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Propagation of *Ginkgo biloba* Linnaeus through air-layering in tropical conditions of West Bengal, India

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Abstract
Ginkgo biloba Linnaeus (Ginkgoaceae), the maidenhair tree, is recognizably similar to fossils dating back to 270 million years. It is variously used in traditional medicine and as an ornamental plant. Almost no or little attention is given in India regarding its cultivation, conservation and management. The present study established the air-layering technique for the vegetative propagation of the species. As much as 80% of air layering has successfully developed roots. This is a low cost and short duration method through which good number of plants can be produced in tropical conditions, which are expected to be better resistant to different odds and can survive on their own roots.

Keywords: *Ginkgo biloba*, Propagation, Air layering, Pest resistance, Conservation.

Introduction

Ginkgo biloba Linnaeus (Ginkgoaceae) is commonly described as 'living fossil' because it is the sole survivor of an ancient group of trees older than Dinosaurs (Purohit *et al.* 2009). It is commonly called ginkgo or maidenhair tree, is a long-lived, deciduous, shade tree native to China (He *et al.* 1997) that can reach a mature height of over 30 m and is the only genus and species of Ginkgoaceae existing today (Li 1956). During autumn, the fan-shaped leaves turn golden yellow, then fall within a short pace of time. A combination of resistance to diseases, insect-resistant wood and the ability to form aerial roots and sprouts rendered ginkgos long-lived, with some specimens claimed to be over 2,500 years old (Del 1991).

Economically Ginkgo is a very important plant. It is used medicinally approximately for last 5,000 years (Bensky & Gamble 1986). In Chinese traditional medicine, it is applied to treat bronchitis, asthma and various brain disorders (Davies *et al.* 2003; Chan *et al.* 2007). The seeds of ginkgo are also used to assist digestion and to reduce the intoxicating effects of alcohol (De Feudis 1998). Leaf extract of this plant is used to the cure of immune system dysfunction, circulatory problems and cognitive disorders, including memory loss (Chandrasekaran *et al.* 2003).

On the other hand this plant can tolerate high level of pollution and attack of insects. For these reasons and for their general beauty, ginkgo is grown as a shade tree besides growing them in the monasteries and temples (Honda 1997). Despite of having so many important qualities, this species has not received much attention as far as its conservation is concerned particularly in India though quite a good number of plants are growing mostly in the temperate regions of this country. Since its sexual reproduction shows some difficulties mainly for its dioceious nature and the low rate of seed germinability the propagation of the plant becomes difficult. Its seeds are recalcitrant and are not able to maintain germinability for a long time (Tommasi *et al.* 1999). Hence, the vegetative propagation of ginkgo has provoked interest. There are some reports regarding its vegetative reproduction by stem cutting (Dirr & Heuser 1987; Doran 1954; Natalia 1994; Purohit *et al.* 2009) but no information is available in literature for the cultivation of *G. biloba* through air layering which is a method widely used in horticulture for the above ground rooting of stems while still attached to the parent plant. When sexual reproduction is hampered by different reasons, air layering can be used for the production of large number of good-sized planting

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materials in a short time. Air-layering is especially attractive because the frequent monitoring and specialized facilities for propagation required for leafy cuttings are not needed for this. This method has been tried sufficiently in many species of gymnosperms as well as angiosperms (Bid & Mukherjee 1969; Desai & Patel 1984; Tyagi & Patel 2004). So, the main aim of the present study was the large-scale multiplication of *Ginkgo biloba* by air layering for its conservation and management especially in tropical conditions in India.

Materials and methods

The propagation experiment was conducted in the Garden of Medicinal Plants of North Bengal University which is located at 26° 42.645' N latitude and 88° 21.352' E longitude, at the feet of the Eastern Himalaya with an average altitude of 132 m amsl and in tropical climatic conditions (Das & Ghosh 2009). The experiment was carried out during the years 2012 – 2014. Eight years old two *Ginkgo biloba* Linnaeus plants growing inside a Net House were selected for this study. The selected plants were healthy, well matured and uniform. Air-layering was done during May – June with the onset of monsoon. Erect growing branches of ±1 cm in diameter, minimum two year old, were selected for layering. The bark, together with vascular cambium and phloem, was completely removed from the old stem part in the form of a ring from ±2.5 cm area (PLATE – I: Figures 1 & 2; Mishra & Agarwal 1975). The distal cut was then coated with commercial Cutting Aid powder (PLATE – I: Figure 3) that contains Indole-Butyric acid (IBA). A moist mixture of green manure and soil in the ratio of 1:2 was applied around the wounded area (PLATE – I: Figure 4) and wrapped first with polyethylene film (PLATE – I: Figure 5) to retain moisture and then with aluminum foil (PLATE – I: Figure 6) to reflect sunlight and to protect the polyethylene film. This procedure is a slight modification of traditional methods using sphagnum moss (Hartmann & Kester 1983) or coir fiber and was adapted from a report by Hare (1979). The branches were checked weekly for signs of rooting seen through the polyethylene.

Results and Discussion

In most of the trees clonally propagated plant parts primarily grow much faster (Schreiner 1939) and the juvenile stage of development can be bypassed (Thulin & Faulds 1968). However, air-layering is a common vegetative propagation technique of horticulture used for trees and shrubs (Eganathan *et al.* 2000). In the present study all the air layers showed a rooting response after 6 weeks (PLATE – I: Figure 7). After 8 weeks of application of this technique, observation was taken. The success rate of rooting was extremely high with 8 out of 10 branches i.e. 80% in first year were rooted. And, in the second year five out of six air-layers (i.e. 83%) were rooted. Ten weeks after air-layering, rooted branches were gradually detached from the mother plant. Branches were then transplanted into earthen pots after removing the polythene sheet without disturbing the roots (PLATE – I: Figure 8). The pot soil was a mixture of garden soil, pressed peat and vermicompost in the ratio of 1:1:1. Pots were then kept in nursery net house covered with 50 % green agro-net (PLATE – I: Figure 9). Plants were kept under polythene cover for about 10 days to maintain high humidity for reducing transpiration. Similar results were noticed by many authors in different plants like *Excoecaria agallocha* Linnaeus, *Heritiera fomes* Wallich *ex* Buchanan-Hamilton and *Intsia bijuga* (Colebrook) O. Kuntze (Eganathan *et al.* 2000), *Litchi chinesis* Sonnerat (Chauhan *et al.* 2008) etc. which are commonly propagated by air-layering method.

By the time when these rooted-branches were detached and potted, the monsoon starts retreating from the area, ambient temperature starts reducing and like many other deciduous species, *Ginkgo biloba* also stops growing. So, these plants are maintained with little care until the next sprouting time after winter.

So, air-layering was highly successful for this study. By this method we can produce huge number of planting materials in a short time with nominal expenditure. Besides, saplings produced through this air-layering technique, using matured and healthy trees in the field are subjected to both biotic and abiotic stresses without any artificial control

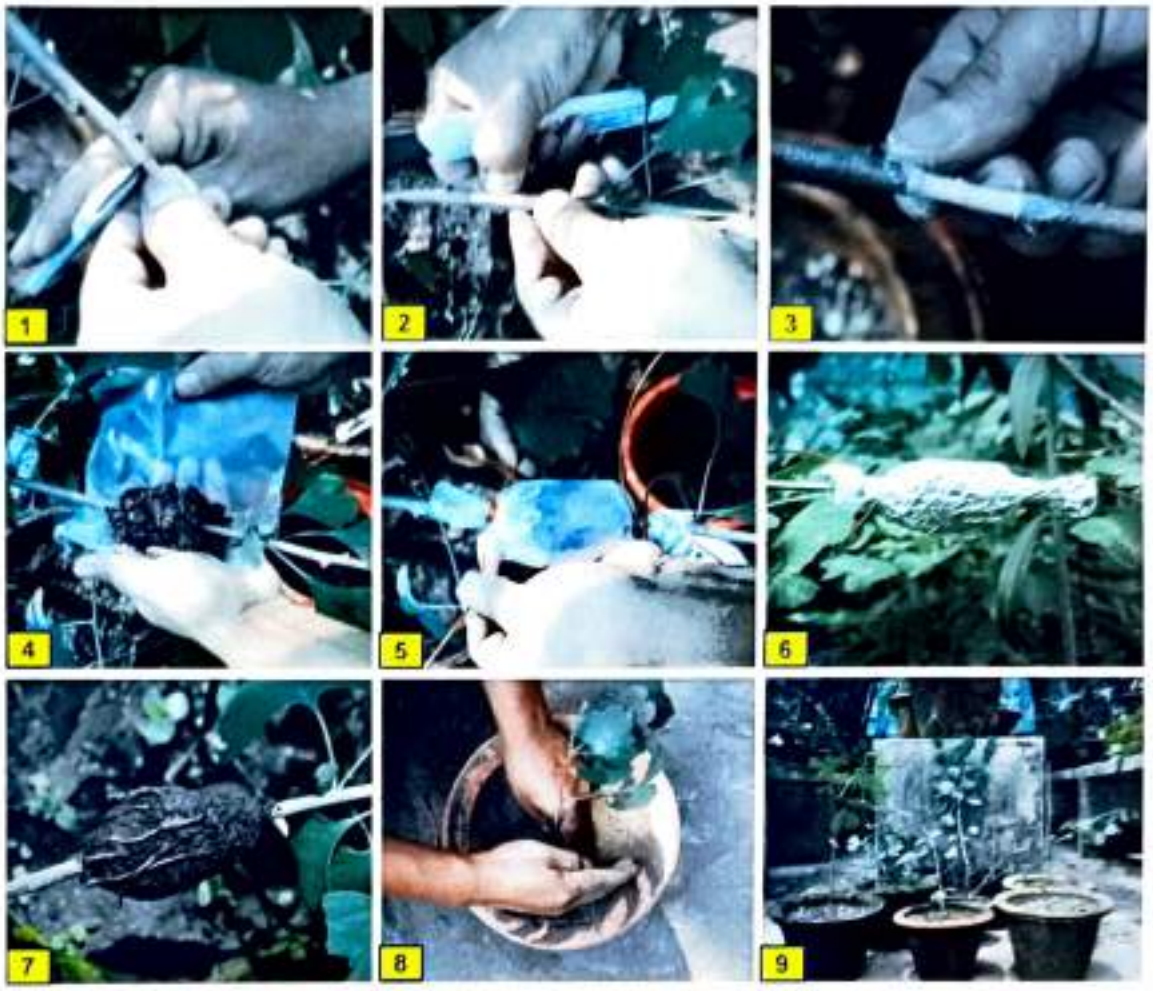

PLATE – I: Figure 1. Cutting two girdles on bark, 2.5 cm apart; **Figure 2.** Bark was removed from the area between the two girdling cuts; **Figure 3.** Rooting hormone was applied; **Figure 4.** Soil mixture was placed around the wounded area; **Figure 5.** Polyethylene film was wrapped around the ball of soil; **Figure 6.** Aluminum foil was used to cover the air layering; **Figure 7.** Roots were developed in air-layer after 6 weeks; **Figure 8.** Rooted branches were planted in earthen pots; **Figure 9.** Newly produced plants are growing inside the nursery net house.

(e.g. fungal, bacterial infection, fluctuation in environmental conditions viz. temperature, light, rainfall etc.). Thus the saplings are produced through this method are more adaptable with the local ambient environment and are resistant to diseases and pests in the nature.

Conclusion

From the results of the present experiment it may be concluded that vegetative propagation through air-layering method is quite suitable for *Ginkgo biloba*. Plants developed through this method perform nicely in tropical environment and are growing with their own root. The technique is simple and needs no precision conditions for the entire operation.

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