

CULTIVATION OF *Aquilaria malaccensis* SEEDLINGS AS SMALL VENTURE FOR RURAL LIVELIHOOD IN ARUNACHAL PRADESH

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ABSTRACT

The *Aquilaria malaccensis* Lam., an economically important tree species, is proclaimed to be native of north-eastern India, however, cultivation of this species as business enterprise has not been taken up in Arunachal Pradesh till date due to lack of knowledge on this valuable plant among local people. Commercial plantations have been raised in southern India (Karnataka, Tamilnadu & Kerala) recently by public sector companies using north-eastern stocks that are earning huge income right from plantation to final products and in providing other services. The soil, topography, weather and micro climate of Arunachal Pradesh is quite amiable to a great extent for the agar cultivation hence this paper mainly aims to fetch the attention of local proprietors for adopting cultivation of this species as business entrepreneur. This paper comprises cultivation technique and other basic requirements for raising *Aquilaria malaccensis* seedlings in Arunachal Pradesh for profit-making and enhancing opportunities for rural livelihood in the state.

INTRODUCTION

Aquilaria malaccensis is an economically important, medicinal and aromatic tree species of north-east India. Internationally, it is chiefly distributed in 10 Asian countries which include Bangladesh, Bhutan, India, Indonesia, Iran, Malaysia, Myanmar, Philippines, Singapore and Thailand (Oldfield *et al.*, 1998). In India, this species is native to the hills of Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura as well as in West Bengal (Palit, 1996). The soil, topography and micro climate of Arunachal Pradesh is very much congenial for the agar cultivation (Palit, 1996). In Arunachal Pradesh, it is found under natural conditions and is widely distributed in forests in the rocky terrain of Tirap, Changlang, Dibang Valley, Lohit, Papum Pare, West and East Kameng districts (Palit, 1996). Two agarwood yielding species i.e. *Aquilaria malaccensis* and *A. cassiana* species of Agarwood tree were available in plenty in NE India which is proclaimed as home

for this species, however; after the 1980's all natural *Aquilaria* species have been disappeared due to illegal felling of trees in search of agarwood. Recently, using the growing stock from north east, many public sector companies have come up in the states of southern India especially in Karnataka, Tamilnadu and Kerala who are earning and getting huge profit out of this business and by providing other consultancy services as well. *Aquilaria malaccensis* is native in Arunachal Pradesh. But due to lack of knowledge of cultivation of this species in commercial level is found very less and no any company have been established in public sector to earn huge profit from this tree.

These trees become significant when heartwood of their standing trees impregnates with precious and fragrant resin as a result of fungal infections/wounding (Shrivastava *et al.*, 2008). It imparts a pleasant aroma hence used in perfumery and incense. The resin embedded wood turns dark brown or black in colour and bears acrid, bitter, warm and aromatic

properties. Agar-wood oil is said to be the most expensive wood in the world trade with prices over US\$ 30,000/kg for higher quality product (Barden *et al.*, 2000). It has been traded across Europe and Asia for more than 2000 years, mainly to consumers in the Middle East and China (Burkill, 1966) in the form of wood chunks, chips, and dust as well as processed goods such as essential oil, perfume, incense, and medicinal preparations (Chung & Purwaningsih, 1999 and Barden *et al.*, 2000). It is highly demanded for medicine, incense and perfumes across Asia and the Middle East. Agarwood also has been used in religious functions, for traditional medicines and aromatic preparations since ancient times. According to Chakrabarty *et al.* (1994), agar oil is valued and used in ointment for small pox as well as for various abdominal complaints (Compton & Ishihara, 2004). It is medicinally used as stimulant tonic, diuretic to expel gas; to treat asthma, cancer, colic, chest congestion, diarrhea, hiccups, nausea, nerves, regurgitation and rheumatism; to relieve spasms especially in the digestive and respiratory systems. The tree has now become extremely rare in the natural conditions; the reason may be the high rate of exploitation as a result of which the tree is also very expensive. Since 1995 *Aquilaria malaccensis* Lam., the primary source of agar wood, has been listed in the appendix II (potentially threatened species) by the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora. There is real danger that this species may become extinct if wild harvesting continues at the current rate. To conserve this species, it is vital that this plant becomes more widely grown in cultivation to reduce the pressure on the few wild populations that remain. The modern biotechnological approaches may also be adopted as safeguards for the future availability of this species and for the conservation of its genetic pool.

BOTANY OF *Aquilaria malaccensis*

Aquilaria malaccensis Lam. (Syn. *Aquilaria agallocha* Roxb.) is a tropical tree species belonging to the family Thymelaeaceae of order Malvales. The tree is a large evergreen grows from 20–35 m average height and may grow at the maximum of 40 m with 60 cm in girth at DBH (diameter at breast height). Inflorescence is terminal or axillary umbel type and

flowers are white and hermaphroditic. Fruits capsular, green and bears 1 or two seeds, egg-shaped with leathery exocarp with fine hair, about 4 cm long and 2.5 cm wide. Generally, the flowering starts from April onwards and continued up to July. Seeds mature from the period of June-September.

SOIL AND OPTIMUM CLIMATIC CONDITION

Agar tree can grow variety of soils even in dry land also if the irrigation system is managed but prefers mainly wet and acidic soil with high organic contents. Agar tree grows well on sandy to sandy clay soil to produce moderately straight stem. Extremely marshy conditions are not suitable for this tree species. It grows best at the foothills where heavy soils developed from gneiss and metamorphic rocks hence landscape of Arunachal Pradesh especially foot hills & slopes are ideal for growing agarwood tree.

The species grows well between altitudes of 100 m up to 1000 msl with temperatures ranging from 20-25°C (Keller & Sidiyasa, 1994 and Wiriadinata, 1995), annual rainfall of 1000-3500 mm and relative humidity between 60% and 80%. Fungi which are responsible for agarwood formations are aerobiological origin and they need high humid climate where moisture content is very high.

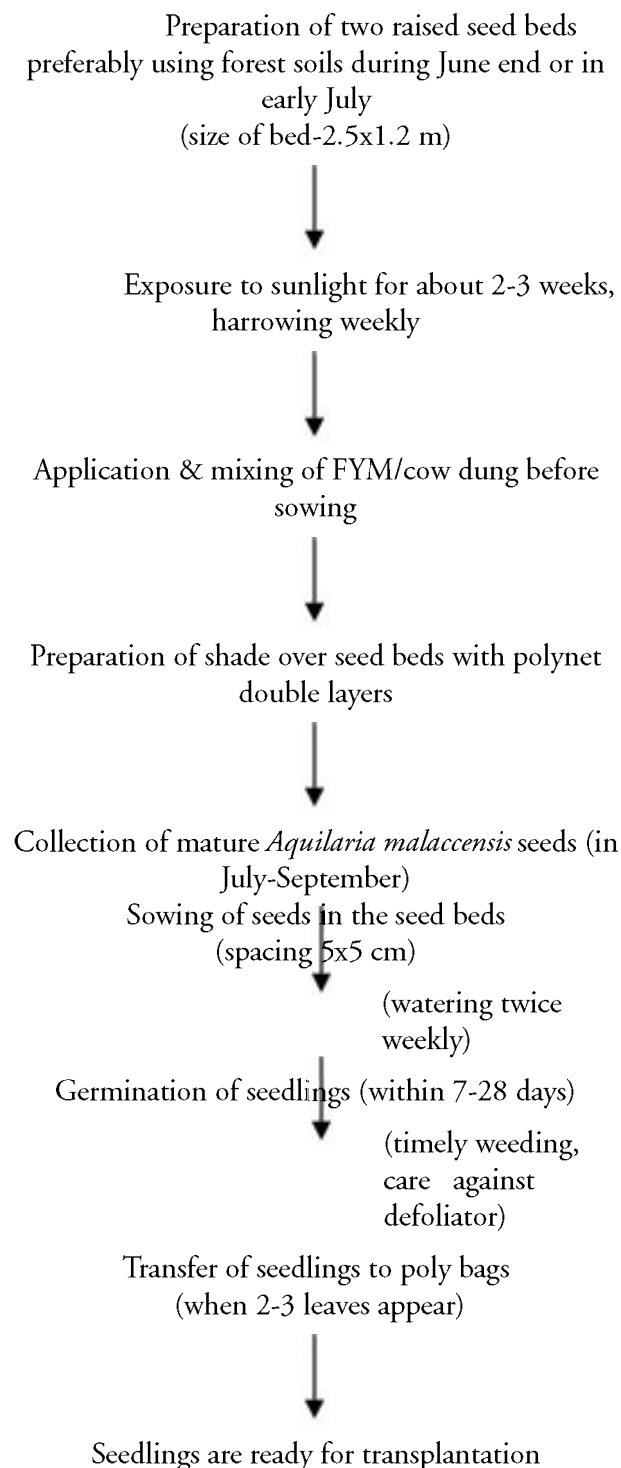
SUITABLE SEASON FOR GERMINATION

Mature agar seeds become available during the period from June to September. The maturity of the capsule can be judged when the capsules split open easily by applying little pressure between two fingers. The knowledge of seed character, germination behavior, storage effect and seed and seedling vigour is necessary for the production of healthy seedlings for raising a successful plantation. The *Aquilaria malaccensis* seeds viability under ordinary storage is very short ranging from 1-15 days only with about 90% germination (Tabin, 2012) hence mature seeds should be sown immediately preferably within 2-5 days after collection to get a higher germination percentage and seedling survival.

CULTIVATION PRACTICES

To conserve the agarwood tree from the threat of extinction and to support socio-economic

development is possible only by regular cultivation. The Agar tree naturally regenerates from seeds and the natural regeneration through seeds is quite fast (Troup, 1986). The Agar seedlings become ready for transplantation when they are about 1-1½ years of age or 1-2 ft. in height (Figure 1).



after 1-1½ yrs. or 1-2 ft. in height

Fig. 1: Flow diagram of the cultivation process

1. Preparation of seed bed

1.1. Size of beds

For germination of seeds, raised type of seed beds are recommended as seedlings are sensitive to soil high moisture and water loggings. For approx. 1000 *Aquilaria* seedlings, two seed beds of 2.5x1.2m size may be sufficient.

1.2. Soil preparation

Seeds of *Aquilaria malaccensis* do not germinate or get died in extremely marshy conditions. Dry land or infertile soil or lack of organic contents hampers seed germination. Application and mixing of Firm Yard Manure (FYM) or cow dang with soils are recommended to use in the seed beds before seed sowing. Soil rich in organic contents do not need any manure.

1.3. Introduction of mycorrhiza

The Arbuscular Mycorrhizae (AM) is considered as biofertilizer and help in increasing total vigor of any plant species. They colonize the root provides positively growth response through increase in phosphorus (P) uptake despite low P availability in the soil (Moyersoen *et al.*, 1998). Roots of *Aquilaria malaccensis* have been reported to form mutualistic associations with AM fungi. Appropriate AM fungi may be used and inoculated during seed sowing for later better development of seedlings (Tabin *et al.*, 2009).

2. Sowing of seed in beds

Seeds of *A. malaccensis* have very short viability period. Therefore, mature seeds should be sown in seed beds at a spacing of 5x5 cm between seeds as well as rows immediately after collection preferably within 1-5 days but not late than 10 days to get a higher seed germination percentage, better seedlings establishment and survival.

3. Quantity of seeds

One kilogram fruits are more than enough for raising 1000 seedlings. Depending upon the size of

seed beds and weight of seeds, quantity of the seeds for sowing can be measured. *Aquilaria malaccensis* bears 1 or 2 seeds/fruit. Under healthy condition, it produces approximately 1300 seeds/ kg of fruits.

4. Care of seedlings

4.1. Watering

Special irrigation facilities does not required for agar plant. In dry weather, watering twice in a week is sufficient for normal growth and development.

4.2. Covering of seed beds with poly nets

The seeds of *Aquilaria malaccensis* are also very sensitive to heat, moisture and soil conditions. Naturally, seedlings germinate under canopy/shade in forests. Extreme heat damaged the seedlings hence seedlings they need protection from direct sunlight. In the nursery, seedlings should be grown in shade by providing double layered poly net shadings. Soils around the seedlings should be loose weekly so that plant grows well.

4.3. Weeding

Weeds also affect adversely the seedling growth of *Aquilaria malaccensis*. Timely weeding is necessary to grow healthy seedlings.

5. Transfer to poly begs

For commercial plantation, seeds from good yielding variety agar tree should be collected. To get best grade agarwood i.e. high and good quality of resin, fast growth, harvesting time etc., the choice of good yielding mother plant is important.

When the seeds get germinated and grow up to 4-5cm in height with 2-3 leaves, seedlings may be transferred in polybags. They become ready for transplantation after about 1-1½ years when they reach up to 1-2 feet height. The development of healthy seedlings in polybags are also depends upon soil mixture, soil volume, available soil moisture and nutrients etc. the development of bushy fibrous roots takes place from the primary, secondary and tertiary roots. It plays a great role in taking moisture and nutrients from the soil because of its large spread and coverage in the soil.

6. Insect & Past management

The young seedlings of *A. malaccensis* are very prone to insect and pest attack. The seedlings are heavily attacked by *Heortia vitessoides* Moore (Pyralidae: Lepidoptera), a major leaf defoliator and by grasshoppers which damage the leaf, vegetative buds and tender shoots causing adverse effect on the growth of the seedlings. These insect pests of Agar plant may be controlled by the application of green chilly extract @1kg/10L in the field conditions. Neem products, fungus based pesticides can also be applied. Chemical pesticides are not environment friendly so it is recommended to use botanical extracts as these extracts are effective and may be used as protectants without hampering non target organisms.

COST AND PROFIT INVOLVED

For cultivation and caring of the seedlings not much high cost is required. Labour charges are needed for collection of seeds, preparation of seed beds, seed sowing, caring of seedlings and transfer of seedlings to poly bags, which is quite less amount as compared to profit that one will get from selling of the seedlings. Seedlings of agar plant costs approx. Rs. 50/seedling. An approx. budget (cost and profit) for 1000 seedlings/year is given below:

Number of seedlings	Laour charges (INR.)	Price / seedlings (INR.)	Total price/ year (INR.)	Profit/ year (INR.)
1000	8000-10000	50	50000	38000-40000

Aquilaria malaccensis FOR RURAL LIVELIHOOD

Agar tree grows well on sandy to sandy clay soil to produce moderately straight stem. As the Arunachal Pradesh is a hilly state and exposed to practice of shifting (jhum) cultivation, there is scope to get more land for agar plantation in the fellow jhum lands. Even agar may be grown along with the agricultural crops in the jhum areas. Agar tree is a medium sized tree that may be cultivated either as main, mixed and border crop for shade loving crops. Cultivation of agarwood in home gardens and private lands may also generate sizable income and employment in the rural sector. The tribal people of Arunachal

Pradesh is chiefly depends on the forests for their livelihood. If they will grow this plant at a large scale for commercial purposes, they may get good profit and helpful in raising their socio-economic status and thereby contribute in the growth of the state as well. Agar cultivation in the jhum fellows and with agricultural crops may give new concept to modify it for higher productivity and will raise the economy and land used management of the local people in the state. The harvesting time of agar tree starts from 5 years onward and continues up to 50 years. The value of agar products is increasing in the national and international market day by day hence agar plantation gives great promises. Agar tree has drawn unique position in the world due to the presence of high quality and world's most expensive essential oil. The wholesale price for high quality agarwood oils is around US\$ 30,000 – 50,000 per liter, depending on the oil quality, which is based upon the fragrance strength and longevity, resin content, geographical origin, and oil purity (Heuveling van Beek & Phillips, 1999). State forest research institute under department of environment and forest of Arunachal Pradesh has been working on plantation and conservation of this important plant through various schemes which can be seen at places like Itanagar, Namsai, Karshinsa, Chessa, Tipi and Sijusa (Murtem, 2000). Now a few local people have been motivated and many have come forward with their own willingness to cultivate agar tree in their farm areas but still awareness among the people of Arunachal Pradesh needs motivation and encouragements.

CONCLUSION

The soil type, weather, climate, landscape and overall environment of Arunachal Pradesh are very suitable for agar plantation. The agar tree was abundantly found in forests of Arunachal Pradesh but now it is now very difficult to find in natural conditions. The government has banned its exploitation from wild. The cultivation practice of Agar tree is very simple, easy and profitable. In addition, cultivation of agar plant as small entrepreneur will help in the conservation of this tree species, enhance opportunities for rural livelihood and upgrade socio-economy of the state. For this purpose,

awareness programs may be organized by government of Arunachal Pradesh and different NGO's by giving emphasis on various benefits of this precious tree.

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