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Vegetative Propagation Methods Adapted to Two Rattan Species *Laccosperma laeve* and *L. secundiflorum*

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Keywords: Rattans- NTFP- *Laccosperma leave*- *L. secundiflorum*- Vegetative regeneration- Sucker- Rhizome

Summary

To set up a community-based forest ecosystem management strategy in South Ivory Coast using rattans as biological model, a research was carried out with the aim of achieving mass-production of seedlings by conventional vegetative propagation of two species: Laccosperma leave *and* L. secundiflorum*. We tested sucker with* L. leave*, and sucker and rhizome with* L. secundiflorum*. For both species, high viability rates were observed at the seedling emergence time: 70% for sucker in* L. leave*, and 80% and 93%, respectively for sucker and rhizome in* L. secundiflorum*. The mean seedling emergence time was estimated to 131 ± 12 days after sowing (DAS) in* L. leave*, and 122 ± 16 and 108 ± 9 DAS in* L. secundiflorum *for sucker and rhizome, respectively. No significant difference has been highlighted between the ability of* L. secundiflorum *to produce seedlings from sucker or rhizome. However, for this species, the use of sucker for the mass-production of seedlings was suggested since the gathering of this organ is less destructive for the maternal plant.*

For the target zone, the sustainability of the rattan seedlings mass-production by the conventional vegetative propagation technique, compared to tissue culture and seed propagation methods are discussed.

Résumé

Méthodes de multiplication végétative adaptées à deux espèces de rotin (*Laccosperma leave* et *L. secundiflorum*)

Pour mettre au point une stratégie de gestion communautaire de l'écosystème forestier dans le sud de la Côte d'Ivoire en utilisant le rotin comme modèle biologique, une recherche a été effectuée en vue d'obtenir la production en masse de plantules par la multiplication végétative de deux espèces: Laccosperma secundiflorum *et* Laccosperma laeve*. La multiplication par drageon a été testée avec* L. laeve *et la multiplication par drageon et rhizome a été testée avec* L. secundiflorum*. Pour chacune des espèces, un taux élevé de viabilité des organes a été observé au moment de l'émergence des plantules: 70% pour les drageons chez* L. laeve*, et 80 et 93%, respectivement pour les drageons et les rhizomes chez* L. secundiflorum*. Le temps moyen d'émergence des plantules a été estimé à 131 ± 12 jours après semis (JAS) chez* L. laeve *et 122 ± 16 et 108 ± 09 JAS chez* L. secundiflorum *pour le drageon et le rhizome, respectivement. Aucune différence significative n'a été mise en évidence au niveau de l'aptitude de* L. secundiflorum *à produire des plantules à partir de drageons et de rhizomes. Cependant, pour cette espèce, l'utilisation de drageons pour la production massive des plantules est suggérée, du fait que leur prélèvement est peu destructif pour les plantes mères.*

Pour la région d'étude, la faisabilité de la production massive de plantules de rotin par la multiplication végétative est discutée comparativement à la multiplication par semis et par la culture in vitro*.*

Introduction

As human populations continue to expand, the limits of national park model for biodiversity conservation are exposed. Indeed, although complete protection is justified in some cases (small population of rare and/or endangered species), the creation of national park does not automatically mean full protection,

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especially in situations where national authorities are not capable of protecting the area because of inadequate training, staff, motivation, equipment or financial constraints. As a result, the concept of buffer zones has arisen (17) with new variant of protection (12): biosphere reserve, natural biotic area, anthropological reserve, and community forest reserve. With respect to community forest reserve model, multiple use approach that maintains forest diversity while allowing local people to draw direct economic benefits offsetting adequately costs incurred from lost access to resources is well documented (2, 8). Non-timber forest products (NTFPs) from tropical forests have become a subject of increasing international concern, as a result of investigations on the possibilities of sustainable exploitation of community forest reserves (1, 2, 5).

Rattans, climbing palms belonging to the Calamoideae, a large subfamily of the palm family (Palmeae or Arecaceae) are the most economically important NTFPs (10, 14, 16). There are around 600 species of rattan belonging to 13 genera that are concentrated solely in the Old World Tropics. Four genera of rattan palm, represented by 20 species occur in West and Central Africa (18). Like their Asian relatives, the rattans of Africa form an integral part of subsistence strategies for many rural populations and provide the basis of a thriving cottage industry (9). Although less celebrated compared to Asian species, the rattans from Africa can significantly contribute to the development of rural people through the access of poor populations to the global market (13). In addition, in the context of cultivation, rattan prefers sites where regular flooding would damage most other crops. In order to take advantage of the socioeconomic potential offered by rattans, a research project was initiated since 1999, aiming at setting up a rural community-based forest buffer zones management strategy in South Ivory Coast, using this plant as biological material. This research program covers economic, vegetative propagation, and genetic characterization, as well as population dynamics aspects. Specifically, the objective of the present work is to develop appropriate protocols, easy to implement and economically endurable by rural community and allowing: 1) the mass-production of economically viable rattan species in Ivory Coast, in particular the single-stemmed *Laccosperma secundiflorum* for which irregular seed supply coupled with low germination rates could be important constraints to the mass-production of seedlings; and 2) the development of an operational planting programme, provided it this is economically viable.

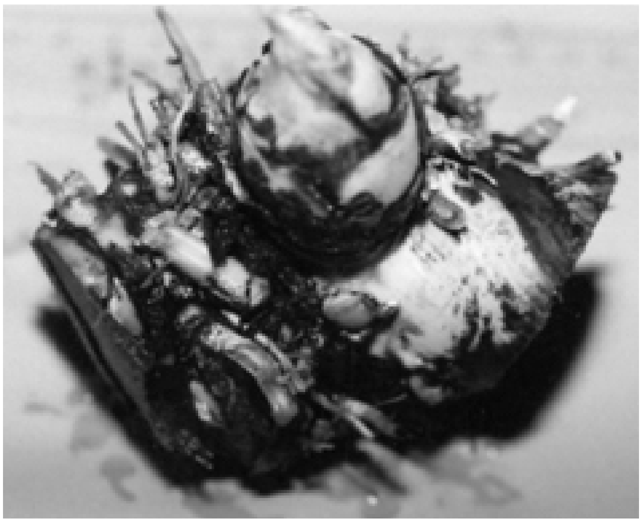
Material and methods

Two rattan species (*Laccosperma laeve* and *L. secundiflorum*) were studied. *L. secundiflorum*, a species with large cane diameter (> 3 cm) forms raw material mainly used in craft and small-scale furniture industries, because of its strength, durability, bending ability which allows the formation of wide variety of shapes, and the aesthetic value of the canes. The second species, *L. leave* has a small cane diameter (< 3 cm) and is utilized by farmers as string in house and granary building, but also for birdcages and baskets construction.

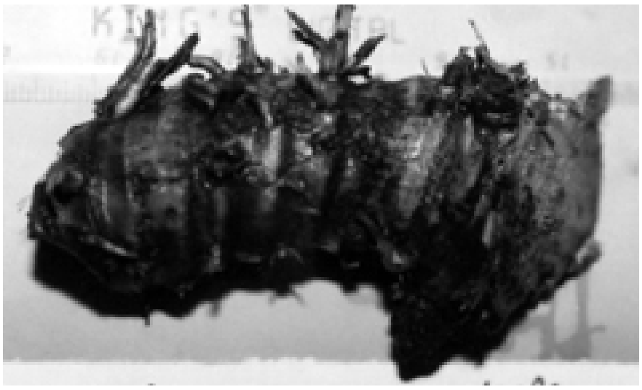
Plant materials were collected in a primary rain forest bordering the east side of University of Abobo-Adjamé (Abidjan, Ivory Coast).

Regeneration trials were carried out using two organs: rhizome and sucker (Figure 1).

A



B



C

Figure 1: Sucker (A: *Laccosperma leave* and B: *L. secundiflorum*) and rhizome of *L. secundiflorum* (C) used for the vegetative regeneration trials.

Note that *L. leave* does not develop rhizome so that only sucker was assayed with this species. For each species, rhizome and sucker fragments measuring 2.5-6 cm diameter and 4-9 cm length were sampled for regeneration experiments. Sample size varied from 15 to 30, according to species (Table 1).

Table 1

Sample size (*n*) and mean values (± SE) for three traits analysed to evaluate the aptitude of two rattan species (*Laccosperma secundiflorum* and *L. leave*) to regenerate from different organs

Analysed traits	*L. leave*	*L. secundiflorum*	
	Sucker (*n*= 15)	Sucker (*n*= 30)	Rhizome (*n*= 30)
Viability rate (%) 60 DAS	100	93^{a}	100^{a}
Viability rate (%) 120 DAS	70	80^{a}	93^{a}
Shoot emergence time (DAS)	80 ± 24	74 ± 41^{a}	84 ± 47^{a}
First leave emergence time (DAS)	131 ± 12	122 ± 16^{a}	108 ± 09^{a}

For *L. secundiflorum*, means within a line, followed by the same superscript were not significantly different ($P \geq 0.05$), the comparisons being based on Student *t*-tests.

Substrate used for regeneration trials was a sandy soil collected in a five-year old fallow plot with vegetation mainly composed of *Chromoleana odorata* and *Panicum maximum*. Nursery plastic bags measuring 25 cm diameter and 30 cm height were filled using the substrate that was treated with a fungicide (maneb 80%). The experiment was set up in a nursery built using palm leaves and located in the primary rain forest where the plant materials were collected.

Observations concerned three traits: (*i*) the mortality rate estimated 45 and 120 days after sowing (DAS), these durations corresponding to the time after which the first shoot and the first single-leaf seedling were observed, respectively; (*ii*) the mean shoot (Figure 2 A) emergence time and (*iii*) the mean first leaf (Figure 2 B) emergence time.

A

B

Figure 2: Shoot (A) and one-leaf seedling (B) emerged from sucker of *L. secundiflorum*.

Such experiment should help us to select for *L*. *secundiflorum*, the appropriate organ that will be used in seedling mass-production. For each species and each organ, the mean values of the analysed traits were estimated. The estimates were then used to make comparisons between rhizome and sucker of *L*. *secundiflorum* using the Student *t*-test. Statistical analyses were performed using the Minitab™ statistical package for Windows, release 13.2 (11).

Results and discussion

The mean values of the analysed characters, estimated for each species and each organ are presented in table 1. The viability rates estimated 120 DAS was 70% with *L*. *laeve* (sucker) whereas this statistic equalled to 80% and 93% with *L*. *secundiflorum* for sucker and rhizome, respectively. Comparison between sucker and rhizome from *L*. *secundiflorum* revealed no significant difference for the viability rates estimated 45 and 120 DAS (t= 0.59; P= 0.56 and t= 1.56; P= 0.13, respectively). Raised from sucker, the first shoot was observed 45 DAS for *L*. *secundiflorum* and 61 DAS for *L*. *laeve*. Overall, the mean shoot growth time equalled to 80 ± 24 DAS for *L*. *laeve* while for *L*. *secundiflorum*, we obtained 74 ± 41 and 84 ± 47 DAS for the sucker and the rhizome, respectively. For this later species, no significant difference was highlighted between the two estimates (t= 0.45; P= 0.66). Concerning the first leaf emergence time, the mean duration was 131 ± 12 DAS with shoot raised from the sucker of *L*. *leave*. With *L*. *secundiflorum*, this statistic was estimated to 122 ± 16 DAS for the shoot that emerged from the sucker and 108 ± 9 DAS for the shoot emerged from rhizome. The Student *t*-test realised for the two estimates revealed no significant difference (t= 1.79; P= 0.12).

Results from this study suggested that seedlings mass-production by mean of vegetative propagation is possible for *L*. *leave* (using sucker) and *L*. *secundiflorum* (from both sucker and rhizome). For *L*. *secundiflorum*, since no significant difference was observed between sucker and rhizome for seedling raising time and regenerated plants vigour, these two organs could be used in seedlings mass-production. However, sucker is more appropriate for this purpose, since its gathering is relatively easy and less destructive for the maternal plant, contrary to rhizome.

It has been argued that conventional vegetative propagation was difficult for some rattans and that it was almost impossible in the solitary and single-stemmed rattan species (20). Contrary to these statements, we observed the highest viability and shoot formation rates with *L*. *secundiflorum*, a single-stemmed species, suggesting a variability of responses from solitary genotypes or species to vegetative propagation trials.

Results from the present study are quite promising for rural community-based rattan resources exploitation in West African rain forests given that the two other approaches, namely tissue culture and seed propagation appear to be not adapted to the current economic situation in the target zone. With regard to plant tissue culture, several studies aiming at developing reliable techniques for the mass-production of commercial rattans, principally *Calamus manan* are in progress since 1984 (6, 7, 20). Two methods of propagation have been investigated: the multiple shoot formation method and shoot formation from callus. It is worth noting that considering the present socioeconomic importance of rattans, propagation by tissue culture is a potentially useful method for raising large-scale plantations, especially when availability of seeds become limited (15). Unfortunately, reproductive protocols for rattan seedlings mass-production have been developed only for a limited number of species, namely those belonging to the genera *Calamus* (6, 19).

Seed propagation, the second way for seedlings mass-production is the more common method since there are some difficulties in gathering enough suckers or rhizomes for extensive propagation. These difficulties are mainly related to the fact that suckers and rhizomes are bulky compared to seeds and also the gathering of these plant parts is time-consuming. However, vegetative propagation using sucker or rhizome is a valuable technique in the clonal production of interesting genotypes and the establishment of seed orchards for economically important species. In addition, although all rattans ordinary produce abundant seeds during a season, some species such as those assayed in the present study produce relatively low number of seeds from a single plant: from a four-year rattan populations monitoring in the forest where our plant materials were sampled, less than 450 seeds have been collected from the two species. Such irregular and insufficient seed production should lead to uncertainty in seed availability so that difficulties in supplying high quality seeds of desired species could be expected. Beside this constraint southern Ivory Coast, the mass-scale harvest of rattans has led to a situation where only a few number of mature plants are maintained, resulting in the scarcity of seeds. The last constraint related to the use of seed for seedling mass-production is the dormancy. Indeed, contrary to Asian taxa for which complete removing of the sarcotesta allows a rapid and uniform germination of the commercial *C*. *manam* and *C*. *caesius*, the commercially important species from Africa (e.g. *L*. *secundiflorum* and *Eremospatha macrocarpa*) have a relatively robust seed coat that impedes their imbibition, causing a physic dormancy that can delay the germination for 9 to 12 months (4). Although soaking the seeds in water for at least 24 hours prior to sowing can reduce shoot emergence time to about 60 DAS, seeds

Figure 3: One hundred thirty one-day old seedlings produced by rhizome of *Laccosperma leave*.

mortality rates often remain high, compared to those observed with sucker and rhizome.

Conclusion and perspective

Rattans represent valuable biological models to set up a community-based forest ecosystem management strategy. However, the success of such strategy requires the availability of seedlings (Figure 3) for rural communities.

The study showed that vegetative propagation using sucker and rhizome could be helpful to improve the well-being of southern Ivory Coast rural communities. However, ongoing research on the main nursery elements such as fertilisation, soil, light, organ's age and size, as well as the size of polybags should help to improve the seedlings mass-production (3).

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