International Research Journal of Plant Science (ISSN: 2141-5447) Vol. 5(2) pp. 30-36, June, 2014
DOI: http:/dx.doi.org/10.14303/irjps.2014.022
Available online http://www.interesjournals.org/IRJPS

Full Length Research Paper

Root suckering of *Lophira lanceolata* Van Tiegh.ex Keay (Ochnaceae) in the Guinean Savannah Highlands of Cameroon

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Abstract

***Lophira lanceolata* is a multipurpose tree species (MPTS) valued by the populations for its various uses. In the Guinean Savannah Highlands of Cameroon, this species is threatened due to human pressure which affects its regeneration potential. In order to contribute to its domestication, the present work characterizes its natural regeneration and artificial root suckering aptitude. Survey was carried out on 20 square plots of 1ha each established in savannah to evaluate relative frequency of adult trees which produced suckers. Artificial root suckering induction trials by simple wound and by complete sectioning were undertaking on superficial roots in the study period (April-January 2012) on 176 adult trees of different ages. An inventory of 824 trees of *L. lanceolata* was carried out among which 98 mother -trees kept 147 natural suckers. For the artificial root suckering, 156 artificial suckers were recorded ten months after the initiation of the trials. The complete artificial root sectioning was more efficient (73.33%) than the simple injury (65%). Among the two types of induction, the roots exposed to the open air presented a successful percentage than the one covered by soil. Induced suckers mostly appeared in distal pole of the mother - root. In *L. lanceolata*, roots induced by simple wound and leave to open air, allowed 63.33% of suckers against 58.33% developed in roots covered with soil. There was a significant difference between distal and proximal suckers (0.0000<0.001). This Ochnaceae presented a good aptitude to artificial suckering. This ability to regenerate by root suckering indicated that it is possible to domesticate the species *in situ*. Nevertheless, during our observations, none of the suckers initiated its own rooting system. This low cost technique could constitute an important step in the domestication process of this species. Complementary studies needed to be conducted for a long observation periods which can allow precise vigorous root neoformation permitting self dependence from the mother tree and important growth of suckers.**

Keywords: *L. lanceolata*, MPTS, Domestication, Root suckering, Vegetative propagation.

INTRODUCTION

Lophira lanceolata (Ochnaceae) is locally known as‘’Saktojé’’ in Fufulde and ‘’Kofia‘’ in Gbaya. It is a potentially agroforestry tree species of the Guinean Savannah Highlands (Mapongmetsem, 2007). The species is distributed in Tropical Africa from Senegal through the Central Africa Republic and northern most RD Congo to Sudan and Uganda (Arbonnier, 2000). The tree is 8 to 15 m height. Its canopy is narrow. Flowers are white and scented with 15 -30 cm long and grouped in terminal panicles. The bark of the tree is light brown. The mature brown conical fruit is surrounded with red wings easy to recognize. Its size varies among tree. The tree bears fruits from February to July. *L. lanceolata* is a characteristic species of the guinean savannah highlands

of Adamawa (Letouzey, 1968). The tree is highly prized by the populations of the region for its wood, medicinal products, edible caterpillars, oil and fodder (Piot, 1970, Yonkeu *et al*., 1997; Mapongmetsem *et al*., 2012). Oil produced from its seeds is appreciated in Cameroon and Chad (Mapongmetsem *et al*., 2012). The species is an excellent firewood producing hot flames and little smoke and is also a good source of charcoal. Edible caterpillars are grown on the tree; in northern Cameroon, where they are called 'dessi', 'sankadang' or 'sélénibétéyo' in the Gbaya language, they are collected, traded and consumed by several tribes (Mapongmetsem, 2007). The flowers are fragrant and an important source of honey in Cameroon and Nigeria (Tchuenguem *et al*., 1997; Persinos *et al*., 1968). It is still exploited from the natural stands and there has been little effort to domesticate and cultivate it despite its great socioeconomic importance (Leakey, 1994; Maghembe, 1994). For this reason, it has been identified as key species for an extensive domestication programme with a view to introduce it in fallows and home gardens (Mapongmetsem *et al*., 1998). Sexual propagation of long lived perennial species is constrained by long vegetative period; important decays between successive generations; irregularity of some characters in cross pollinated species (Ladipo, 1993; Leakey, 1991). Vegetative propagation permits to select individuals for which genetic characters are known, and multiply the material in a great scale and conserve their characters (Tchoundjeu *et al*., 1998). Among vegetative propagation techniques, root suckering has many advantages for desired traits (Bellefontaine, 2010). This approach is simple and inexpensive for use in rural communities. In Cameroon, researches on root suckering are scarce except the studies on *Balanites aegyptiaca*, *Diospyros mespiliformis* and *Sclerocarya birrea* (Noubissie -Tchiagam *et al*., 2011). Therefore, to contribute to domestication of local species, root suckering was developed for *L. lanceolata*. It is envisaged that this would allow, in the near future, starting trials of root cuttings to be able to transplant the most productive clones in a rural environment for the benefit of local populations.

The objective of this research was to evaluate the suckering aptitude of *L. lanceolata* notably by induction techniques, so as to favor its *in situ* conservation and its future domestication for rural populations; particularly assessing the influence of the induction type and determining the incidence of the root exposition on the artificial root suckering.

MATERIALS AND METHODS

Study site

Root suckering was studied from April 2011 to January 2012 for 10 months, in the Guinea savannah Highlands periodically burned and grazed. Investigations were carried out in the locality of Bini-Dang (altitude: 1079 m; latitude: 7°24' North; longitude: 13°32' East). This zone is submitted to the guinean climate characterized by two seasons: a dry season from November to March and a rainy season which starts in April by a period of violent thunder untill October. Precipitations are particularly important between July and September. From 2001 to 2012, mean annual rainfall was 1550 mm, monthly average temperature 22,3° C, the monthly relative humidity of the air was 66,2 % while the mean annual evapotranspiration was 1651,5mm. The region is covered by shrubs and/or woody savannahs species dominated by *Daniellia oliveri* and *Lophira lanceolata* (Letouzey, 1968). The human population is in majority composed of herders (Bororo, Fulani) and farmers (Mboum, Dii and Gbaya).

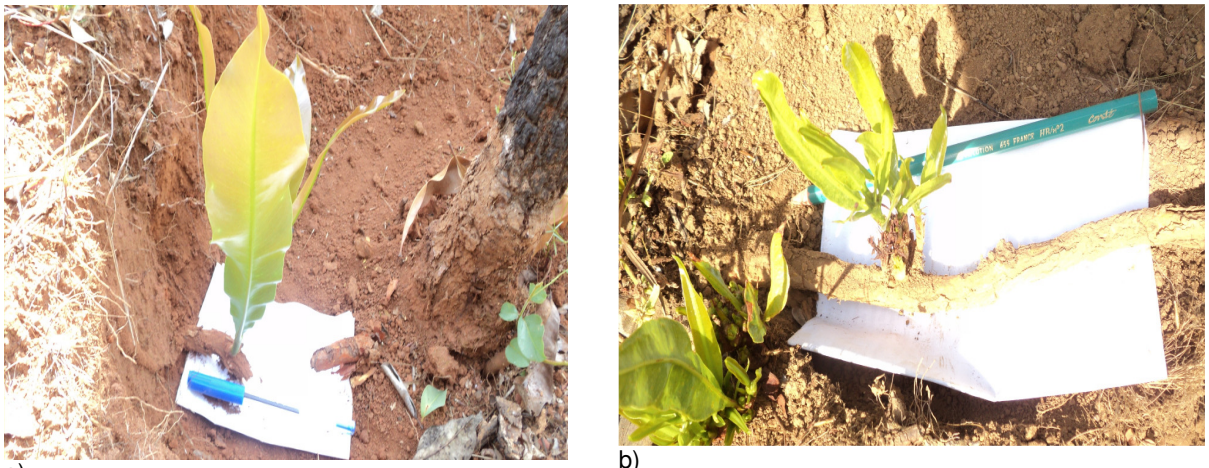
METHODOLOGY

Characterization of natural root suckering

The study consisted of delimitating at random 20 plots of 100 m x 100 m spaced of 120 m along a transect SW-NW (Mapongmetsem *et al*., 2011). Inside each quadrate and around each individual adult of *L. lanceolata*, all the regenerations were found in a radius of 5 m. A tree or a resprout as the most developed of a coppice was considered as adult when its diameter at breast height (1.3m) was more than 3 cm and /or at minimal height of 2 m; the regeneration (seedling and suckers) comprised all the plants less than 3 cm in diameter at breast height and /or a height of 2 m. The coppice which has at least one stem with a diameter more than 3cm was assimilated to an adult tree. A careful excavation of superficial root system was realized to determine its origin: the natural seedlings presented a deep root system, whereas suckers maintained a morphological connection with the superficial parent- root. The total number of suckers kept by mother-root, their distance in connection with the mother-tree, their height and diameter and the presence or not the new root system developed by suckers was recorded for each sucker.

Characterization of artificial root suckering

The sectioning and wounding of roots were undertaken for 2 days at the end of May (beginning of the rainy season). Excavations of one or two superficial roots from 1 to 4 cm diameter were realized at the bottom of each tree. Thus, 240 roots coming from 137 adult *L. lanceolata* were selected. Two methods of induction (complete sectioning and simple wound) were assessed (Noubissie – Tchiagam *et al*., 2011):



a) b)

Figure 1. Roots of *L. lanceolata* completely (a) and slightly sectioned (b) showing aerial axis.

- a complete sectioning of 120 roots with a sharp scissors (removal of 2-4cm of root segment long), for which 60 were covered from the original soil whereas the 60 other roots (5 -10 cm) remained exposed to free air;

- an injury was realized on 120 roots, for which 60 were covered with original soils as above and 60 others were exposed in the open air as above. The simple injury was made with a knife by removing a piece of root of 2-4 cm long to 1-2 cm deep according to the diameter of the mother –root (Meunier *et al.,* 2008).

According to the minimal diameter retained, these two types of inductions were realized at a distance of 17 -52 cm from the base of the mother-tree. Diverse characteristics of the induced suckers were measured monthly from July 2011 to January 2012: the total number of suckers (a sucker can form more than one aerial axis), the total number of new aerial axis formed per sucker, the height, the number of leaves per sucker and their position in connection with the place the root was sectioned. The first induced suckers were observed in July. Monthly assessments were carried out from July 2011 to January 2012.

By definition, distal suckers appear on the disconnected extremity of the mother-root and the proximal suckers on the part of the root connected on the mother-root (Figure 1), the most near of the mother-tree (Meunier *et al*., 2006).

The experimental design installed was a split-plot with three replicates. Type of induction (complete sectioning *versus* superficial injury) represented the main treatment and the exposition mode (roots exposed in the open air *versus* roots covered with the originate soil) corresponding to the sub - treatment. The clone effect and position of trees in the field (exposition, soil type, slope, etc.) were not taken into consideration.

Data processing

At the end of the trial, data collected was subjected to analysis of variance. Significant means were separated with Duncan Multiple Range Test (DMRT). The statistical programme used was Stagraphics plus 5.0.

RESULTS

Natural regeneration

After partial excavation of mother – trees of different ages, 213 seedlings and 147 suckers were recorded. In dry season, these regenerations were vulnerable to bushfires as well as livestock. In Guinean savannah highlands, *L. lanceolata* shows natural predispositions to regenerate by these modes of propagation (sexual, root suckering).

Natural root suckering

In total, 824 stems of *L. lanceolata* of different ages from 20 plots (mean density: 41.20 individuals/ha) and 147 suckers were sampled under 98 mother-trees. The percentage of adult tree which developed suckers is 11.89% ((98 / 824) x100). The number of suckers per mother-tree varied from 1 to 5. This variability of the ability to root sucker can be explained by differences in genotypes. Among the 824 adult trees of *L. lanceolata*, 88.11 % did not produced suckers whereas 6.2 and 0.69 % presented one and five suckers respectively. Their characteristics are indicated in table 1. None of the natural suckers observed, developed its inner root system in order to acquire a certain autonomy. In the

Table 1. Characteristics of natural suckers

Total number of suckers	Average distance from mother –trees (cm)	Average height of suckers (cm)	Soil average diameter of suckers (cm)
147	42.17±8.54	50.86±8.85	2.77±0.47

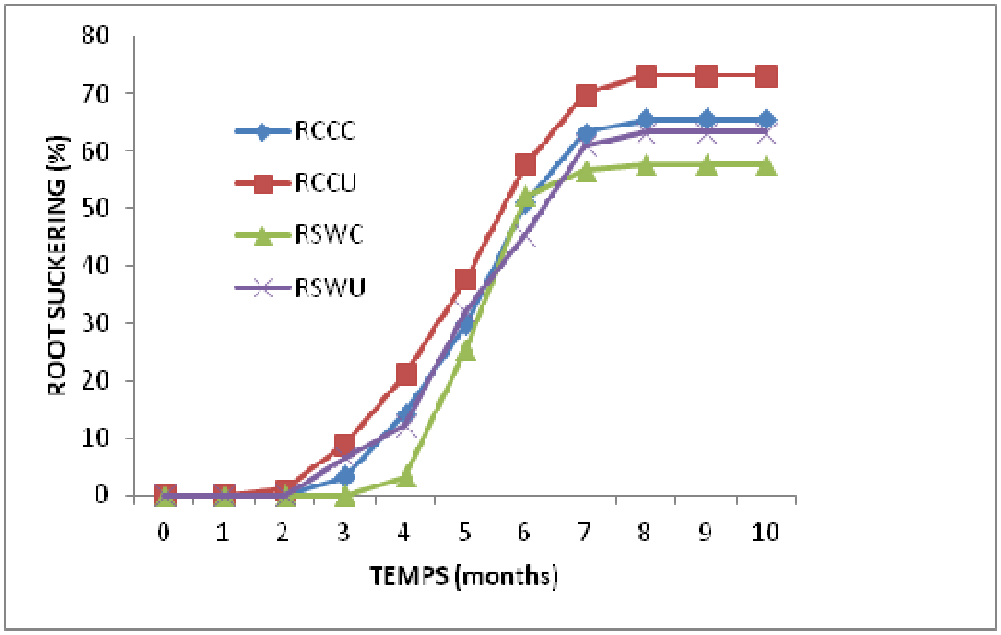


Figure 2. Evolution of the artificial root suckering.
Legend-RCCC: Root complete cut and covered with soil
RCCU:Root complete cut and uncovered
RSWC:Root slightly wounded and covered with soil
RSWU: Root Slightly woounded and uncovered

Guinean savannah highlands, the mean density of suckers of *L. lanceolata* was 7.35 individuals/ha. The average diameter of the suckers at the ground level is 2.77 cm and the average height is 50.86 cm (Table 1).

Artificial root suckering

A total of 240 superficial roots of *L. lanceolata* were induced from 176 parent-trees. The first suckers produced were observed 2 months after induction. At the end of the trial, the total number of suckers formed in January 2012 was 156 among which 72 were from the slight sectioning while 84 from the complete sectioning. Thus, the effect of induction mode on root sucker number was significantly different (0.0026 < 0.01). The complete sectioning allowed to obtain 73.33% of suckers from uncovered roots against 65% of those from roots covered by the originate soil (Figure 2). Despite this variability, the effect of exposition on root sucker number was not significantly different (0.4612 > 0.05). Concerning the mode of induction * exposition type, the number of suckers varied from 10.09 in root slightly wound covered with originate soil to 15.69 in root completely sectioning and covered with originate soil. The interaction mode of induction * type of exposition was significant (0.0222 < 0.05).

Position of the suckers on the roots

For the polarity of the suckers, the total suckers produced by the root completely sectioned, were distal (100%) while for the roots slightly injuried, 83.33% appeared in distal pole and only 16.67% in proximal (Table 2). The effect of induction mode on this parameter is significant (0.0000<0.001). The number of aerial axis per sucker varies significantly (0.0080<0.01) from 1.94±0.12 in distal suckers to 2.00±0.21 for proximal as far as the suckers from slight root wounded are concerned. The number of leaves varies equally significantly (0.0063<0.01) from 9.89± 1.62 in suckers from root slightly wounded and leave in free air to 11.88±1.67 in those covered with the soils (Table 2).

Table 2. Growth parameters of the artificial suckers

Parameters	Complete sectioning			Slight wound			
	Uncovered roots	Roots cover with soils	Distal suckers	Uncovered roots	Roots cover with soils	Distal suckers	Proximal suckers
Number of suckers	44	39	84	37	35	50	22
Percentage of suckers (%)	73.33	65	100	63.33	58.33	83.33	16.67
Number of aerial axis	1.65±0.11	1.42±0.12	1.53±0.11	1.91±0.21	2.00±0.15	1.94±0.12	2.00±0.21
Mean height of suckers (cm)	14.53±1.00	13.42±1.05	13.97±1.02	14.39±1.17	10.53±1.20	12.50±1.00	13.31±1.68
Number of leaves	6.47±0.42	5.62±0.24	6.04±0.33	9.89±1.62	11.88±1.67	10.62±1.36	11.52±2.28

DISCUSSION

Natural root suckering

In the guinean savannah highland observation conditions, the rate of natural suckering in *L. lanceolata* is low (17.83 %). High values are reported in *Diospyros mespiliformis* (36 %), *Sclerocarya birrea* (49 %), *Balanites aegyptiaca* (9 %) (Noubissie-Tchiagam *et al*., 2011). Concerning *Isoberlinia doka* and *I. tomentosa*, suckering percentage was respectively 83 and 56 % for farms and fallows against 39 and 35 % for forest (Dourma *et al*., 2006). In diverse «naturals» ecosystems represented by the 20 plots of a hectare each, this low rate of suckering could be explained by the root system which is not sufficiently superficial according to our observations. Suckering is often more abundant when the network of superficial roots is important (Sauve, 1987 cit. Bellefontaine and Monteuuis, 2002). Aptitude to root suckering varies between species and within the same species. According to ecological ecosystem conditions (season, pedoclimatic factors, etc.) and genetic variability, suckering aptitude could vary considerably (Bellefontaine, 2005; Meunier *et al*., 2008; Belem *et al*., 2008). In the 20 plots studied, the maximum distance of appearance of the suckers on root was 130cm. This distance was low compared to that recorded in various plant species. Concerning *Sclerocarya birrea* and *Diospyros mespiliformis,* it was respectively 1.7 and 2.5 m (Noubissie-Tchiagam *et al*., 2011). For *Bombax costatum,* suckers were concentrated under canopy and could be extended to 15 m (Belem *et al*., 2008). In *Litsea glutinosa,* this distance varies from 0.5 to 25 m, even more. They could appear very far from the mother-tree from which they were observed (Jacq *et al.,* 2005). In Togo for *Isoberlinia doka* and *I. tomentosa,* suckers were distributed around the mother-tree between 1 and 2.5 m and often more than 10 m on the well drained and deep soils (Dourma *et al*., 2006).

Artificial root suckering

The behavior of the mother –trees after root induction is different. Traumatisms of the roots affect the growth hormones balance of the root system which could increase the density and growth of suckers (Farmer, 1962; Lavertu *et al.,* 1994; Fraser *et al.,* 2004). Meanwhile, severe traumatisms of the roots reduce the suckering percentage by provoking degeneration of roots which decreases hormonal stimulation such as cytokine and limits the access of nutritive substances to suckers (carbohydrate, water, nutrients, etc.) necessary to development of suckers (Schier, 1981; Fraser *et al.,* 2002). Roots containing important reserve quantity of carbohydrate favor good development of suckers (Landhausser and Lieffers, 2002). In the present study, the root suckering percentage is consistent in complete sectioning (73.33%) compared to simple injury (65%). These findings were in agreement with those of Noubissie-Tchiagam *et al*. (2011) who reported that the complete sectioning in *B. aegyptiaca* (36.7 %), *D. mespiliformis* (66.7 %) and *S. birrea* (70 %) was efficient than simple injury (respectively 18.3 %, 36.7 %, 58.3 %).

Induction mode and exposing type affect the number and the growth of suckers. In *Populus tremuloides,* roots sectioned and covered with soil produced 9.7 suckers with 6 cm height against 12 versus 15 cm from those sectioned and uncovered (Renkema *et al.,* 2009). During the complete sectioning, suckers from roots exposed in the open air presented a high performance as far as the studied parameters were concerned than those from roots covered by the original soil. Concerning the simple injury applied on the roots and covered with the original soil were more vigorous than roots kept in free air, while distal suckers were more vigorous than proximal. The exposition of the extremity of the roots to the ‘’open air’’ (wind, light, sun, temperature, etc.) should be an amplificatory factor of suckering for some clones of *L.*

lanceolata. In those induction trials, there was no sucker which developed its own root system, so in tropical regions, suckers of *Detarium microcarpum* and *Miconia calvescens* produced rapidly their own root system (Bellefontaine, 2005). Our experiments were carried out on 10 months (April to January), however observations in dang savannah suggest that suckers of *L. lanceolata* could not become autonomous in a few months or years and then disconnected itself from the mother-tree in the natural conditions. The height of the natural suckers was higher than that of artificial suggesting that the formers were at an advanced stade of growth compared to that of artificial one.

Position of suckers on the root

In the present study as elsewhere, 100% of suckers were developed in distal pole of the root completely sectioned. In Uganda, Meunier *et al*. (2006) reported in *Spathodea campanulata* that complete sectioning of root allows always neoformation of distal suckers (exclusively on the part of the root disconnected from the mother-root). The simple injury of the root of *L. lanceolata* covered with original soil engendered 83.33% of suckers on distal pole and 16.67% on proximal as the roots covered with soil were concerned. For roots kept in the open air, the distal pole (68.42%) produced suckers than the proximal (31.57%). In general *L. lanceolata* developed more suckers on the distal pole than the proximal as the simple injury is concerned and exclusively the distal pole (100%) for the complete sectioning. Different physiological answers were observed: our results are in disagreement with those which showed rather a high proportion of proximal suckers for *B. aegyptiaca* (59.3 %), *D. mespiliformis* (72.80 %) and *S. birrea* (90.90 %) (Noubissie-Tchiagam *et al*., 2011).

Implication for conservation

The aptitude of certain genotypes of *L. lanceolata* to root sucker, seems to be an advantage for the savannah stand management, suggested that the adventitious root system is well balanced. Initiation of the first domestication steps of this Ochnaceae with the participation of the local populations, could contribute to its introduction in farmer production systems and for the biodiversity conservation in the region. Thus, to enrich fallow in guinean savannah highlands with multipurpose tree species for various productions (edible carterpillars, biofuel, edible oil, medicines, etc.), *L. lanceolata* having suckering ability, presents a real potential for the local populations. It is greatly appreciated for its multiples usages and services (Mapongmetsem *et al*., 2008). It is equally considered as a suitable species for improved fallow (Mapongmetsem, 2005). In order to enrich and menage land use, to diversify and increase farmer revenue, this low cost vegetative propagation technique proposed will permit to select performing clones of this multipurpose tree which is in a dynamic regression. To practice this technique which is closer to root cutting, farmers do not need a particular tool or training (Ky-Dembele *et al.,* 2010; Bellefontaine *et al.,* 2013).

CONCLUSION

L. lanceolata shows natural predispositions to regenerate by seedlings and root suckers the Guinean savannah highlands of Cameroon. *L. lanceolata* presented a good artificial suckering aptitude. The majority of suckers developed are in distal pole. Open air was an amplificator factor of the root suckering. Mastering of vegetative propagation at very low cost by inducing root suckering. Complementary trials should equally be undertaken in other seasons. It should be suitable to analyse the root system of the suckers induced during their growth so as to determine whether an autonomous disconnection from the mother-root can be produced in long term. This to root suckering will allow in near future to carry out trials on its root cutting. Based on the ability of *L. lanceolata* to root suckering, the root cutting should be assessed. We do hope that, the introduction of the species in farmer production systems will help to maintain a satisfactory biodiversity in the region.

ACKNOWLEDGEMENTS

The authors thank Pr.Ngakou A. and Mr Nguepi B. as well as anonymous referees for their useful comments which permit to improve the earlier version of the paper.

REFERENCES

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

Basham JT (1988). Decay and stain 10 years later in aspen suckers subjected to scarification at age 3. *Can. J. For. Res.* 18, 1507-1521.

Belem B, Boussim JI, Bellefontaine R, Guinko S (2008). Stimulation du drageonnage de *Bombax costatum* Pelegr. et Vuillet par blessures de racines au Burkina Faso. *Bois et forêts des tropiques*, 295 (1): 71-79.

Bellefontaine R, Monteuuis O (2002). Le drageonnage des arbres hors forêt: un moyen pour revégétaliser partiellement les zones arides et semi-arides sahéliennes? In Verger M. (Ed) Multiplication végétative des ligneux forestiers, fruitiers et ornementaux. Montpellier, France: Cirad-Inra, pp.135-148.

Bellefontaine R (2005). Pour de nombreux ligneux, la reproduction sexuée n'est pas la seule voie: analyse de 875 cas. Texte introductif, tableau et bibliographie. Sécheresse 16 (4): 315-317 et *Sécheresse* électronique, 3E, déc. 2005, 55 p. http://www.secheresse.info/article.php3?id_article=2344

Bellefontaine R (2010). De la domestication à l'amélioration variétale de l'arganier (Argania spinosa L.Skeels). *Sécheresse* 21 (1): 42-53.

Bellefontaine R, Ferradous A, Alifriqui M, Bouzoubaa Z, Ky-Dembele C, Nsibi R, Le Bouler H, Meunier Q (2013). Multiplication végétative d'arganiers par greffes, drageons et boutures de segments racinaires, pp. 379-388. In: Actes du 1er Congrès international de

l'arganier, Agadir, 15-17 décembre 2011, INRA-ANDZOA Ed., Agadir, 516 p.
Dourma M, Guelly AK, Kokou K, Batawila K, Wala K, Bellefontaine R, Akpagana K (2006). Multiplication par drageonnage d'*Isoberlinia doka* et *I. tomentosa* au sein des formations arborées du Nord-Togo. *Bois et Forêts des Tropiques*, 288 (2): 49-57.
Farmer RE (1962). Aspen root sucker formation and apical dormance. *For. Sci.* 8, 403-410.
Fraser EC, Lieffers VJ, Laudhausser SM (2004). Wounding of aspen roots promotes suckering. *Can. J. Bot.* 82: 310-315.
Fraser EC, Lieffers VJ, Laudhausser SM, Frey BR (2002). Soil nutrition and temperature as drivers of root suckering in trembling aspen. *Can. J. For. Res.* 32:1685-1691.
Jacq F, Hladik A, Bellefontaine R (2005). Dynamique d'un arbre introduit à Mayotte *Litsea glutinosa* (Lauraceae): une espèce envahissante? *Revue d'Ecologie* (Terre Vie), 60: 21-32.
Ky-Dembele C, Tigabu M, Bayala J, Savadogo P, Boussim IJ, Oden PC (2010). Clonal propagation of Detarium microcarpum from root cuttings. *Silva Fennica* 44 (5): 775-787.
Ladipo D (1993). La multiplication végétative d ans l a recherche sur l'amélioration des arbres: Suggestions pratiques. In Rapport de stage de formation méthodologie expérimentale et de collecte des données en agroforesterie. Nyamey, Niger: ICRAF /ICRISAI-SC.
Laudhausser SM, Lieffers VJ (2002). Leaf area renewal, root retention and carbohydrates reserves in a clonal trees species following aboveground disturbance. *J. Ecol.* 90: 658-665.
Lavertu D, Mauffette Y, Bergeron Y (1994). Effects of stand age and litter removal on the regeneration of Populus tremuloides. *J. Veg. Sci.* 5: 561-568.
Leakey RRB (1994). Les arbres au bois dormant. *Agroforestry Today*, 6 (2): 3
Leakey RRB (1991). Towards a strategy for clonal with tropical trees. In J. E. Jackson (Ed.), Tree breeding and improvement. Tring, United Kingdom: Royal Forestry Society of England, Wales and Northern Ireland.
Leakey RRB et Jaenicke H (1995). The domestication of indigenous fruit trees: opportunities and challenges for agroforestry. *In* Suzuki K., Sakurai S., Ishii K. and Norisada M. (éds). Proceedings of the 4th International Workshop of Bio-Refor, Tampere.46p.
Letouzey R (1968). Etude phytogéographique du Cameroun, Le Chevalier (Ed.), Paris, 551 p.
Maghembe JA (1994). Les trésors de la forêt: Arbres fruitiers indigènes en Afrique Australe. *Agroforestry Today*, 6 (2): 4–7.
Mapongmetsem PM (2005). Phénologie et apports au sol des composés biogènes par la litière de quelques essences fruitières locales (Adamaoua, Cameroun). Thèse d'Etat, Université de Ngaoundéré. 168p.
Mapongmetsem PM (2007). *Lophira lanceolata* Van Tiegh.ex Keay. In: van der Vossen H.A.M. & Mkamilo G.S. (Editors). PROTA 14. Vegetable oils / Oléagineux. [CD-ROM] PROTA, Wageningen, Netherlands.
Mapongmetsem PM, Akagou Zedong HC (1998). Inventaire et essai de domestication des Oléagineux locaux du Cameroun. In : Kapseu c et Kengue J.(Eds). Actes du second colloque International sur la valorisation du safoutier et autres oléagineux non conventionnels. Ngaoundéré, Cameroun. pp.13-24.
Mapongmetsem PM, Hamawa Y, Djeumene P, Maissele D, Kossebe CF, Ndoum JF, Nduryang JB, Bebbe F, Bouba D, Wouldata S, Zigro L, Barbi M (2008). Valorisation des plantes alimentaires sauvages dans les savanes soudano-guinéennes du Cameroun. In : Kapseu C., Mbofung C.M. et Amvam Zollo P.H. (éds). Développement de l'agro-industrie et création des richesses. Actes de Colloque International, Ngaoundéré, Cameroun. pp. 50-61.
Mapongmetsem PM, Nkongmeneck BA, Rongoumi G, Dongock Nguemo D.et Dongmo B (2011). Impact des systèmes d'utilisation des terres sur la conservation de Vitellaria paradoxa dans les savannes soudano-guinéennes. *Int. J. Environ. Studies* 68 (6): 851-872
Mapongmetsem PM, Kapchie VN, Tefempa BH (2012).Diversity of local fruit trees and their contribution in sustaining the rural livelihood in the northern Cameroon. *Ethiopian J. Environ. Studies and Manage* 5 (1): 32-46.
Meunier Q, Bellefontaine R, Boffa JM (2006). Le drageonnage pour la régénération d'espèces médicinales en Afrique tropicale: cas du *Spathodea campanulata* en Ouganda.*Vertigo – La revue en sciences de l'environnement*,7 (2) :1-6.
Meunier Q, Bellefontaine R, Monteuis 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.
Noubissie-Tchiagam JB, Ndzie JP, Bellefontaine R, Mapongmetsem PM (2011). Multiplication végétative de *Balanites aegyptiaca* (L.) Del., *Diospyros mespiliformis* Hochst. ex. A. Rich. et *Sclerocarya birrea* (A. Rich.) Hochst. au nord du Cameroun. *Fruits,* 66, 1–16.
Persinos GJ, Guimby MW (1968). Studies on Nigerian plants. V: comparative anatomy of *Lophira lanceolata* and *Lophira alata*. Economic Botany 22: 207–220.
Piot J (1970). Pâturage aérien au Cameroun. Utilisation des ligneux par les bovins. *Revue de l'Elevage et Médecine vétérinaire des Pays Tropicaux* 23: 503–517.
Renkema KN, Laudhausser SM and Lieffers VJ (2009). Suckering response of aspen to traffic-induced-root wounding and the barrier-effect of log storage. *Forest Ecology and Management*. 258: 2083-2089.
Schier GA (1981). Physiological research on adventitious shoot development in aspen roots. In: USDA *Forest Service, General Technical Report* INT-107.
Tchuenguem Fohouo FN, Mapongmetsem PM, Hentchoya JH et Messi J (1998). Comportement d'*Apis mellifera* sur les fleurs de quatre plantes oléagineuses dans l'Adamaoua (Cameroun):*Dacryodes edulis*, *Vitellaria paradoxa*, *Lophira lanceolata* et *Bombax costatum*. In: Kapseu C., Mbofung C.M. et Amvam Zollo P.H. (éds). Développement de l'agro-industrie et création des richesses. Actes de Colloque International, Ngaoundéré, Cameroun. pp.89-96.
Tchoundjeu Z, Duguma B, Fondoum JM, Kengue J (1998). Strategy for domestication of indigenous fruit trees in West Africa: Case of *Irvingia gabonensis* in southern Cameroon. Annual Conference of the Cameroon of Biosciences Society, 17–19 December 1997. *Cameroon J. Biol. Biochem.* Sci. 4: 21–28.
Yonkeu S (1983). Végétation des pâturages de l'Adamaoua (Cameroun): écologie et Potentialités pastorales. Thèse de Doctorat unique. Univ. Rennes I, France. 207 p.
Yonkeu S, Mapongmetsem PM, Ngassoum MB (1998). Distribution et caractérisation écologique d'une plante oléagineuse à usage alimentaire en Adamaoua (Cameroun): *Lophira lanceolata* Van Tiegh ex Keay. In: Kapseu, C. & Kayem, G.J. (Editors). Actes du 2ème Séminaire International sur la valorisation du safoutier et autres oléagineux non-conventionnels. Ngaoundéré, Cameroun. pp. 239–246.

How to cite this article: Fawa G., Mapongmetsem P.M, Tchingsabe O., Doumara D., Nenbe N. and Dona A. (2014). Root suckering of *Lophira lanceolata* Van Tiegh.ex Keay (Ochnaceae) in the Guinean Savannah Highlands of Cameroon. Int. Res. J. Plant Sci. 5(2):30-36