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# Improving Regeneration of The Endangered Millettia Laurentii De Wild: Effect of The Substrate, Leaf Area, Auxin and Leaf Fertilizer on The Rooting Ability of Stem Cuttings

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***Abstract***

*Vegetative propagation of tropical tree species through cuttings is an important alternative for mass multiplication of high-quality species for large-scale reforestation programs. In this way, multiplication of Millettia laurentii through cuttings is an asset for improving the cultivation and regeneration of this endangered species for its conservation. It is in this order of ideas that a nursery study was carried out to assess the effect of substrate, leaf area, auxin and leaf fertilizer on the ability of rooting under non-mist propagator. This equipment is designed to maintain a humid environment and reduce water loss through transpiration and evaporation. The non-mist propagator is a wooden box of 3 m long by 1 m high which consists of three equal-dimension compartments. The experimental setup consisted as follow; Test 1: combined effect of leaf area and type of substrate on rooting of stem cuttings; Test 2: combined effect of foliar fertilizer and rhizogenic hormone treatments. The parameters for evaluation were: mortality rate, rooting rate and average number of roots. The data collected were edited in Excel 2010 software. Subsequently, they were subjected to analysis of variance using the software IBM SPSS 20, general linear multivariate model. Means were separated using the smallest significant difference. The chosen probability threshold was 5%. The results of propagation tests show that rooting ability is significantly influenced by leaf area and auxin concentration. Cuttings with a leaf area of 100 cm² had the best rooting rate, 88.89%. Application of various concentrations of the growth hormone produced significant positive effects on the rooting rate and the number of roots produced. The most effective propagation factors were the leaf area (100 cm²) and the 100-µg concentration of Indole-3-butyric acid (IBA). The results of this study are of great interest in improving propagation for sustainable cultivation and regeneration of this threatened tree as well as the conservation of forests for it allows the development of appropriate and efficient propagation methods for mass production of high-quality plant material for this species.*

**Keywords:** Millettia Laurentii, Endangered, Cuttings, Rooting, Conservation.

## Introduction

Millettia laurentii from its commercial name 'wenge' is a species of the Fabaceae family, characteristic of dense humid semi-deciduous forests and whose distribution area is very restricted in the Congo Basin [1]. The natural distribution of M. laurentii extends from southern Cameroon, eastern Equatorial Guinea and Gabon to the western parts of the Central African Republic and the Democratic Republic of Congo [2]. In Cameroon, M. laurentii is found in the far south of the country, particularly in the areas of Ma'an, Ebolowa, Sangmélima, Ambam, also in the east, more precisely in the Ngoko-Sangha confluence [3]. Well known for its dark brown wood veined with black and finely streaked, Wenge is one of the main species in the wood industry because its wood is very popular for cabinetmaking and veneer. Wenge is also used in the manufacture of massive furniture, shop fittings, interior decoration, railway construction, sculpture, engraving, wood turning, etc. [1]. As a result, this species is particularly appreciated by forest operators for its economic value and is therefore overexploited. The report of the regional workshop on the conservation status of Bubinga and Wengué species from 2012 indicates that the FOB (Free on Board) price of a wenge log is estimated at 104,720 FCFA/m³. Between 2008 and 2012, a total of 1972 m³ volume of Wenge wood was exported from the port of Douala [4]. In addition, Millettia laurentii is classified as endangered on the IUCN red list because it is overexploited and also because of the degradation of its habitat. The main problem that arises is the alarming reduction in the number of individuals species in its natural environment. Until now, very few measures have been taken to ensure the conservation and sustainable management of this species. Faced with this threat of extinction, it is absolutely necessary to take effective actions to ensure the long-term regeneration of Wenge. M. laurentii propagates by seed. However, (assert that M. laurentii is facing a deficit in natural regeneration due to the destruction of its habitat and the overexploitation of wood [5]. These different pressures are at the origin of the constant decrease in its distribution area.

In this regard, it is essential to create new alternative sources of supply of this species which will meet the needs of local populations in the long term in order to reduce the pressures weighing on it and guarantee its regeneration. The vegetative propagation of tropical species such as wenge by the stem cutting technique is an important alternative for the mass multiplication of very high-quality species for large-scale reforestation programs [6]. Rooting cuttings is a type of vegetative propagation which involves stimulating root initiation on a piece of leaf, root or stem of a plant by placing it in suitable conditions such as the no-misting propagator developed by Leakey [6]. This propagation option has already been developed on several agroforestry tree species, namely Dacryodes edulis, Baillonella toxisperma and Allanblackia floribunda [7-9]. The three authors showed that the three species were suitable for cuttings with success rates of around 95%. The objective of this work was therefore to determine the most effective propagation factors to ensure the regeneration of the species by cuttings. Specifically, the aim is to determine the effect of the type of substrate, hormonal application, leaf surface area and foliar fertilizer on the rooting ability of M. laurentii.

## Materials and Methods

### Description of the Stem Cuttings Collection Site

The cuttings were taken from the cutting park of the National Forestry Development Support Agency (ANAFOR), located in Oyack in the town of Mbalmayo department of Nyong and So'o, Central region. This park has the geographical coordinates of 3°29.8' north latitude and 11°30.1' east longitude. The site is characterized by a bimodal Guinean climate with an average annual rainfall of between 1600 and 1700 mm divided into two rainy seasons: the rainy seasons go from March to June and from September to November. The two dry seasons are from December to February and from July to August [10]. A study by Sarlin (1968 in Foahom, 1983) on soil types makes it possible to distinguish four types of soil, namely hydromorphic soils, leached gray soils, clayey soils and gravelly soils.

### Description of the Study Site and the Non-Mist Propagator

The cutting tests took place in the World Agroforestry (ICRAF) nursery in Nkolbisson, a locality in Yaoundé and whose coordinates are 03° 51.976' N and 011° 27.670' E (Ambassa-Kiki, 2000). This site is part of the low altitude humid forest zone which is located between 600 and 800 m above the sea [11]. The climate is subequatorial, Congo-Guinean type, with two dry seasons alternating with two rainy seasons. The average rainfall varies between 1500 and 2000 mm over 10 months. The average annual temperature is relatively constant (around 23 to 27°C). The relative and average humidity is above 80% (Moundingo, 2007).

The cuttings were handled in a shed covered with corrugated sheets and transparent sheets which retain 60% of the sun's rays. The propagation device called non-mist propagator or poly-propagator is an equipment designed to maintain a humid environment to reduce water loss through transpiration and evaporation. The non-mist propagator is a wooden box 3 m long and 1 m high divided into three equal compartments. When installing the non-mist propagator, we carefully examine the horizontality and planimetry of the ground in order to ensure the sharing of the water table present in each block of the non-mist propagator. The bottom of the non-mist propagator is covered with a triple layer of plastic (hard and in good condition) to create a pool. The base of the non-mist propagator has a thickness of 30 cm and is made up of several layers: the first layer from the buttom poccess a thickness of 10 cm and is made up of rubble. This layer of rubble rests below a thin layer of fine sand; this layer of fine sand prevents perforation or tearing of the plastic. A 20 cm long pipe marked on its half with paint or a point is placed on an angle of the rubble layer. The second layer consists of gravel with a thickness of 10 cm. At this point, water can be poured up to the level of the gravel but then the water level should not go beyond the gravel layer. The third layer consists of 10 cm of the rooting substrate. The rest of the non-mist propagator is surrounded with transparent plastic which will be carefully attached to the non-mist propagator with thumbtacks. The final step in installing the non-mist propagator involves covering the covers of the three compartments with transparent plastic. The system thus described makes it possible to create a permanently humid environment (humidity level > 80%), and light favourable to the good development of the cuttings [6].

### Collection and Management of Cuttings

The cuttings were taken around 9:30 a.m. using pruning shears in the ANAFOR wood yard in Mbalmayo, from juvenile stems approximately 8 months old, and apparently healthy. The cuttings taken were then placed in a polyethylene collection bag (white on the outside and black on the inside) and watered with clean water, so that they were kept in conditions of humidity and more or less stable temperature. This is to limit perspiration. Once in the greenhouse, the cuttings were taken from the bag in small quantities and introduced into a container filled with water, then the rest still in the collection bag was kept in a closed non-mist propagator.

The cuttings were cut with a scalpel blade so as to have a circular base and an oblique top. Leaf areas were determined using templates cut from Millettia laurentii leaves and graph paper. The lengths of the cuttings varied between 3 and 5 cm in length.

**Experimental Apparatus**

**Trial 1: Combined Effect of Leaf Area and Substrate type on Rooting of Stem Cuttings**

Two factors were studied in this trial: the type of substrate and the leaf area.

Three types of substrate were tested: (1) river sand, (2) decomposed sawdust, (3) mixture of river sand and decomposed sawdust (50:50). The different leaf areas were 0 $cm^2$, 50 $cm^2$, 100 $cm^2$ obtained from templates cut on cardboard using graph paper. The experimental design was composed of three completely randomized blocks. In each block, there were two factors tested, namely the substrate (main factor) and the leaf area (secondary factor). The experimental unit was the cutting and the number of treatments was 9 (3 substrates * 3 leaf surfaces). The number of cuttings per treatment was 10. A total of 270 cuttings were therefore used for this test (9*10*3).

**Trial 2: Combined effect of Foliar Fertilizer and Rhizogenic Hormone Treatments**

Two factors were studied in this trial: the type of foliar fertilizer and the hormonal concentration. Concerning the foliar fertilizer, three doses of foliar fertilizer (NPK 20-20-20) were applied, namely: 0g, 3g and 6g. To obtain these different doses of fertilizer, a Denver APX-60 brand precision balance was used for weighing. Then, these doses were diluted separately in 0.70 l bottles containing tap water. The diluted fertilizer solutions were shaken and sprayed onto the leaves of the cuttings following the experimental protocol.

As for hormones, three levels of hormonal Indole Butyric Acid (IBA) treatments were highlighted in this experiment: 50 µg, 100 µg and the control (without hormones). The Denver APX-60 precision balance was used to weigh 50 mg and 100 mg of IBA powder. The weighing having been carried out, these different doses were subsequently diluted separately in 10 ml of alcohol and then introduced into the syringes. These solutions were applied to the base of the cuttings following the established experimental protocol. The experimental setup was arranged in three blocks. In each block, there were two factors tested, namely foliar fertilizer and rhizogenic hormone. The experimental unit was 10 cuttings and the number of treatments was 9 (3 hormonal concentrations * 3 doses of foliar fertilizer). The number of cuttings per treatment was 10. A total of 270 cuttings were used for this test (9*10*3). The distribution of treatments was done randomly.

**Cutting Management and Data Collection**

These tests were set up on January 28, 2019. Every morning between 7:00 a.m. and 9:00 a.m. (before sunrise), the non-mist propagator was opened, dead leaves were collected in order to limit infections, the water level was checked in order to readjust if necessary, the mist deposited on the plastic was cleaned with a clean sponge to facilitate the entry of sunlight into the interior of the non-mist propagator, spraying the leaves with water using a sprayer.

The evaluation was carried out every two weeks. It consisted of first carefully removing each cutting to avoid traumatizing the root initiation, then checking the base if it was rooted. A cutting was said to be rooted when it had a root of at least 1cm. The unrooted cuttings were put back in the non-mist propagator and those which had been able to develop roots were put in the pots containing black soil then placed in the non-mist propagator.

The evaluations focused on the following morphological parameters: rooted cutting, number of roots per rooted cutting and dead cutting. During the evaluation, the rooted or dead cutting was recorded by the number 1 and the unrooted and alive cutting was represented by the number 0. When the cutting was rooted, the number of roots was counted.

**Analysis of Cutting Data**

The data collected during this study were entered in Excel 2010. Subsequently, they were subjected to an analysis of variance using the IBM SPSS 20 software, general linear multivariate model. Means were separated using the smallest significant difference. The probability threshold chosen was 5%.

## Results and Discussion

**Combined Effect of Substrate and Leaf Surface on the Rooting of Wedge cuttings**

**Combined Effect of Substrate and Leaf Area on Rooting Rate**

**Effect of substrate on rooting rate**

Over the entire period of the test, the substrate does not influence ($p = 0.179 > 0.05$) on rooting. Rooting of the cuttings started from the second week and continued until the 10th week. From the 4th to the 8th week, the rooting rate increased from 44.44% to 54.44% in the sawdust substrate. Whereas, this rooting rate increases from 5.55% to 54.44% in the 6th week and subsequently becomes constant in the sand substrate. At the end of the 2nd week, the sawdust sand mixture does not produce any roots. But from the 4th week to the 8th week, the rooting rate varies between 41.11% and 56.67% in the sawdust-sand substrate and subsequently becomes constant. Despite the fact that the substrate did not significantly influence the rooting rate, the best rooting rate was recorded in the sand-sawdust substrate. The sand-sawdust mixture makes it possible to obtain a high rooting percentage and number of roots per cutting.

**Effect of Leaf Area on Rooting Rate**

The influence of the leaf surface of the cuttings on their rooting is perceptible from the second week after cultivation. In the second week, the rooting rate is not influenced by leaf area. On the other hand, at the end of the 4th, 6th, 8th and 10th week, the rooting rate is highly significantly influenced by the leaf area ($P < 0.001$). The percentage of rooted cuttings varies between 0 (2nd week) and 3.33% (10th week) for leafless cuttings (0 $cm^2$). At the same time, the percentage of rooted cuttings varies between 4.44% and 73.33% for cuttings of 50 $cm^2$ while the percentage of rooted cuttings varies between 4.44% and 88.89% for cuttings with a Leaf area of 100 $cm^2$ (Figure 1).

According to the Mann-Whitney U test between the influences of leaf surfaces 0 and 50 $cm^2$ on rooting, we observe that these impacts differently on rooting in a highly significant way because P value $0.00 < 0.01$ of the 4th to the 10th week. The same is true for leaf area 0 and 100 cm². On the other hand, for surfaces of 50 and 100 cm² these have an insignificant impact on rooting over the entire period of the test. The larger the leaf surface area, the better the rooting rate. Cuttings with a leaf area of 100 cm² obtained the best rooting rate of 88.89%. This indicates that the leaf area 100 cm² can be recommended for cuttings of Wenge.

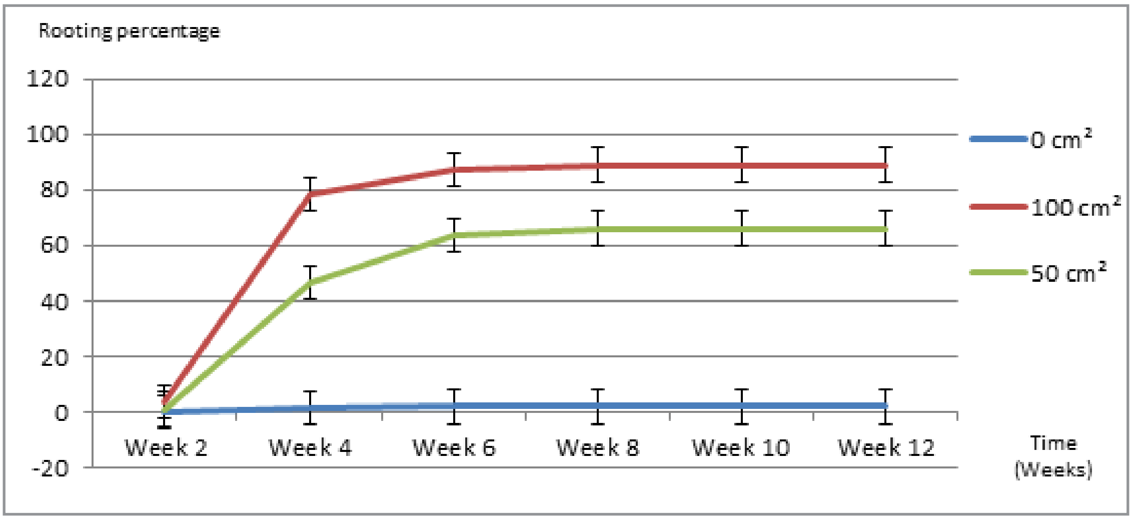


**Figure 1:** Evolution of the influence of leaf surface on rooting

**Combined Effect of Leaf Area and Substrate Type Treatments on Rooting**

The combination of leaf area and substrate type treatments did not have a significant influence on the rooting of 'Wenge' cuttings.

**Combined Effect of Substrate and Leaf Area on Mortality Rate**

**Effect of substrate on mortality rate**

According to the Kruskal Wallis test, we observe that the type of substrate does not significantly influence the mortality rate over the entire period of the test because $p > 0.05$. The values 37.78%, 42.2% and 38.89% are the mortality rates recorded at the tenth week respectively in the sawdust, sand and sawdust – sand mixture substrates. However, the best survival rate is recorded in the sawdust substrate followed by the sand-sawdust substrate (mixture) and finally the sand substrate.

**Effect of Leaf Area on Mortality Rate**

During the first two weeks, no mortality is observed in the cuttings whatever the leaf surface. The influence of leaf surface area on the survival of the cuttings shows from the fourth week a significant difference between the mortality percentages in the different treatments (0, 50, 100 cm²). The percentage of dead cuttings ranges from 2.22% in the 4th week to 8.89% in the 10th week with the leaf area 100 cm². With the leaf surface area of 50 cm², the mortality rate ranges from 2.22% during the 4th week to 16.67% at the end of the 10th week. However, with the leaf surface area 0 cm² the mortality rate ranges from 57.78% after the 4th week to 93.33% after the 10th week. The very high mortality rate among leafless cuttings could be explained by the fact that no photosynthesis process is noted, nor that of auxin biosynthesis, which limits the rhizogenesis process. The larger the leaf surface area, the lower the mortality rate. The leaf surface area of 100 cm² is recommended for the conservation of cuttings.

**Combined Effect of Substrate and Leaf Area on Mortality Rate**

The combination of leaf surface area and substrate type did not have a significant effect on the mortality rate over the entire trial period ($p > 0.05$).

**Combined Effect of Substrate and Leaf Surface on the Average Number of Roots**

**Influence of the Substrate on the Average Number of Roots**

Over the entire period of the experiment, the substrate did not significantly influence the average number of roots. In other words, the average number of roots does not differ from one substrate to another. Rooting of the cuttings began from the 2nd week after establishment of the cuttings and continued until the 8th week regardless of the substrate used. At the end of the second week, the sawdust + sand mixture produces no rooting and therefore no roots; however, the average number of roots per cutting varied from 4.5 to 6 from the 4th to the 10th week. In the sawdust substrate, the average number of roots per cutting varied from 0.1 to 5.6 from the 2nd to the 10th week. In the sand substrate, the average number of roots varied from 0.37 to 4.6 roots from the 2nd to the 10th week. It appears that the sawdust – sand mixture recorded the highest average number of roots per cutting, i.e. 6 roots followed by sawdust with an average number of 5.6 and finally 4.6 for sand.

**Influence of Leaf Area on Average Number of Roots**

At the second week, leaf surface area had no significant influence on root number. This could be because roots form slowly. However, from the 4th to the 10th week, the number of roots varied highly significantly depending on the leaf area ($P < 0.001$). For cuttings with a leaf area of 0 cm², the total number of roots from week four to week ten is 3. For cuttings with a leaf area of 50 cm², the total number of roots varies between 138 and 166 of the 2nd week to 8th week (Figure 2). For cuttings with a leaf area of 100 cm², the total number of roots varied between 235 and 268 from week four to week eight. The disparity observed would be induced by cuttings having a leaf surface area equal to 0 cm². A significant number of deaths of these leafless cuttings were recorded from the 4th week. From all these observations, it appears that the number of roots per cutting increases with the leaf surface area. Further analysis with the Duncan Multiple Range Test shows that among the three leaf areas, the 100 cm² leaf area provides the greatest number of roots followed by the 50 cm² leaf area while the 0 cm² leaf area is the less efficient. Thus, we recommend the leaf surface area of 100 cm² for cuttings of Wenge. Frame

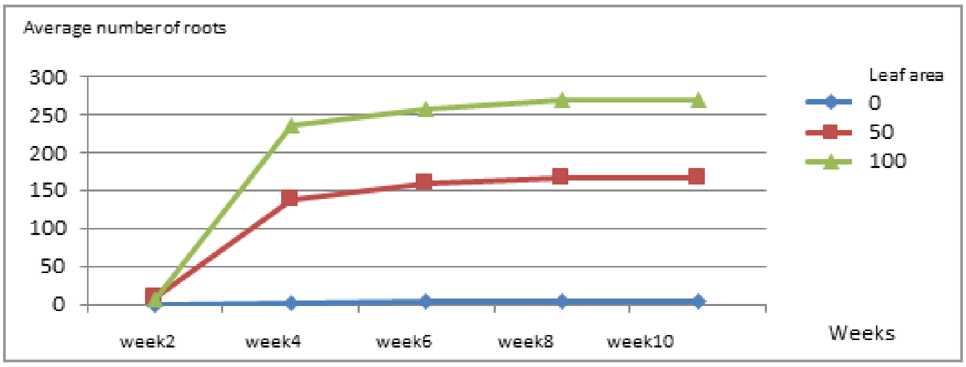


**Figure 2:** Evolution of the number of roots depending on the leaf area

For the leaf area 0 cm² we observe a very low number of roots. This observation clearly informs us that without leaf surface there is no rooting. We note that the number of roots increases considerably from the 2nd week to the 4th week to reach the number of 138 roots in the 4th week for the leaf surface area 50 cm². It then increases slightly uniformly to reach the value of 166 in the 8th week. Concerning the leaf surface area 100 cm², the number of roots increases suddenly from the 2nd to the 4th week to reach the value of 235 roots; thereafter, it increases slightly uniformly to reach the value of 268 at the end of the 8th week, from which point the number of roots becomes constant. The following information emerges from this graph: rooting only occurs in the presence of a portion of leaf; the larger the leaf surface, the greater the number of roots formed; For the species used, 8 weeks are enough to have the maximum number of roots. Thus, after the 8th week, the cuttings are ready for potting because at this time the maximum number of roots has formed.

**Combined Effect of Leaf Area and Substrate Type on Average Root Number**

We note that the interaction of leaf area and type of substrate has no significant effect on the number of roots over the entire period of the test ($p > 0.05$).

**Combined Effect of Hormonal Application and Foliar Fertilizer Application on the rooting of Wenge Cuttings**

**Combined effect of Hormonal Application and Foliar Fertilizer Application on Rooting Rate**

**Effect of Hormonal on Rooting Rate**

Auxins increase the rooting rate of cuttings of many plant species. As shown in Figure 3 below, we see that Wenge cuttings root with or without application of IBA, rhizogenesis hormone. At the end of the second week, no rooting was observed on the control cuttings. On the other hand, we note a rooting rate of 2.2% and 11.11% respectively for the cuttings treated with 50 and 100 µg of hormone at the end of the second week. In addition, we note that from the fourth to the twelfth week the rooting rate of hormonal cuttings remained significantly higher than non-hormonated cuttings. At the end of the experiment, the percentage of rooted cuttings was 66.67% for the cuttings treated with 100 µg of hormone and 46.33% for the cuttings treated with 50 µg of hormone. On the other hand, the rooting rate of cuttings not treated with the hormone (control cuttings) remained very low with a value of 27.78% at the end of the experiment. The higher the concentration of the hormone, the greater the rooting over the entire period of the test because the rooting rate is higher with cuttings treated with IBA compared to untreated cuttings. Analysis of the response of cuttings to increasing IBA shows that throughout the experiment, the dose of auxin that provides optimal rooting is 100µg.

Rooting varies depending on hormonal concentrations. Thus, according to the Mann-Whitney U test between concentrations o and 50 µg on the one hand and between 50 and 100 µg on the other hand, there is no difference in action. In other words, we see that the two concentrations taken in pairs impact rooting in a non-significant way ($p > 0.01$). According to this same test, we observe that concentrations 0 and 100 µg significantly impact rooting.

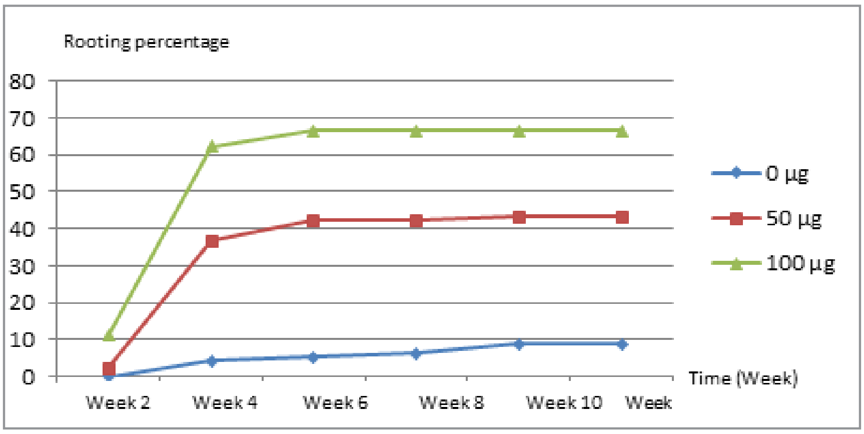


**Figure 3:** Evolution of rooting depending on hormonal application

**Effect of Foliar Fertilizer on Rooting Rate**
The application of foliar fertilizers did not have a significant effect on the rooting rate over the entire trial period (p> 0.05).

**Combined Effect of Hormonal Application and Foliar Fertilizer Application on Rooting**
The hormone and foliar fertilizer interaction did not have a significant effect on rooting (P>0.05).

**Combined Effect of Hormonal Application and Foliar Fertilizer Application on Mortality Rate**
**Effect of Hormonal Application on Mortality Rate**
The application of the IBA did not have a significant effect on the mortality rate. The mortality rate of cuttings treated with IBA concentration 100 µg varied from 0% in the second week to 33.33% in the twelfth week. The mortality rate for cuttings treated with IBA 50 µg ranged from 0% in the second week to 58.89% in the twelfth week. However, the mortality rate of cuttings that were not treated with the hormone ranged from 0% to 72.22%. It emerges from these observations that cuttings treated with different concentrations of auxin recorded a lower mortality rate compared to cuttings which had not received treatment. It is noted that the application of IBA at high concentrations made it possible to have a low mortality rate. This result suggests that IBA improved the survival of wenge cuttings.

**Effect of Foliar Fertilizer on Mortality Rate**
The application of foliar fertilizer did not have a significant effect on the mortality rate over the entire trial period.

**Combined Effect of Hormonal and Foliar Fertilizer on Mortality Rate**
The interaction between auxin and foliar fertilizer had a significant effect on mortality (p<0.05). However, the application of these factors taken individually has no significant effect on mortality while, by combining them, we observe a significant effect on the mortality rate. The high level of mortality could be explained by the fact that the combination of these two factors proved toxic to Wenge cuttings.

**Combined Effect of Hormonal Application and Foliar Fertilizer Application on Average Root Number**
**Effect of Hormonal Application on Root Number**
According to the analysis of variances, we see that the hormonal application has a highly significant influence on the number of roots. On the cuttings having received the 100 µg treatment, the average number of roots varies between 5.2 and 4.45 roots per cutting from the 2nd to the 12th week. For cuttings that received 50 µg, the average number of roots varied between 1 and 2.82 roots per cutting from the 2nd to the 12th week (figure 4). At the same time, for cuttings that did not receive treatment, the average number of roots varied between 0.2 and 1.68 roots. These results show that the application of IBA made it possible to have a high number of roots per cutting.

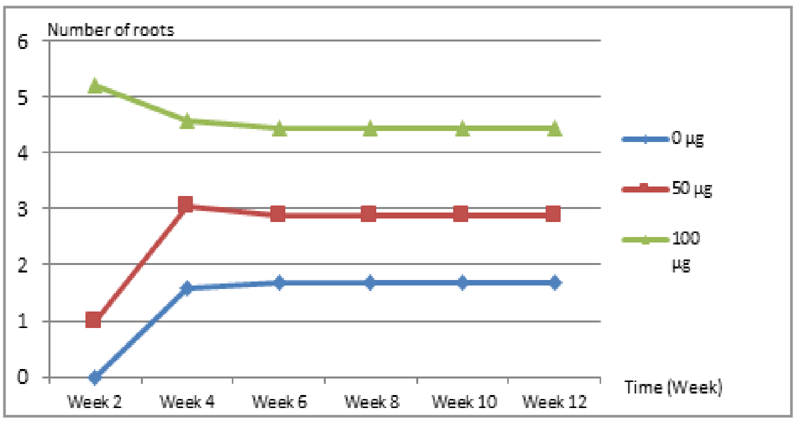


**Figure 4:** Evolution of the number of roots depending on hormonal concentrations

#### Effect of Foliar Fertilizer on Average Root Number

The application of foliar fertilizers did not have a significant effect on the number of roots over the entire trial period (P> 0.05).

#### Combined Effect of Hormone and Foliar Fertilizer on Average Root Number

The hormone and foliar fertilizer interaction did not have a significant effect on root number (P> 0.05).

## Discussion

This study is the very first to describe the rooting ability of M. laurentii. Our study showed that leaf area and rooting hormone treatments had significant effects on rooting rate. Concerning the leaf area, the percentage of rooted cuttings was 73.33% for cuttings with a leaf area of 50 cm² while cuttings with a leaf area of 100 cm2 obtained a rooting percentage of 88.89%. . These results show that the 100 cm2 leaf surface is the best for rooting cuttings of this species under propagation non-mist propagator. It made it possible to obtain a high number of roots. However, leafless cuttings of the species had almost zero rooting percentage and degenerated during the trial. Indeed, the rooting rate and the average number of roots per leafy cutting increases up to an optimal surface area beyond which any increase in leaf surface area becomes unfavourable for rooting. A similar behaviour was obtained in Vitex doniana where the highest rooting rates, namely 65.57 and 58.9%, were recorded respectively in leaf surface cuttings 234 and 183 cm2 [12]. It follows from these observations that cuttings with a reduced leaf surface area behave better than those with entire leaves because the reduction in leaf surface area makes it possible to limit water stress while ensuring good photosynthesis. This explains the importance of optimal leaf surface area which promotes a balance between photosynthesis and losses due to water stress caused by transpiration. Thus, given the fact that the optimal leaf area does not emerge in the context of this work, additional studies consisting of increasing the leaf area appear to be necessary.

The application of the hormone (IBA) had a significant effect on the rooting percentage of cuttings of this species. At the end of the experiment, the percentage of rooted cuttings was 66.67% for cuttings treated with 100 µg of hormone and 46.33% for cuttings treated with 50 µg of hormone. On the other hand, the rooting rate of cuttings not treated with the hormone (control cuttings) remained low with a value of 27.78% at the end of the experiment. These observations show that the 100 µg concentration is the best for rooting cuttings of this species. Similar behaviour has been reported in Garcinia kola [13]. This author reports that IBA treatment showed a significant effect on the rooting parameters of Garcinia kola cuttings under the non-mist propagator. In addition, the IBA made it possible to have a high number of roots per cutting in the context of our work. Similar results were obtained on Vitex doniana who found that the average number of roots increased significantly in cuttings treated with IBA [12]. Since the requirements of cuttings relating to the quantity and quality of auxin applied vary with the species, it would be necessary to add the concentrations of this hormone in the framework of complementary studies. From the same perspective, it would be wise to study the interaction of IBA and Naphthalene Acetic Acid to know if this combination is favourable to rooting or not [14-20].


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