.0	3.0	3.6	5.2	6.6	5.5	9.1	8.8	8.9	12.0	11.0	15.0
Duranta erecta	2.1	9.1	12.2	2.4	12.0	13.6	6.4	13.7	16.2	4.3	15.0	18.7
Duranta repense	2.1	9.0	6.9	2.5	14.5	8.2	3.3	17.3	9.3	4.3	20.7	16.6
Duranta repense Golden	2.2	3.1	8.7	3.3	6.3	10.1	5.6	8.7	12.6	6.3	12.0	14.6
Hamelia patense	1.1	4.3	9.0	1.43	5.3	10.3	2.0	6.3	12.1	2.5	7.0	13.0
Alternanthera dentata Ruby	13.5	11.2	14.0	17.0	17.1	18.0	19.5	19.7	25.0	30.0	30.0	35.0
Single ixora	2.2	3.5	4.0	3.0	5.0	6.8	3.7	6.8	11.3	4.5	9.0	15.0
Boungainvillea graba(wild)	1.1	4.3	9.8	1.5	5.5	10.9	2.5	6.4	13.0	3.0	7.1	14.5
LSD (≤0.05)		0.14			0.04		0.15				0.09	

DISCUSSION

Non-significant differences in the number of days to shoot initiation among cuttings with different numbers of nodes suggests that the number of nodes in a stem cutting has nothing to do with the sprouting. However, there were significant differences between days to shoot initiation among the plant species, *Acalypha species* was the first to sprout followed by *Duranta species* while *Bougainvillea* glabra was the last. *Duranta species, Acalypha species*, *Hamelia paten and*

Alternanthera dentata performed best in terms of days to shoot initiation and rooting compared to Single Ixora and *Bougainvillea*. This shows their property as easy to propagate hedge plants with early rooting and shoot initiation. *Ficus retusa,* which was supposed to be the tenth species, did not sprout at all during the period of the experiment supporting the report by Odusanya et al (2019) who observed that a greater percentage of the yellow *Ficus* stem cuttings either did not root on time or died out during propagation in the nursery. The report by Ibrahim (2007) that the percentages of rooting of *Ficus* cuttings tended to be very low is also in line with this study. First shoot initiation at the second node from the base for cuttings with 2 and 3 nodes showed that the active buds that contained reserve carbohydrates to support the new shoot were located at the lower nodes, whereas, in cuttings with 5 nodes, the active buds were found at the upper node. The time to root was similar across number of nodes per cutting but differed across species, with a range of 14-28 DAP and this supports the report of Karimi et al (2012) that species and cultivars had a significant effect on all rooting parameters. The increase in number of roots and root length as the node number per cutting increased was in line with Ky-Dembele et al (2011), Adugna et al (2015) and Yesuf et al (2021) who observed that the number of roots increased with the increase in node number of cuttings and previous studies also stated that it may be due to larger cuttings storing more carbohydrates (Tchoundjeu and Leakey 1996, Yesuf et al 2021) and that root growth is dependent on carbohydrates reserves in the stem (Yesuf et al 2021). KA (2010); Umesha et al (2011) and Hailemichael et al (2012) also reported that root initiation is faster and more vigorous in three to five node cuttings. This shows that an increase in node number per cutting will increase root number and length. This may be because as the number of nodes increases the auxin influences as a plant growth regulator increases (Solikin 2018). Simanjuntak and Wardani (2021) reported that early growth of cuttings is indicated by callus appearance at the wound and when a callus is formed, auxins accumulate at the callus (Ditengou et al 2008) and this differentiates into cells to form roots. Increases in the root length could also be due to the cutting type which ranged from softwood to semi-hard wood. As reported by Simanjuntak and Wardani (2021) semi-hardwood cuttings yielded the longest roots, followed by softwood.

According to Hailemichael (2012), a good quality cutting is one that is as tall as possible and possesses the largest diameter as possible with a good number of leaves. The significant effect of the number of nodes per cutting on the plant height and girth shows that the number of nodes on a cutting would determine the girth and height of the cuttings during growth. This shows that the number of nodes per cutting has a relationship with plantlet development in terms of height and girth. This is supported by Solikin (2018) who revealed that top stem cuttings that had a greater number of nodes compared to middle and base stem cuttings resulted in taller plants. Stem girth was significantly affected ($p \leq 0.05$) by hedge plant species. The stem girth of *Acalypha wilkesiana* and *Alternanthera dentata* was significantly wider than all other species supporting the report of Odusanya et al (2019) that there were significant differences in the stem girth of species propagated across the sampling period with the widest girth observed from the cuttings of *Acalypha wilkesiana* while *Duranta repens* showed the smallest stem girth throughout the observation period. The differences among the hedge species' stem girth were because of their genetic differences. This is supported by Kendal et al (2008) and Hitchmough (2004) that there can be genetic diversity in plants when propagated from cuttings and that this can occur through morphological differences such as different leaf size and foliage colour characteristics,and physiological differences such as different habits (erect or spreading) and vigour.

The higher rate of leaf production in cuttings with 3 and 5 nodes shows that the number of nodes per cutting may relate to leaf production because of higher auxin level. This agrees with Yesuf et al (2021) who observed that the reported number of leaves produced by cuttings with three nodes was higher than cuttings with one or two nodes and explained that it could be due to the longer cutting having more carbohydrate accumulation which helps in the early growth of the seedlings. The significant effects of the number of nodes on root and shoot fresh biomass alignes with Adugna et al (2015) who reported maximum root weight from 5 node cuttings. Adugna et al (2015) explained that plants with long cuttings would produce longer roots and this could provide the plant with deeper penetration for a greater capacity for water and nutrient absorption leading to heavier root fresh weight.

CONCLUSION

The number of nodes per cutting plays a prominent role in all the growth parameters taken except days to shoot and root initiation. Species used in this study except *Ficus retusa* can be easily propagated in the nursery because of their early root formation, relatively early sprouting and survival rate, thus indicating the potential suitability for raising cuttings of hedge plants at a commercial level in floriculture and the landscape industry. It is also desirable to domesticate some wild species with ornamental properties as found in the species *Alternanthera dentata* used in this study.

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AUTHOR CONTRIBUTIONS

OCO: conceptualized and designed the study for her Undergraduate and Postgraduate Diploma students. She's the initiator and correspondent of the manuscript.

UC and FDO: carried out the research as part of the requirements for their Degree of Post graduate Diploma and Bachelor of Agriculture, respectively.

AOI: is the biostatistician who analyzed the data collected for the research work.

BJG: contributed by critically reviewing the entire work and adding important intellectual content.

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AVAILABILITY OF DATA AND MATERIALS

Data generated during the study are included in this article and available from the corresponding author upon request.

ETHICAL CONSIDERATION

This study was carried out on human being or animal, therefore, was no need for ethical approval.

COMPETING INTEREST

The authors declare that they have no conflict of interest.

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