Plant
2023; 11(1): 21-26
http://www.sciencepublishinggroup.com/j/plant
doi: 10.11648/j.plant.20231101.13
ISSN: 2331-0669 (Print); ISSN: 2331-0677 (Online)

Effect of Covering Mode and Substrate on the Rooting of Marcots of *Anacardium occidentale* L. in the Sahelian Zone (Maroua, Cameroon)

Jacques Dominant Beyo[1], Baye-Niwah Claudette[1], Fawa Guidawa[2, *], Oumarou Haman Zéphirin[3]

[1]High Teacher's Training College, The University of Maroua, Maroua, Cameroon
[2]Faculty of Sciences, The University of Ngaoundéré, Ngaoundéré, Cameroon
[3]Faculty of Sciences, The University of Bamenda, Bamenda, Cameroon

Email address:
fawaguidawa@gmail.com (Fawa Guidawa)
[*]Corresponding author

To cite this article:
Jacques Dominant Beyo, Baye-Niwah Claudette, Fawa Guidawa, Oumarou Haman Zéphirin. Effect of Covering Mode and Substrate on the Rooting of Marcots of *Anacardium occidentale* L. in the Sahelian Zone (Maroua, Cameroon). *Plant.* Vol. 11, No. 1, 2023, pp. 21-26.
doi: 10.11648/j.plant.20231101.13

Received: January 30, 2023; **Accepted**: March 1, 2023; **Published**: March 9, 2023

Abstract: *Anacardium occidentale* is one of the most popular fruit trees in the dry tropics. Unfortunately, several genotypes of this species face the problem of productivity and low variability. The objective of this study is to contribute to the improvement of the agronomic potential of *Anacardium occidentale* by aerial layering in Diamaré. Specifically, the effect of the covering mode and the substrate on the rooting of marcots were evaluated. The work consisted in carrying out a 7 cm girdling on orthotropic branches having a diameter ranging from 2.54 to 5.73cm, and then sleeves were laid. Three substrates were used: sawdust previously decomposed, sawdust/black soil mixture (in the proportion One-half) and black soil. The mantles were covered with aluminum foil and polyethane plastic. The experimental design used was a split plot with three replications. The substrate constituted the main treatment, the covering mode, the sub- treatment. The experimental unit was 15 marcots. The rooting rate ranged from 98.88±2.24% in marcots covered with aluminium foil to 99.44±1.66% in those covered with plastic. As for the substrate, it varied from 98.33±2.58% for the substrate composed of black soil to 100% for the sawdust/black soil mixture. No significant difference was recorded between the modes of covering ($P \geq 0.05$) and also for the substrates ($P \geq 0.05$). However Root length ranged significantly ($p \leq 0.01$) from 49.6±13.32mm in sawdust to 72.5±23.39mm in black soil. All treatments were satisfactorily. *A. occidentale* shows good aerial layering ability. These results are useful in the process of improvement the productivity of this species.

Keywords: *Anacardium occidentale*, Vegetative Propagation, Aerial Layering, Sahelian Zone

1. Introduction

Anacardium occidentale or cashew apple tree native of the Caribbean and northeastern Brazil is among the fruit trees valued by people in dry tropical areas [1]. It is a species with high socio-economic potential. All parts of the plant are used. The false fruit called the cashew apple is formed of sour and sweet-sour flesh. It is very juicy and very rich in vitamin C. It is used to make fruit juices, vinegar, wine, alcohol and jams [2]. Despite the importance of this species, it presents a diversified genotypes and is often marked by weak agronomic performances. This poor performance is justified by the absence of any varietal selection for agronomic purposes and this reality is common to most cashew orchards in Africa [3]. One of the major constraints related to cashew productivity would be genetic [4]. Therefore, there is a need to propagate genotypes with good agronomic potential and produce the best false fruits and fruits.

Propagation of woody plants by sexual means remains the most common mode of propagation [5]. However, this mode of propagation is evolutionary and does not retain parental traits. Vegetative propagation is a faster and lower-cost alternative. It produces clones identical to the mother tree [6].

In Africa, little works have been done on the vegetative propagation of *Anacardium occidentale*. The present work was initiated to fill this gap. The general objective of this study is to contribute to the improvement of agronomic potential of *Anacardium occidentale* by aerial layering in Diamaré (Far North Cameroon).

2. Material and Methods

2.1. Presentation of the Study Area

The study was conducted in Diamare (Figure 1), one of the six departments of the Far North region, in the city of Maroua (Far North Cameroon). On-station work took place at the agricultural farm of the Regional College of Agriculture for the laying of marcots and the French school "Boukarous" for acclimatization. The Far North is one of the ten regions of Cameroon bordered by Chad and Nigeria, with the city of Maroua as the chief town of the Diamare division. It comprises six departments: Diamaré (Maroua), Mayo Sava (Mora), Logone et Chari (Kousseri), Mayo Tsanaga (Mokolo), Mayo Kani (Kaélé) and Mayo Danay (Yagoua). This region has an area of 3.424.600 ha with a population of approximately 3.480.414 inhabitants and a density of 101.6 inhabitants/km^2 [7]. Agriculture is therefore the main activity practised by the people of the Far North. The location of this region on the shores of Lake Chad gives it a hot and dry climate, with average annual temperatures ranging between 25°C and 30°C [8]. Annual rainfall is concentrated for the most part over 4 to 5 months from June to October with a maximum observed in August [9].

Vegetation remains highly influenced by populations. In the Far North region, on the clay soils of the plains, a thorny savanna develops that is highly anthropized for off-season crops [10]. This vegetation is characterized by the following species: *Acacia gerrardii, A. nilotica, A. polyacantha, A. seyal, A. senegal, Anogeissus leiocarpa, Azadirachta indica, Balanites aegyptiaca, Boswellia dalzielii, Bridelia ferruginea, Combretum collinum, C. glutinosum, C. molle, Dichrostachys cinerea, Daniellia oliveri, Gardenia aqualla, G. erubescens, Guiera senegalensis, Maytenus senegalensis, Piliostigma reticulatum, P. thonningii, Prosopis africana, Sclerocarya birrea, Strychnos spinosa, Vitellaria paradoxa, Vitex madiensis, Ziziphus mauritiana,* etc. In the thorny steppes meet the species such as *Acacia* spp., *Balanites aegyptiaca* et *Zizphus* spp. [11].

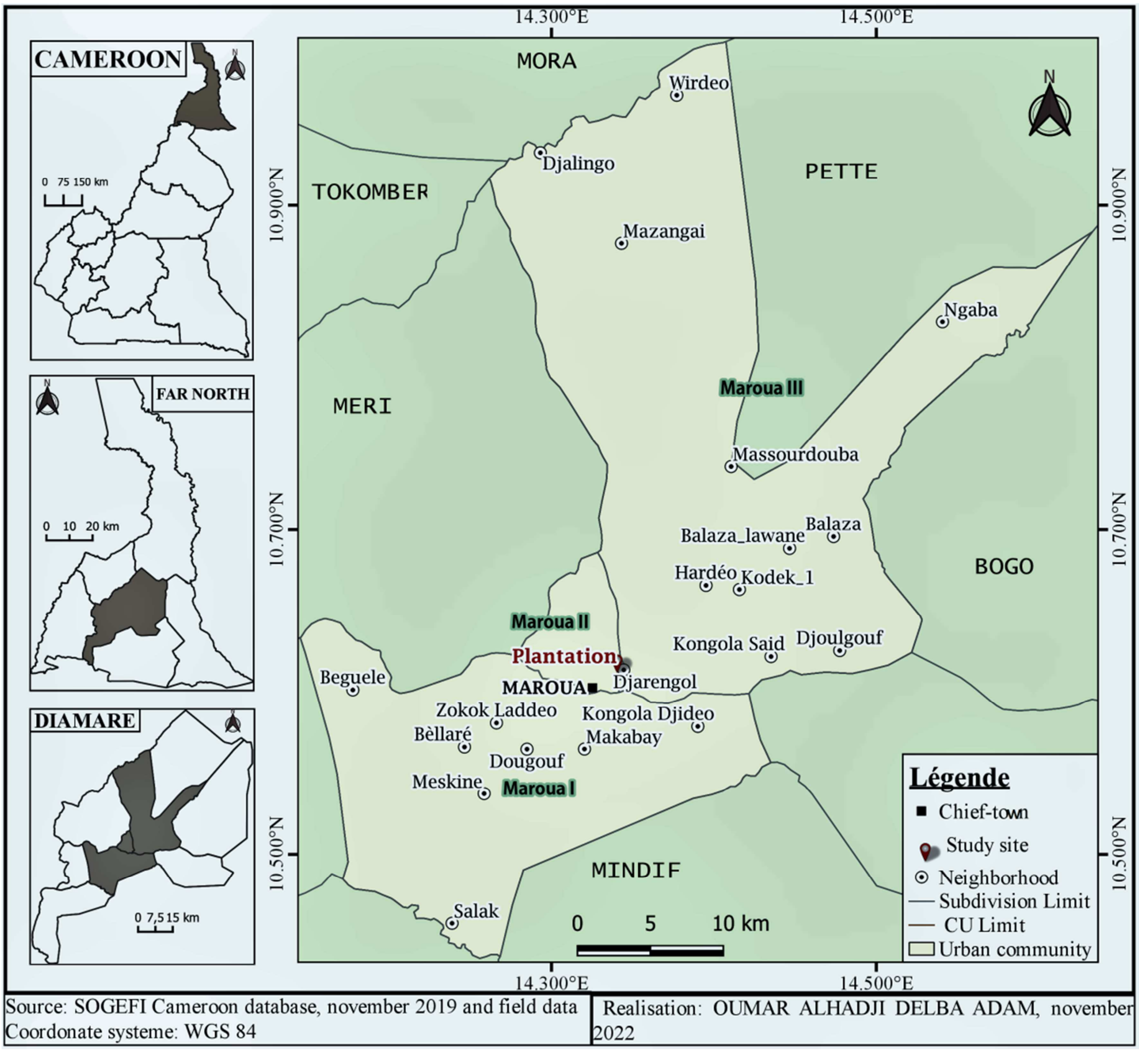

Figure 1. *Location of the study site.*

2.2. Methodology

The installation of the sheaths took place in August 2021. Using a sharp knife, rings were made on orthotropic branches whose diameter range between 2.54 cm and 5.73 cm. Branch girdling consisted of removing the bark over a length of 07 cm [12-13]. Then the cambium was well scraped and the bast removed to stop the flow of downward elaborated sap. The substrate bead was held around the incised area with clear polyethene film and securely taped at the ends. One-half of the sheaths of each substrate was covered with aluminium foil (Figure 2) which was tightly bound at the ends to protect the Marcots from excessive temperatures [14]. The following inscriptions are made on the sleeves: date, nature of the substrate and repetition. Three substrates were used: sawdust, sawdust/black soil mixture in the proportions 1/2 and black soil. The trial was visited monthly and data collection started in September 2022 and lasted 5 months. It continued monthly. Watering of the sleeves was done with a syringe.

a b

Figure 2. *Marcot covered with aluminium foil (a); Marcot covered with polyethan (b).*

The rooted marcots were weaned 5 months after their installation; then transferred to the nursery for acclimatization. The acclimatization consisted in putting them in pots of dimension 24 X 12 cm with arable substrate and then they were introduced in the propagator of re-education for five weeks; they were taken out to spend three weeks under the shed of propagation before being transferred in field.

The experimental design was a split plot with three replicates. The main treatment is the substrate and the cover mode the secondary treatment. The experimental unit consisted of 15 cores. A total of 270 pellets (15 x 3 x 3 x 2) were laid.

The collected data were subjected to analysis of variance with Statgraphic 5.0. The Excel spreadsheet of Microsoft Office 2013 allowed us to draw the curves.

3. Results

3.1. Effect of Cover on Rooting of the Marcots

Rooting started 30 days after the installation of the Marcots. For both coverings, it evolved until day 90 and then stabilized at the fourth month (120 days). The cores were densely rooted (Figure 3).

Figure 3. *Rooted marcot.*

120 days after test placement, rooting rates ranged from 98.88±2.24% in foil-covered marcots to 99.44±1.66% in plastic-covered marcots (Figure 4). Analysis of variance revealed no significant difference between exposure modes (0.5744 ≥ 0.05).

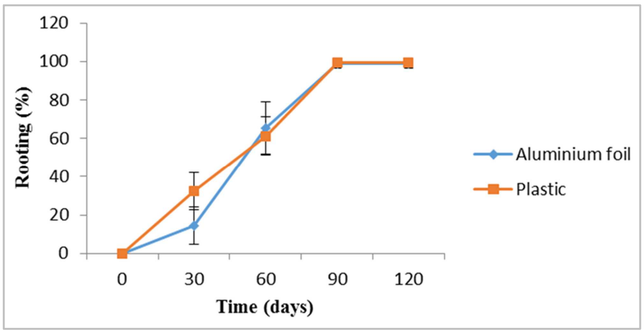

Figure 4. *Rooting rate of marcots as a function of time.*

3.2. Influence of the Substrate on the Rooting of the Marcots

Irrespective of the substrate used, the marcots rooted very well. The rooting rate increased until the 90th day for all the substrates and stabilized thereafter. Next to 120 days rooting ranged from 98.33±2.58% for the black soil to 100% for the sawdust/black soil mixture (Figure 5). No significant difference is recorded between substrates (0.3966 ≥ 0.05).

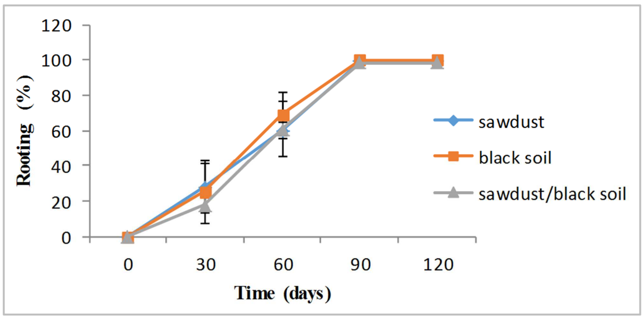

Figure 5. *Rooting among the substrate as a function of time.*

*3.3. Interaction of Coverings Modes*Substrates on Rooting of Marcots*

120 days after marcots settlement, rooting rates ranged from 98.33±2.88% for foil-covered sawdust, foil-covered black soil, and plastic-covered black soil to 100% for plastic-covered sawdust, foil-covered sawdust/black soil mixture, and plastic-covered sawdust/black soil mixture (Table 1). Analysis of variance indicated no significant difference (0.7230 ≥ 0.05).

Table 1. *Rooting rates according to the interaction of cover and substrate.*

Traitements	Sawdust	Black soil	Sawdust/blacksoil	Means
Aluminium foil	98.33±2.88	98.33±2.88	100	98.88±2.24
Plastic	100	98.33±2.88	100	99.44±1.66
Means	99.16±2.04	98.33±2.58	100	99.16±1.92

3.4. Effect of Covering Mode on Rooting Parameters of Marcots

Root numbers ranged from 18.8±15.91 in marcots covered with plastic to 22.76±20.01 in those covered with aluminium foil (Table 2). Analysis of variance indicated no significant difference (0.3963 ≥ 0.05).

Root length ranged from 60.36±18.32 mm in plastic-covered marcots to 62.8±24.86 mm in aluminium foil-covered marcots (Table 2). No significant difference is recorded (0.6376 ≥ 0.05).

Table 2. *Effect of covering mode on rooting parameters of marcots.*

Covering mode	Number of roots	Length of roots (mm)
Aluminium	22.76±20.01	62.8±24.86
Plastic	18.8±15.91	60.36±18.32
Means	20.78±18.03	61.58±21.68

3.5. Effect of Substrate on Rooting Parameters of Marcots

Concerning substrate, the number of roots ranged from 16.45±13.93 in the black soil to 25.15±20.06 in the black soil/sawdust mixture (Table 3). Analysis of variance revealed no significant difference (0.3174 ≥ 0.05).

Root length ranged significantly (0.0026 ≤ 0.01) from 49.6±13.32 mm in sawdust to 72.5±23.39 mm in black soil (Table 3).

Table 3. *Influence of substrate on rooting parameters of marcots.*

Substrates	Numbers of roots	Lenght of roots (mm)
Sawdust	20.75±19.32	49.6±13.32a
Blacksoil	16.45±13.93	72.5±23.39b
Black soil/sawdust	25.15±20.06	62.65±21.38b
Means	20.78±18.03	61.58±21.68

Means in the same column followed by the same letter are statistically identical (p ≤ 0.05)

*3.6. Effect of Covering Mode*Substrate Interaction on Rooting Parameters of Marcots*

The number of roots varied from 14.1±6.44 in the black soil covered with aluminum foil to 31.5±20.11 in the blacksoil/sawdust mixture covered with aluminum foil (Table 4). Despite this variation, analysis of variance did not reveal a significant difference (0.3174 ≥ 0.05).

Table 4. *Cover mode*substrate interaction on root number.*

Treatments	Sawdust	Blacksoil	Blacksoil/sawdust	Means
Aluminium	22.7±25.98	14.1±6.44	31.5±20.11	22.76±20.01
Plastic	18.8±10.22	18.8±18.86	18.8±18.86	18.8±15.92
Means	20.75±19.32	16.45±13.93	25.15±20.06	20.78±18.03

Roots lengths varied from 49.5±11,16 mm in sawdust covered by plastic to 79.2±26.01 mm in black soil covered by aluminium foil. (Table 5). Despite this variation, no significant diference was observed. (0.2882 ≥ 0,05).

Table 5. *Root length by mode of cover*substrate interaction.*

Treatments	Sawdust	Blacksoil	blacksoil/sawdust	Means
Aluminium	49.7±15.81	79.2±26.01	59.5±23.74	62.8±24.86
Plastic	49.5±11.16	65.8±19.48	65.8±19.48	60.36±18.32
Means	49.6±13.32	72.5±23.39	62.65±21.38	61.58±21.68

The marcots are weaned and placed in pots for acclimatization (Figure 6). They will then be reintroduced into the farmers production systems.

Figure 6. *Weaned marcots in pots and placed for acclimatization.*

4. Discussion

Aerial layering applied to *Anacardium occidentale* was one of the cloning techniques that responded favourably in a short time frame. Rooting started 25 days after the marcots were placed. In Burkina Faso on *Sclerocarya birrea*, rooting started 40 days after the marcots were placed [15]. In other species, roots appear little later, as in the case of *Coula edulis* in Gabon, where rooting was observed 120 days after the installation [16]. The rooting process of the marcots is influenced by the combination of endogenous and exogenous factors among which the period of marcotte laying, the substrates type, the diameter of the branches, the sleeves covering mode, the use of growth regulators or not etc [17, 18, 19, 14, 20];

According to reference [21], covering the marcottes with aluminium foil improves the rooting of the sleeves. In the present work, both modes of covering the sleeves gave satisfactory results. The trial was initiated during the rainy season, which shows that moderate solar radiation does not harm the rooting process of the marcots of this Anacardiaceae.

Sawdust, black soil/sawdust mixture and black soil used in the present study optimized the rooting rate of the marcots. Indeed, these substrates maintain moisture around the ring, facilitate the circulation of oxygen and water and therefore are conducive to the rooting of the marcots of *Anacardium occidentale*. During photosynthesis, there is an accumulation of carbohydrates and auxins in the part above the ring band. These products of photosynthesis thus activate rhizogenesis in the presence of moist substrates [22]. Reference [19] on *Cola nitida* in Congo Brazzaville reports that black soil is the best rooting substrate compared to peat and compost. Reference [23] shows that sphagnum moss is a good substrate for rooting aerial marcots of *Argania spinosa*. In the same logic, [24] showed that sphagnum moss is the best rooting substrate for aerial layering of *Vitellaria paradoxa*. In the Guinean savannahs highlands of Adamaoua Cameroon, the same trend was observed on *Berlinia grandiflora*. Sphagnum moss was found to be a better rooting substrate for marcots than sawdust, black soil and black soil/sawdust mixture [20].

The length of neoformed roots was significant in the black soil. This substrate would retain more moisture. At 120 days after marcots placement, root development was considered sufficient and then followed by weaning. The high root production of the marcots is an asset in the process of transplanting clones into farmers production systems [16].

5. Conclusion

Anacardium occidentale solicited for its false fruit and kernel has a good aptitude for aerial layering in the Sahelian zone. Sawdust, black soil/sawdust mixture and black soil used as well as covering the marcots with plastic and aluminium foil revealed satisfactory rooting rates. Covering the sheath with aluminium foil improved the number and length of roots as did the black soil substrate and the black soil/sawdust mixture. Layering is one of the inexpensive techniques for obtaining clones from genotypes with characteristics desired by farmers. In the future, it would be desirable to monitor the evolution of clones in the field.

References

[1] Ndiaye S., Charahabil M. M. et Diatta M. (2017). Caractérisation des Plantations à base d'anacardier (*Anacardium occidentale* L.) dans le Balantacounda: cas des communes de Kaour, Goudomp et Djibanar (Casamance/Sénégal). *European Scientific Journal*, 13: 242-257.

[2] Arbonnier M. (2000). *Arbres, arbustes et lianes des zones sèches d'Afrique de l'Ouest*. CIRAD/MNHN/UICN. 539 p.

[3] Aliyu O. M. and Awopetu J. A. (2005). In vitro regeneration of hybrid plantlets of cashew (*Anacardium occidentale* L.) through embryo culture. *African Journal of Biotechnology*, 4 (6): 548-553.

[4] Horea J. K., Murmu D. K., hattopadhyay N. et Alam K. (2015). Evaluation of Cashew Germplasms in West Bengal. In Acta Hort., 1080: 135-142. DOI: 10.17660/ActaHortic.2015.1080.15.

[5] Meunier Q., Bellefontaine R. et Monteuuis O. (2008). La multiplication végétative d'arbres et arbustes médicinaux au bénéfice des communautés rurales d'Ouganda. *Bois et Forêts des Tropiques*, 295 (2): 71-82.

[6] Hannah J. et Jan B. (2003). La multiplication des ligneux en agroforesterie. Manuel de formation et bibliographie. ICRAF, Nairobi, 142 p.

[7] Ministère de l'Administration Territoriale et de la Décentralisation (MINATD) (2010). Enquête agricole au Cameroun. Manuel d'instruction aux agents recenseurs, forme, 45 p.

[8] Wafo G. T., et Fotsing J. M. (2008). Les aires protégées de l'Extrême-Nord Cameroun entre politiques de conservation et pratiques locales. Sciences de l'Homme et Société. Université d'Orléans. Français. pp. 12-96.

[9] Abib F. C., Ibrahima A., Ntoupka M., Tapsou J. M., Harmand J. M., Thaler P., Peltier R., et Dreyer E. (2016). Valorisation inter-provenance de la production de gomme arabique par *Acacia Senegal* (L.) Will en relation avec la croissance des arbres et l'efficience d'utilisation de l'eau. *Afrique science,* 12 (2): 135-150.

[10] Donfack P. (1998). Végétation des jachères du Nord Cameroun: typologie, diversité, dynamique et production. Thèse de Doctorat d'État, Université de Yaoundé 1, Cameroun, 270 p.

[11] Letouzey R. (1985). Domaine sahélien et domaine soudanien. Notice de la Carte Phytogéographique du Cameroun. IRA: Toulouse, pp. 1-26.

[12] Bellefontaine R., Malagnoux M. et Ichaou A. (2012). Techniques forestières et innovations dans les opérations de reboisement. In: La Grande Muraille Verte. Capitalisation des Recherches et Valorisation des Savoirs Locaux, Dia A, Duponnois TR (eds.). I.R.D.: Marseille: 433-469.

[13] Nguema Ndoutoumou P., Ondo-Azi A. S., Mbeang Beyeme A. M., Ondo Ovono P., Ignanga Ignanga A. W. et Campa C. (2013). Essais de propagation de *Pseudospondias microcarpa* A. Rich. dans les conditions climatiques de Franceville (Sud-Est du Gabon). *Biosciences Proceedings*, 19: 131-137.

[14] Noubissié Tchiagam J. B., Nzié J. P., Bellefontaine R. et Mapongmetsem P. M. (2011). Multiplication végétative de *Balanites aegyptiaca* (L.) del., *Diospyros mespilimiformis* Hochst. Ex. A. Rich. et *Sclerocarya birrea* (A. Rich.) Hochst. Au nord Cameroun. *Fruits*, 66: 1-16.

[15] Zida W. A. (2009). Étude de la régénération de *Balanites aegyptiaca* (L.) Del., *Sclerocarya birrea* (A. Rich.) Hochst. et de *Diospyros mespiliformis* Hochst. ex. A. Rich., Université, Polytechnique de Bobo Dioulasso, Mémoire, Burkina Faso.

[16] Moupela C., Doucet J., Kasso D., Meunier Q. et Vermeulen C. (2013). Essais de propagation par semis et marcottage aérien de *Coula edulis* Baill. et perspectives pour sa domestication. *Bois et forêts des tropiques*, 318 (4): 3-4.

[17] Hartmann H. T., Kester D. E., Davis F. T. and Geneve R. L. (2002). Plant Propagation: Principles and Practices, 7th edn. Prentice Hall, Upper Saddle River, New Jersey, 880 pp.

[18] Harivel A., Bellefontaine R. et Boly O. (2006). Aptitude à la multiplication végétative de huit espèces forestières d'intérêt au Burkina Faso. *Bois et Forêts des Tropiques,* 288 (2): 39-50.

[19] Mbete P., Makosso S., Lelou B., Douh C. et Ngokaka C. (2011). Essai de multiplication végétative du colatier (*Cola nitida*) via la technique du marcottage au Congo Brazzaville. *Journal of Applied Biosciences,* 37: 2485-2490.

[20] Kouojip Nganjouong J., Tsoubou R., Guidawa Fawa, Oumarou Z., Loura B. et Mapongmetsem P. M. (2022). Multiplication vegetative de *Berlinia grandiflora* par marcottage aérien dans les hautes savanes guinéennes de l'Adamaoua, Cameroun. *Afrique Science*, 21 (3): 15-27.

[21] Bellefontaine R., Ferradous A., Alifriqui M., Bouzoubâa Z., Ky-Dembélé C. et Nsibi R. (2011). Multiplication végétative d'arganiers par greffes, drageons et boutures de segments racinaires. *Actes du 1er Congrès International sur l'arganier,* Agadir. 9p.

[22] Rabechault H. et Cambony H. (1964). Physiologie des plantes tropicales cultivées. I (1): 30.

[23] Bellefontaine R. (2010). De la multiplication à l'amélioration variétale de l'argania (*Argania spinosa* L. Skeels). *Sécheresse*, 21 (1): 42-53.

[24] Yeboah J., Banful B. K. B., Boateng P. Y., Amoah M. F., Maolekuu B. K. et Lowor S. T. (2014). Rooting response of air layered shea (*Vitellaria paradoxa*) trees to media and hormonal application under two different climatic conditions. *American Journal of plant Sciences,* 5: 1212-1219.