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Chapter 6.7
Testing the Propagation and Growth of the Liana *Flagellaria indica*, Used to Make Lobster Traps, and *Bambusa multiplex* as an Alternative Source

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Abstract

Pursued as a cottage industry, lobster fishing is one of the main economic activities in the Tolagnaro region. Lobster traps are generally constructed with the liana *Flagellaria indica*, which is becoming increasingly rare in the region. According to germination tests, this slow- growing liana is easy to propagate from seed, but difficult to regenerate with cuttings. Transplanting in the Petriky Forest was successful, with a survival rate of about 90% for young plants. As a potential alternative for use in the production of lobster traps, a species of bamboo, *Bambusa multiplex*, has the best characteristics found to date to replace *Flagellaria*.

Résumé

Essais sur la propagation et la croissance de la liane *Flagellaria indica*, utilisée pour confectionner des casiers à langoustes, et de *Bambusa multiplex* à titre de ressource alternative. Pratiquée de façon artisanale, la pêche à la langouste constitue une des activités économiques principales de la région de Tolagnaro. De moins en moins disponible sur place, les villageois doivent parcourir de longues distances pour se procurer des lianes de *Flagellaria indica* pour en faire des cages à langouste. Des essais de germination ont été réalisés et la liane se multiplie facilement par graine. Elle ne se régénère pas adéquatement par bouturage. Il a été mis en évidence qu'avec un accroissement moyen en longueur de l'ordre de 20 cm pour 2 ans, la liane se caractérise par un très lent rythme de croissance. Des transplantations faites dans la forêt de Petriky ont réussi avec un taux de survie des jeunes plants de l'ordre de 90%. Par ailleurs, ayant une bonne performance technique et économique, une espèce de bambou, *Bambusa multiplex*, rassemble jusqu'ici les meilleurs aspects et caractéristiques pour se substituer à l'utilisation de la liane.

Introduction

In addition to the deterioration of natural habitat for a variety of organisms, one negative consequence of deforestation is the decrease in natural resources available to people. Reduced to about one tenth of their original area (see Vincelette *et al.* Chapter 2.4), littoral forest stands have lost a significant percentage of their woody and non-woody forest products, which play important roles in the daily economic life of the Malagasy people.

Flagellaria indica L. (Flagellariaceae), called *vahipiky* in Malagasy, is a highly valued littoral forest liana used to fabricate lobster traps. Lobster fishing is one of the primary economic activities in the Tolagnaro coastal region (see Sabatini *et al*. Chapter 5.2). However, given the reduction in habitat of this liana and its over exploitation, it is now rare in portions of its former range. In the littoral forests of Mandena and Sainte Luce, sources of liana of the appropriate diameter for harvesting have been depleted. As we know from discussions with local villagers, it is often necessary to travel up to 30 km to find natural populations of this liana that can be used in lobster trap construction. The Petriky Forest still contains a stock of the liana, but local villagers will not allow fishermen from other areas to collect this species.

Since 1998, researchers have been conducting multiplication tests on *Flagellaria indica*. The principal goals of this work are the sustainable management of this natural resource, which is rapidly disappearing from southeastern Madagascar, and testing of potential alternative lianas for the construction of lobster traps.

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Botanical description

Flagellaria indica is a pantropical species found from Australia to South America. In Madagascar, this species occurs mainly in coastal forest and moist lowland forest. It is a climbing liana which clings to surfaces using terminal leaves that have been transformed into tendrils. Its small white flowers form terminal panicles (Heywood *et al*. 1978, Mabberley 2002). The species is heliophytic, and grows best on lateritic soils where it can reach diameters of 2 cm or more. It flowers throughout the year, but fruit formation peaks in December. The fruit is a drupe, and ripe fruits can be observed until April. During periods of food scarcity, local villagers crush the seeds into powder and use them as an alternative food source. In general, specimens of this liana greater than 1 cm in diameter are used for the fabrication of lobster traps. Based on our observations, they represent individuals that are at least 15 years old.

Methods

Seed collection and drying

The distinctive ripe, black seeds were collected in the Petriky Forest usually during the month of December. The seeds are orthodox (see Randriatafika *et al.* Chapter 3.3). They were first dried in the open-air shade, and then placed in sealed containers with silicate gel for long-term storage. Moisture content of the processed seeds was reduced to about 15% before being stored.

Germination tests

The germination tests were conducted in a plant nursery. The seeds were planted in plastic pots of 20 x 10 cm, using topsoil from degraded forests in Mandena as a substrate. Three seeds were planted in each pot. After being picked and dried, the seeds were tested using different types of pretreatments to accelerate their germination: open air-drying for 10 days, drying and then soaking in water for a day, drying and then soaking in water mixed with sand for scarification for a day, and drying and short term storage (180 days) and drying and long term storage (2 years), each in a hermetically sealed container.

Cuttings

At the same time, cutting-replanting tests were conducted in order to investigate the ability of the plants to produce shoots and to find a means to accelerate their growth. Stalks with an average diameter of 0.25 cm were cut into pieces of 25 cm length. They were planted in a 2 x 2 m plot in the open and under natural littoral forest cover in Mandena.

Finally, transplantation and direct seeding tests were conducted in different types of ecosystems and plant formations to try to understand different growth inhibition factors. The sites were located: under a *Eucalyptus robusta* plantation, under degraded natural littoral forest, under a *Trema orientalis* (Ulmaceae) plantation, and on agricultural lands.

Search for alternatives

Since 1998, various materials have been tested to identify alternatives to *Flagellaria* lianas in the production of lobster traps. A FAO project tested synthetic materials such as plastic in 2003 (M. Nambole, Service de Peche, Tolagnaro, pers. comm.). The results were negative because, not only are these materials generally not available in the immediate Tolagnaro region, but the fishermen were also rather reluctant to use artificial materials since they believe that lobsters are not attracted to traps fashioned from them. Subsequently, given the local depletion of *Flagellaria*, we began testing various natural materials such as lianas of different species from the families Asclepiadaceae and Apocynaceae, as well as species of bamboo and palms. The goal was to identify common plants that are technically efficient, cost-effective, and easy to propagate.

Results

Multiplication and growth tests

After being removed from the seed coat, dried, and planted, the seeds began to germinate after about 180 days. Their germination rate varied from 0 to 80%, depending on the type of treatment (Table 1). The germination rate is based on the number of pots in which one or more of the three seeds planted in each pot germinated.

Table 1. *Flagellaria indica* germination tests on different planting regimes.

Test	Treatment duration	Quantity tested	Germination rate (%)
Open air drying	10 days	250 g	80
Drying and soaking in water	11 days	250 g	80
Drying and soaking in water mixed with sand	11 days	250 g	60
Drying and storage	180 days	250 g	30
Drying and storage	2 years	250 g	0
Cuttings planted in 2 x 2 m plots in the open	1 day	100 stalks	0
Cuttings planted in the littoral forest	1 day	100 stalks	0

Table 2. *Flagellaria indica* transplantation tests under different ecological settings.

Date	Treatment	Site	Number of individuals transplanted	Survival rate to 2000 (%)	Survival rate to 2005 (%)
January 1999	Transplantation	Under introduced *Eucalyptus robusta*	30	70	0
January 1999	Transplantation	Degraded natural littoral forest	38	75	50
April 1999	Transplantation	Under *Trema orientalis*	20	70	0
April 1999	Direct seeding (4 seeds/hole)	Under *Trema orientalis*	160 holes	0	0
April 1999	Transplantation of seedlings	Agricultural field	50	0	0
June 2004	Transplantation	Degraded natural forest in Petriky	250	-	50

Soaking previously dried seeds in water had no particular effect on their germination. However, only 60% of the seeds that had been dried, treated with water, and then mixed with river sand for scarification purposes germinated. The germination rate gradually decreases with amount of storage time. Seeds which had been stored for two years did not germinate. Long-term storage tests are currently underway, in cooperation with the Royal Botanic Garden's (Kew) Millennium Seed Bank project, to identify and understand the determining factors. The various cutting experiments did not yield any positive results with respect to asexual reproduction (Table 1).

Young, two-month-old plants reach 4 to 5 cm in height. At the age of 2.5 years, their average height was about 20 cm with a diameter of about 3 mm. Growth is very slow or even stagnant after the two-year mark. The growth rate of plants in natural habitat is unknown, and it is estimated that lianas require about 10 years of growth to reach the minimum 1 cm diameter required for use in the production of lobster traps. Inquiries made with villagers indicate that growth is more rapid on lateritic soil.

Reintroduction tests

After two years in the nursery, young lianas 20 cm in length were transplanted to a variety of different ecological settings, and direct seeding was conducted in some experimental areas (Table 2).

Transplanting *F. indica* under *Eucalyptus robusta* yielded a liana survival rate of 70% in 2000. However, by 2005, the undergrowth of this site had been invaded by *Erica goudotiana* (Ericaceae), which resulted in the disappearance of all transplanted *F. indica*. In 2000, 75% of the individuals transplanted to degraded natural littoral forest were still alive, and 50% were still living in 2005. After one year, 50% of the plants transplanted in June 2004 into the degraded natural forest at Petriky were still alive. Under *Trema orientalis*, a native, pioneering species, the transplanted lianas had a survival rate of about 70% during their first year of growth. However, the *Trema* plantation died in 2005 and those *Flagellaria* subsequently succumbed to sun exposure. The seedlings transplanted onto exposed agricultural areas all died within the first year (Table 2).

Alternatives

Given the depletion of *Flagellaria* in certain parts of southeastern Madagascar and the distance local people have to travel to obtain this plant, alternatives are being sought. First, local experiments commenced in 1999 with the palm *Dypsis scottiana*, which is endemic to the southeastern coastal forest (Dransfield and Beentje 1995). However, given this plant's relative rarity, it was quickly realized that it would not be a viable alternative. Other plants were tested as alternatives for *Flagellaria*, including a variety of bamboos and stalks of *Secamone* sp. and *Baronella* sp. (Asclepiadaceae).

A widespread, introduced species of bamboo, *Bambusa multiplex* (Poaceae), which grows mainly along small streams or in damp areas with lateritic soils, has the same mechanical and physical traits (strength, malleability, color) as *F. indica* and was identified as a possible substitute (Table 3). Based on various tests, *B. multiplex* seemed to be the best alternative, and thus, we decided to test cuttings of this plant to determine the best method of multiplication. Stalks of 0.5 to 1 m in length were tested with four different treatments (N = 40 per treatment): the stalks were perforated with small cuts and buried completely in the soil, stalks were left intact and buried completely in the soil, stalks were left intact and partially buried in the soil, and stalks were partially buried in the soil with rhizomes.

The bamboo was then braided using the same lobster trap construction technique as is used for *Flagellaria*. *Bambusa multiplex* trap prototypes were given to the fishermen for testing and their performance was evaluated and compared to that of *Flagellaria* (Table 4).

Traps made of *Flagellaria* last about five to ten days. This is similar to traps made of *Bambusa*, which last five to eleven days (Table 4). Fishermen at Sainte Luce noticed that bamboo traps perform notably better when the plant material used is not too dry. Tests are underway to identify how to optimize this parameter.

Table 3. Comparison of different materials tested to replace *Flagellaria*.

Type of Materials	Benefits	Drawbacks
Synthetic materials (nylon, metal)	Very strong, durable	Not available on site, not biodegradable, costly
Stalks of *Dypsis scottiana*	Available on site, accessible, strong, already used by fishermen	Endemic species, limited supply
Lianas (Asclepiadaceae, Apocynaceae)	Available on site, accessible, strong, already used by fishermen	Limited supply
Stalks of *Bambusa multiplex*	Available on site, accessible, strong, can be propagated	Not yet very widely used by fishermen

Table 4. Results of *Bambusa multiplex* traps tests.

Date	Number of fishermen	Location	Depth (m)	Number of traps	Condition before immersion	Actual resistance (days)	Catch (kg)
December 2003	2	Sainte Luce	9	4	Fresh	5	2.5
December 2003	3	Sainte Luce	9	7	Fresh	5	2.8
May 2004	3	Sainte Luce	32	8	Fresh	11	14.2
March 2005	1	Ehoala	30	10	Very dry	1	0

Table 5. Results of cutting experiments of *Bambusa multiplex* to determine the best method for propagation.

Treatment	Sowing date	Number	Survival rate in 2004	Average height in August 2004 (cm)	Average height in November 2004 (cm)
Perforated and partially buried cuttings	April 2004	40	0	0	0
Unperforated and buried cuttings	April 2004	40	0	0	0
Unperforated and partially buried cuttings	April 2004	40	0	(120 cm) dead	(120 cm) dead
Partially buried cuttings with rhizome	April 2004	40	40%	130 cm	145 cm

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Propagation of Bambusa multiplex

With respect to the bamboo cutting tests, those with a rhizome have a survival rate of about 40%, and their average growth over three months is about 15 cm (Table 5). *Bambusa multiplex* grows faster than *F. indica*.

Discussion

Flagellaria growth and multiplication

The planting of seeds is an appropriate way to propagate *Flagellaria indica ex situ* and *in situ*. However, the very slow growth of young plants is a problem that needs to be resolved. According to villagers, the liana grows much better in Petriky than in Mandena. This is consistent with our observations in the degraded forest of Petriky, where there is a higher abundance of young liana with diameters below 0.5 cm than in Mandena. Vegetative reproduction by cuttings is not a good option for multiplying the liana. Nursery production followed by seedling transplantation rather than direct seeding is definitively the best way to ensure survival.

Young lianas cannot survive under full sun exposure. Based on our experiences with the plantations under *Trema* and in the open, it can be concluded that *F. indica* requires shade in order to grow. All individuals that had been planted with full exposure or that had lost their shade cover died. Adult lianas are known to be heliophytic, and most require trees and shrubs to cling to in order to receive light. The slow growth observed in the nurseries is probably because these liana had no adjacent vegetation to climb. It might be important to change shade and sun exposure at different stages during the growth of the liana.

Conclusion

Fresh *Bambusa* traps are as efficient as *Flagellaria* traps. However, dry *Bambusa* does not perform as well, and according to fishermen, can be broken easily by the action of sea waves. According to local fishermen, there is another major drawback to *Bambusa* traps - the material has a sharper edge and the lobsters can be injured. Thus, the utilization of bamboo traps requires specific construction material and fishermen must be trained accordingly. Fishermen at Sainte Luce believe that a bright colored trap is more attractive to lobsters, while those at Ehoala maintain that a drab colored cage is most successful. This should be examined in detail in order to determine the best color for the materials.

Since bamboos are graminaceous plants, they can propagate from rhizomes. This works well particularly along streams and in areas that are periodically flooded. The purpose of the cuts made in the cuttings was to enable soluble minerals in the percolating water to circulate better. Without a rhizome, the cuttings were unable to germinate and eventually rotted. More tests should be done in order to determine the best conditions for the propagation of this species.

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