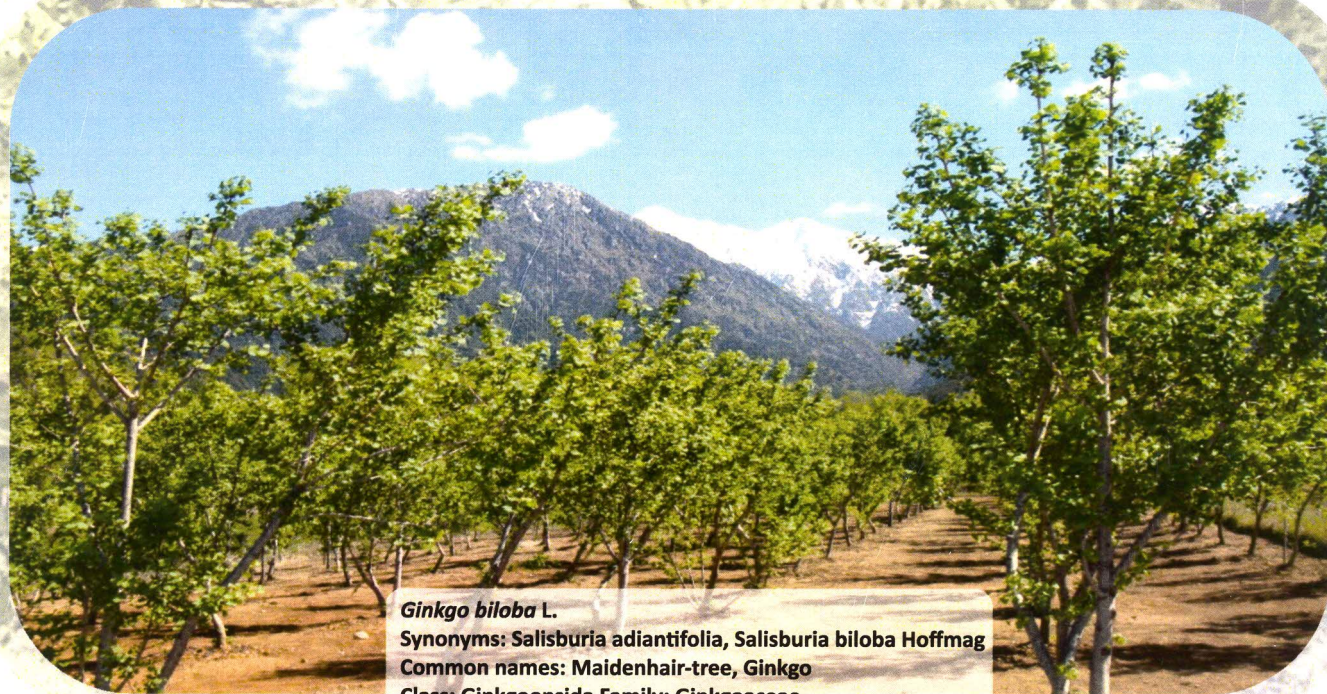


# STANDARDIZED PROPAGATION AND AGROTECHNIQUES OF *GINKGO BILOBA* L. - A MEDICINALLY IMPORTANT PLANT



*Ginkgo biloba* L.  
Synonyms: *Salisburia adiantifolia*, *Salisburia biloba* Hoffmag  
Common names: Maidenhair-tree, Ginkgo  
Class: Ginkgoopsida Family: Ginkgoaceae

*Ginkgo biloba* L. is a valuable plant for mankind since more than 5000 years and is considered as a “living fossil” of Jurassic period. *G. biloba* has been mentioned in the Chinese Materia Medica about 5000 years ago by Deng. Though its natural habitat is in China, Japan and Korea, but its place of origin is believed to be in the remote mountainous valley of Zhejiang province of eastern China. Hence, up to 350 years ago, knowledge about this plant resource was limited to China. As per the surveys done in India, more than 50% population of *G. biloba* was found near the extinction stage.

Linnaeus (1771) was the first pioneer who described *G. biloba*. The English term “Maidenhair tree” is used for it, which is due to its resemblance to the foliage of the “Maidenhair fern” (*Adiantum*). In Japan, it is known as “Ginkyo”. In France, it is known as “L'arbre aux Quarante ecus” and “Noyer Du Japon”.

## Need of Conservation

As per the report of a London based management consultancy the *G. biloba* is a species, which urgently needs conservation because of its global use in herbal medicines. The demand of *G. biloba* in the world is increasing from 26 to 32% every year. In India only 30 trees of *G. biloba* are recorded of which 60% are below the age of 30 to 35 years, rest 40% are in semi dried condition, i.e., just about to die due to illegal commercial exploitation as most of its branches and bark have been removed from the plant. In different continents, *Ginkgo* is reported to have achieved climax of its diversity during the Jurassic period, which declined rapidly at the end of the early Cretaceous period. It's all relatives became extinct in other parts of the world. More than 300 scientific studies have been conducted on chemistry, pharmacology and clinical



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effects of its leaf. On the basis of experimental studies, *G. biloba* has a new era in human society.

### Distribution

The *G. biloba* tree surviving in the botanical garden of Utrecht is among the first ones that arrived in Europe in 1730. One of the last wild plants of *G. biloba* is reported to be in Zhejiang Province, China on the west peak of Tianmu Mountain (1506 m amsl). *Ginkgo* was introduced in Europe around 1730 and is widely cultivated as an ornamental tree in streets and parks. In the recent surveys done by scientists of CSIR-Institute of Himalayan Bioresource Technology, Palampur, India it was revealed that there are only 14 plants of *G. biloba* planted all over India, mostly in hilly tracts from north-west to north-east India.

### Medicinal uses

The *Ginkgo* tree has been of interest to mankind for more than 2000 years, making it one of the oldest known medicinal plants. The medicinal properties of *G. biloba* seeds were reported in "Pen Ts'ao Kang MLL". It is used for treating allergies, Alzheimer's disease, headache, asthma, tinnitus, impotence, circulatory disorders, eye disorders, diabetes, multiple sclerosis, brain-trauma. The extract of *G. biloba* leaves have been used in the cardio protective mechanism, myocardial ischemia and reperfusion injury its efficiency against environmental pollution tolerance to SO<sub>2</sub> and accumulation of sulphur. In China, Korea, France, Germany and United States, *Ginkgo* is a tree of great beauty, with a long span, highly resistant to insects, bacterial, viral infections and air pollution. Extract of leaves of *G. biloba* is among the top 10 commercial products in the world. Pharmacological

properties of its leaves include radical scavenging, improved blood flow, vasoprotection and anti-platelet activating factor activity. *Ginkgo* extract is also known for its anti-ischemic, antioxidant and anticonvulsant properties. Moreover, the increasing research evidences support that the bioactive components of *Ginkgo* extract have significant therapeutic effects on age related physical and mental deterioration and on cerebral vascular insufficiency, e.g., Alzheimer's and cardiovascular disease. Among its constituents, bilobalide (BB), ginkgolide A (GA), ginkgolide B (GB), ginkgolide C (GC) and ginkgolide J (GJ).

**Soil:** *G. biloba* prefer clayey loam soil rich in organic matter and generally grows in acidic to neutral soil with soil pH value ranging from 5.11 to 8.05. Electrical conductivity of soil should be amid 0.07 M mhos/ cm to 1.965 M mhos/ cm. Organic matter content should vary from 0.974 to 15.02 %. The available nitrogen, available phosphorus and available potassium in soil must be between 191.29 to 686.78 kg/ha, 12.30 to 846.89 ppm, and 45.89 to 456.10 ppm, respectively.

**Climate:** *G. biloba* prefer temperature ranging from 10°C to maximum 25°C, relative humidity 60 - 85%, rainfall 1800 - 3200 mm and it likes bright sun shine. It is observed to grow well at the altitude of 500- 3600 m. During the growing season drought, hail storm, excessive rain fall, etc., affect the quality of the leaves.

**Cultivation:** *G. biloba* is a perennial plant, which is raised with a plant to plant spacing of 3 to 6 m. It prefers full sunlight and well drained soil with mean soil temperature 15 to 27 °C. A study on effect of physical treatment on germination of *G. biloba* seeds has confirmed that its seed viability decreases with time.

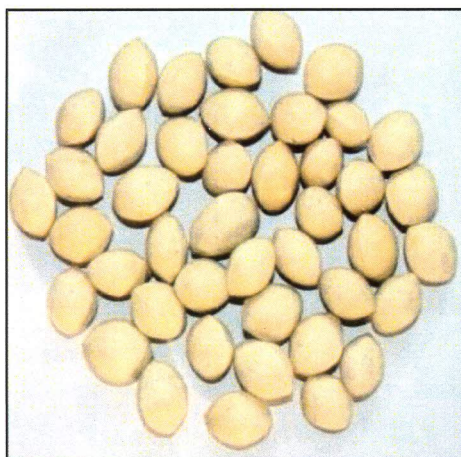


Fig. 1 Seeds of *G. biloba*

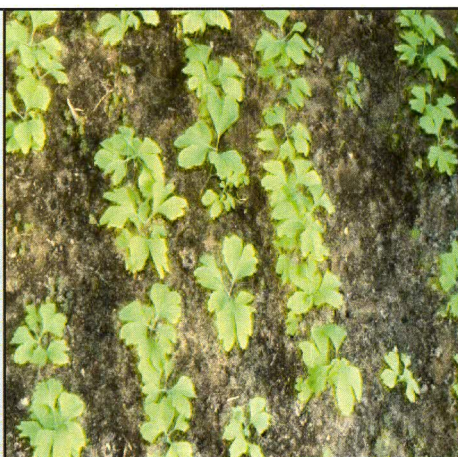


Fig. 2 Seedlings of *G. biloba*



Fig. 3 Nursery of *G. biloba*





Fig. 4 *G. biloba* propagation by seed



Fig. 5 *G. biloba* by stem cutting



Fig 6. *G. biloba* planting material



Fig . *G. biloba* transfer to the field



Fig . *G. biloba* plantation in field

**Propagation through seeds:** Seeds are stored in an incubator at 5°C for three months (Fig. 1). After every 15 day's interval, the seeds are dipped in ordinary water for five to six minutes; the seeds are washed and cleaned with a clean towel and all the water droplets are removed from the outer layer of the seed coat. The seeds are again kept in an incubator at 5°C. This process is applied after every 15 days of interval. Before sowing, in polyhouse under controlled condition, temperature 25°C±2 and humidity 70% is maintained. The old soil from beds is removed up to 8". A 2" layer of fine sand is spread in deep surface of the beds. In the middle layer 1:1:1 ratio (soil: FYM: sand) are thoroughly mixed and spread a 4" layer above at the fine sand layer. Again at the top a 2" fine sand layer is also spread out. The seeds are sown at 2" depth in the sand layer. The treatment of hormones IAA, IBA, NAA and Salicylic acid, 250mg/l, 500mg/l and 1000mg/l are taken and the seeds are dipped for three hours. One set are sown in polyhouse (Fig. 2) and 2<sup>nd</sup> in open bed covered with 50% agro-net providing partial shade as it

was observed that the under agronet shade no germination were recorded. Irrigation is done as and when it is required. The same culture media can be used in both the treatment. In controlled condition (Polyhouse), the seed germination was observed 85.74 % (Fig. 3 & 4).

**Propagation through stem cuttings:** It is done using semi hard cuttings (3-4 year old) of pencil thickness. The best results were observed in the cuttings taken from three year old side branches from mother plants. The stem cuttings should be 12-15 cm in length and 6-9 mm in diameter with 5-6 nodes. The stem cutting should be treated with some selected growth hormones using different concentrations. The cuttings have to be planted in the month of December in polyhouse under controlled condition (Fig. 5). The sprouting is observed in the month of April (91.33%), just after returning the normal climatic conditions after winters. The sprouted cuttings are placed in the poly house for three years under controlled conditions (temperature 25°C ± 2 and humidity 70%). After 4<sup>th</sup> year, these plants are shifted in



polythin sleeves (Fig. 6) and put for hardening under partial shade using 50% green agronet. CSIR-IHBT has raised more than 30,000 (thirty thousand) number of saplings by following above techniques and also has six acre area of plantations of this species in CSIR-IHBT research farms.

**Transfer to the field:** After 5 years, the nursery raised plants are ready to transfer in the field (Fig. 6 & 7).

#### **Results of field experimentation at CSIR-IHBT**

For field trial, the FYM doses were used @ 15, 30, 45 and 60 t/ha. This resulted in statistically significant plant height and relative growth rate/year. Among these, the lower doses of FYM 15t/ha has produced better plant height. In the field experiment (FYM x spacing), the fresh leaves were harvested in five consequent years viz. 2009 to 2013 in the month of November every years. In the year 2009 and 2010, FYM dose 30t/ha showed better performance (fresh weight of leaves) while in 2011, 45t/ha resulted in excellent and produced statistically significant fresh weight. In the year 2012 to 2014 the fresh and dry weight of leaves was observed to decrease. In the nursery about 30000 plants were raised during 2005 to 2007 in highly protected climatic conditions. The incubation period for nursery raising up to hardening was five year.

#### **Reproduction**

*Ginkgo* is a dioecious species, with male and female plants. The sexual maturities are attained during 20 to 30 years. Male and female sex organs are produced on short shoots, in the axils of bud scales and leaves. The male catkins emerge before the leaves and fall off immediately after shedding their pollen. Wind pollination occurs during early April in the regions with mild winters, and during late May in areas with severe winters. As the pollination ceases, it is difficult to say what is the maximum limit of dispersal of pollens, however in the Boston area no setback to seed setting was recorded even when the male and female trees were 400 m apart. Its ovules are 2 to 3 mm long and produced in pairs at the end of stalks 1.5 to 2.0 cm long. In receptive stage, it secretes a somewhat mucilaginous fluid from its micropyle, which facilitates trapping airborne pollen chamber. Once inside the ovule, the male gametophyte commences a 4 month long

development period that culminates into production of a pair of multiflagellated spermatozoids, one of which fertilizes a waiting egg cell while the ovules are still on the tree. Depending upon the date of pollination, the union can occur anytime from late August to late September. *Ginkgo* seed at maturation is large and consists of an embryo encircled, in the tissue of the female gametophyte covered by a thick seed-coat layer. The seed-coat consists of a soft, fleshy outer layer (sarcotesta), a hard, stony middle layer and a thin membranous inner layer. The seed contains fleshy sarcotesta, which is generally known as the *Ginkgo* nut.

#### **Harvesting and yield**

The plant is ready to harvest in the month of October end till mid of November. The leaves are plucked manually from the plant and these are dried under partial shade/ shade conditions for a week. The yield from its fresh leaves are 3.338t/ha after four year of plantation.

#### **Economics**

The total expenditure involved in this crop including nursery raising, plantation and all over management of the crop after 7-8 years is about Rs.241444 (Two lacs forty one thousand four hundred and forty four). As per our calculation in five year period, the expenditure on each plant was Rs. 200. The cost of its dry leaf is Rs. 300-400/kg. The dry weight of these leaves are 1.536t/ha, which cost around Rs.460800.00 Rs.300/kg. The net benefit is therefore Rs. 219356.00. The recurring expenditures for the plantations after 7-8 years will be Rs. 8000-10000/ha. However, the average yield and benefit ratio will increase every year. In 1<sup>st</sup> and 2<sup>nd</sup> year the income may be low but after 3<sup>rd</sup> year onwards all expenditure will be reduced and acquire higher income.

**Planting materials:** Planting materials can be obtained from CSIR-IHBT presently @ Rs. 200/plant.

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