# Vegetative propagation of *Ficus benjamina* using non-sterile sand and hardwood cuttings

Bhoj Bahadur Kshatri[1], Peter D. Kemp[1], John Hodgson[1] N. R. Devkota [2]
[1]Institute of Natural Resources, Massey University, Palmerston North New Zealand, [2]Institute of Agriculture and Animal Science (IAAS), Rampur, Tribhuwan University, Nepal

**Abstract**

*Ficus benjamina* a multipurpose tree, used as fodder, firewood, and for shade in Asia and Africa. With an objective to identify a low cost rooting medium for farm-grown cuttings a comparative experiment was conducted to compare the effect of: 1) 100% non-sterile sand (S), 2) a mixture of 50% sand and 50% commercial media (M), and 3) commercial media (CM) on root and shoot growth using three replicates of 16 cuttings per plot in a randomised complete block design. A single wound was made in the cambium layer, using a sharp knife, and then treated with 0.3% indolebutyric acid (IBA). Cuttings were maintained under controlled temperature of 20 to 24 $^{o}$ C in a heat bed, where the mist was regulated for a 10-second spray every five minutes throughout the experiment. The root and the shoot growth were recorded 55 days after planting. Number of surviving roots and leaves did not differ between media. Length of the longest root (5.3, 7.8, and 7.0 ± 0.45 mm) and number of new leaves (1.2, 3.2 and 3.0 ± 0.23 leaves in treatment S, M, and CM respectively) were lower in the sand treatment. It is concluded that unwashed sand provides a satisfactory medium for establishing cuttings of *Ficus* plants in farm conditions.

***Additional keywords***: *Ficus glaberrima*, mountain ecology, tree fodder, epiphytes, strangling fig, tree establishment.

## Introduction

Ficus species are multipurpose trees well adapted to harsh mountain terrain and used by rural populations as an evergreen source of fodder for ruminant livestock, for fuel and providing shade as well in ecological conservation in Nepal (Kshatri, 2001), and in Sahelian and Sudanian zones of Africa (Danthu, 2002)

*Ficus glaberrima* and *Ficus benjamina* are both known as epiphyte and strangling fig (Corner, 1978). *Ficus glaberrima* is a sub-tropical tree, found in the Himalayan foothills (Corner, 1978), where it is used for fodder, fuel, erosion control and minor industrial purposes (Maithani *et al*., 1987). In Thailand, it is used as a framework tree (Elliott *et al.*, 2003). *F. benjamina* is present in New Zealand (NZ) where it is an indoor plant but *F. glaberrima* has never been recorded in NZ because only one species is available in NZ and the research is aimed at Nepalese and similar farmers, *F. benjamina* was used to develop appropriate propagation technology.

Although vegetative propagation is a basic method for mass scale production of cuttings, vegetative propagation of *F. benjamina* has not been extensively studied (Danthu *et al*., 2002). Micro-propagation techniques (Joshee *et al*., 2002) advanced by the western world are practically useless for remote areas in Nepal, Bhutan and similar areas where there are no electricity and irrigation facilities. Therefore, there is a need to develop suitable propagation methods, by combining indigenous technical knowledge of local farmers and relevant scientific information.

Nepalese farmers require a hardy and healthy sapling that needs relatively limited care after planting for reforestation of the mountain ecology. Selection of species, hardening of the saplings produced and raising them to a stage of transplantation and establishment is challenging.

Previous experience found that larger size cuttings with more than 15 leaves performed poorly. The objective in this study, which formed part of a project on the establishment and management of *F. glaberrima* in Nepal, was to develop an effective propagation method.

## Material and Methods

Treatments were 100% river sand (S), 100% commercial medium (CM) and 50:50 mixture of the two (M) Particle diameter in the sand was 70% <2 mm and 30% 2-5 mm diameter; no fertilizer was added and the sand was not sterilised. The commercial medium was formed on composted pine bark with added lime, dolomite and osmocote (100 gm, 300gm, and 150 per 100 gm bark respectively).

A randomised complete block design (RCBD) with three treatments and three replications with 16 cuttings per plot was used for the experiment.

### Preparation of cuttings

*Ficus benjamina* leaves, bark and wood contain milky sap, which oozes out during, twisting, breaking and cutting. To avoid stickiness while preparing the cuttings, the sap was washed off by immersing cuttings in clean water immediately after branches were cut from the trees. This also helped minimise evapotranspiration stress of cuttings.

A total of 144 cuttings were prepared using trees available at the PGU, Massey University, New Zealand. Three out of 25 trees were randomly selected as mother trees from which the cuttings were taken. In this trial cuttings varied from 20 to 80 cm in length, 2 to 21 branches, 2 – 100 leaves. They were trimmed to 22.5 cm length, 2 - 8 branches and 2 – 15 leaves, and were allocated at random between treatments and replicates.

A single wound was made in the cambium layer of each cutting using a sharp knife and then treated with 0.3% indolebutyric acid (IBA). Cuttings were maintained at 20 to 24 $^{o}$C in a controlled temperature heat bed, where the mist was regulated for a 10 second spray every five minutes throughout the experiment. The root and the shoot growth were recorded 55 days after planting. After washing gently using a water hose total roots on a cutting were counted, and the longest root in a cutting was measured. Retention of older leaves and the growth of new leaves on a plant was also recorded.

### Statistical analysis

The general linear model (GLM) of Statistical Analysis System was used to perform analysis of variance (ANOVA) and means were compared (SAS version 8.2, 1999-2001). Unless otherwise stated, statistical significance was tested at the 5% level ($P < 0.05$).

**Table 1. Effect of sand (coarse and non-sterilised S), commercial plant growth media (CM) and 50% mixture of sand and commercial media (M) on root and shoot growth of *Ficus benjamina* cuttings in a glasshouse.**

| Plant growth media | Root growth | | Shoot growth | |
|---|---|---|---|---|
| | Live Root Number | Root length (mm) | Retained leaves (no) | New leaves (no) |
| S | 10.8 | 5.32[b] | 2.71 | 1.18[b] |
| M | 9.5 | 7.80[a] | 3.31 | 3.18[a] |
| CM | 9.3 | 6.98[a] | 2.58 | 3.00[a] |
| LSD 5% | 1.6 | 1.27 | 0.73 | 0.65 |
| SEM | 0.5 | 0.45 | 0.26 | 0.23 |
| P- value | 0.1318 | 0.0007 | 0.1128 | 0.0001 |

Note: Means within a column with the same letter were not significantly different.

## Results

Evaluation of sand as plant growth medium There was no difference in number of roots per cutting for the three treatments. Also, there was no difference in old leaf retention per cutting. M and CM treatments had significantly greater root length per cutting than S and growth of new leaves was three times greater in M and CM than S. Root length and emergence of new leaves were in the order of CM=M>S.

## Discussion

Rates of root and leaf development were clearly better on cuttings growing in commercial medium than in sand (Table 1), but there were no differences between treatments in the number of surviving roots and leaves and no differences in cuttings survived. There is a strong correlation between number of roots and survival of plants (Ahmed, 2003)

Survival of *Ficus benjamina* hard wood cuttings was 26% during an initial trial, whereas in this trial survival was 93%. It is not clear whether the apparent growth advantage of cuttings in commercial rooting medium reflected the effect of medium structure (Navatel and Bourrain, 1994), nutrient supply (Dick *et al*., 2004) or avoidance of pathogens (Preece, 2003)

Automatic misting assists moisture maintenance in sand and farmers would need to water regularly and shade.

## Conclusion

Coarse and non-sterile sand can be a low cost alternative medium for rooting of *Ficus benjamina* cuttings.

## Acknowledgements

The authors gratefully acknowledge the New Zealand's Ministry of Foreign Affairs and Trade (NZAID) for financially supporting the PhD project without which this study would have been left incomplete.

## References

Ahmed, M.S., Abbasi, Nadim Akhtar and Amer, Muhammad. 2003. Effect of IBA on hardwood cuttings of peach rootstocks under greenhouse conditions. *Asian Journal of Plant Science* **2**: 265 -269.

Corner, E.J.H. 1978. *Ficus glaberrima* Bl. and the pedunculate species of *Ficus* subgen. *Urostigma* in Asia and Australasia *Philosophical Transactions of the Royal Society of London*, B **281**: 281 - 371.

Danthu, P., Gaye S.P., Sarr. A., Seck M and Thomas, I. 2002. Vegetative propagation of some West African Ficus species by cuttings. *Agroforestry systems* **55**: 57-63.

Dick, J.M., Leakey, R.R.B., McBeath, C., Harvey, R.,. Smith R.I and C. Woods. 2004. Influence of nutrient application rate on growth and rooting potential of the West African hardwood Triplochiton scleroxylon. *Tree Physiology* **24**: 35 - 44.

Elliott, S., Navakitbumrung, P., Kuarak C., Zangkum, S., Anusarnsunthorn V and Blakesley, D. 2003. Selecting framework tree species for restoring seasonally dry tropical forests in northern Thailand based on field performance. *Forest Ecology and Management* **184**: 177 - 191.

Joshee, N., Bastola, D.R., Agrawal V.P., and Yadav, A.K. 2002. Lakoocha: A Multipurpose Tree of Warm Climate p. 405–406. In: Janick, J and Whipkey A. (eds.), *Trends in new crops and new uses*. [Online]. Available by ASHS Press, Alexandria, VA. http://www.hort.purdue.edu/newcrop/ncnu02/v5-405.html.

Kshatri, B.B. 2001. Forage Development Model in Nepal: A Review. *Proceedings of the 4th. National Animal Science Convention*. Nepal Animal Science Association (NASA) July 2001, Kathmandu Nepal 4rth.:110 - 114.

Maithani, G.P., Bahuguna, V.K and Sood. O.P 1987. Maturity indices and pre-treatment studies on the seeds of *Ficus benjamina*. *Indian Forester* **113**: 6 - 10.

Navatel, J.C., and Bourrain L. 1994. Influence of the physical structure of the medium on in vitro rooting. *Advances in Horticultural Science* **8**: 57 -59.

Preece, J.E. 2003. A century of progress with vegetative plant propagation. *HortScience* **38**: 1015-1025.