

Prospect of Agar (*Aquilaria malaccensis* Lamk.) Planting in Denuded Hilly Areas of Chittagong

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Abstract

Experimental planting with *Aquilaria malaccensis* Lamk. was undertaken to assess its suitability on denuded hilly areas of Chittagong, Bangladesh. Germination of the species was 70 percent, and the seedlings attained a height of 40-60 cm in the nursery at the age of one year. Average survival of the out-planted seedlings in four locations was 34.7 percent with 1.85m mean height and 1.92 cm mean diameter after three years. Survival and seedling increment decreased with increasing height of hill slope, apparently because of gradual low soil moisture content. Strong and direct sunshine seemed to have adverse effect on seedling survival. The prospect of *A. malaccensis* appeared to be uncertain for the denuded areas. However, further investigation needs to be undertaken.

সারসংক্ষেপ

বনায়নের উপযুক্ততা যাচাই-এর জন্য চট্টগ্রামাঞ্চলে ন্যাড়া পাহাড়ে আগর (*Aquilaria malaccensis* Lamk.) লাগান হয়। এ প্রজাতির অঙ্কুরোদগমন ৭০ শতাংশ এবং এক বছর বয়সে নার্সারীতে এর উচ্চতা ৪০-৬০ সেঃমিঃ হয়। চারটি বনায়নের স্থানে তিন বছর পর বেঁচে থাকার গড় ছিল ৩৪.৭ শতাংশ এবং গড় উচ্চতা ও গড় ব্যাস ছিল যথাক্রমে ১.৮৫ মিঃ ও ১.৯২ সেঃমিঃ। চারার বেঁচে থাকার হার পাহাড়ের উচ্চতা বৃদ্ধির সাথে সাথে হ্রাস পায় যা মাটির আর্দ্রতার কারণে হচ্ছে বলে আপতঃ দৃষ্টিতে মনে হয়। সূর্যের তীব্র ও সরাসরি কিরণ চারার বেঁচে থাকার উপর বিরূপ প্রভাব ফেলে। উন্মুক্ত পাহাড়ে *A. malaccensis* চাষ করা অনিশ্চিত, অবশ্য এ বিষয়ে আরও অনুসন্ধান করা প্রয়োজন।

Key words : Agar, *Aquilaria agallocha*, Bangladesh, denuded hills, performance, planting

Introduction

Aquilaria malaccensis Lamk. (Syn. *Aquilaria agallocha* Roxb), (Family-Thymelaeaceae), locally known as agar, is a moderately tall and erect evergreen tree. It may grow to a height of 20m and a girth of 2.5m. The species is distributed naturally in India, Bhutan, Bengal and Myanmar. It is particularly found in Assam on hill forests of Khasia, Garo, Naga, Cachar and Sylhet (Anon 1948). The wood is soft and light. The main value of the species is the formation of dark colour,

resinous and aromatic substance in wood called agar (Troup 1921). In Bangladesh, *A. malaccensis* occurred naturally at Adampur of Sylhet forests but has become rare due to indiscriminate felling of trees for agar wood. Forest Department has plantations of agar at Lawachara of Sylhet (Das and Alam 2001).

Agar is highly priced material and is used for cosmetic, perfume and medicinal purposes (Anon 2001). Previously it was believed that agar formation was the result of fungal attack. However, Gibson (1977) suggested that agar formation was not related

to fungal activity. Rahman and Basak (1980) and Rahman and Khisa (1984) conducted studies on the relationship between fungal activities and agar production but with no conclusion and suggested further studies in this direction. In Bangladesh agar plantation was never raised commercially. However, Forest Department personnel casually planted agar in some localities of Sylhet and Chittagong and found the growth rate of this species to be satisfactory. At present about 25-30 families in Sylhet and Moulavibazar are engaged in agar processing using the raw materials mostly collected from abroad. Because of the value of agar, Bangladesh Forest Department undertook a pilot project for agar plantation in 1998-99 in the denuded hilly areas. In order to support the planting programme, and observe the feasibility of the species in denuded hilly areas, Bangladesh Forest Research Institute (BFRI) conducted studies on nursery and plantation techniques of agar. This paper is based on data collected from the experiments initiated in 1999 by the BFRI and experience gained during nursery raising and planting.

Material and methods

An agar plant was found to produce profuse and viable seeds from the age of ten years. Seeds of agar were collected in June by climbing the trees at Bilashchara (Srimangal) and Moulavibazar of Sylhet Division. These were cleaned manually and 1100g of seeds were sown in each bed (1.2m x 3m) at BFRI nursery in Chittagong. There were three beds. The seedbed was prepared by mixing cow dung and sandy soil in the proportion of 1:6. After seed sowing, the beds were protected from direct sun by shading. Watering of seedbeds when necessary was made till pricking of seedlings. Initiation and completion of germination and its success were recorded. The seedlings were transferred from the beds to polybags (15cm x 25cm) 25 days after germination. Seedling mortality and seedling height were recorded over time in the nursery. Shade was provided to the polybag seedlings for two months after pricking from the beds. The seedlings were maintained in the nursery for one year. Regular watering, weeding and rearrangement of bags were made during this period.

One-year-old seedlings were outplanted at four sites *viz.*, Hinguli, Korarhat, BFRI campus and Padua under Chittagong Division (Fig.1). The original tree vegetation of these denuded areas included *Dipterocarpus alatus*, *D. turbinatus*, *Anisoptera scaphula*, *Hopea odorata*, *Syzygium grande*, *Artocarpus lakoocha*, *A. chaplasha*, *Albizia* spp., *Gmelina arborea*, etc (Das 1990). Vegetation of the denuded areas included grass and climber like *Ipomoea fistulosa*, *Hyptis suaveolens*, *Smilax roxburghiana*, *Imperata cylindrica*, *Eupatorium odoratum*, *Clerodendrum viscosum*, etc. The plantation sites were in the low hills with gentle to medium slope gradient. However, at Podua, the slope was medium to steep and thus allowed observing the effect of increasing height of site on the performance of planted seedlings. The annual rainfall of these areas is in the range of 2500 to 3500mm with an average temperature of 20°-30°C. The elevation of sites from the mean sea level is within 10-40m. The soil is generally deep being the effective soil depth 0.5-1.0m. Soil moisture is Udic. Soil texture varies from sandy clay loam to silty clay loam. Soil is acidic, p^H ranges from 4.5 to 6.0. Organic matter content is low to medium, and up to 30cm depth it varies from 1.2 to 1.8 percent. The available nutrient (NPK) is low.

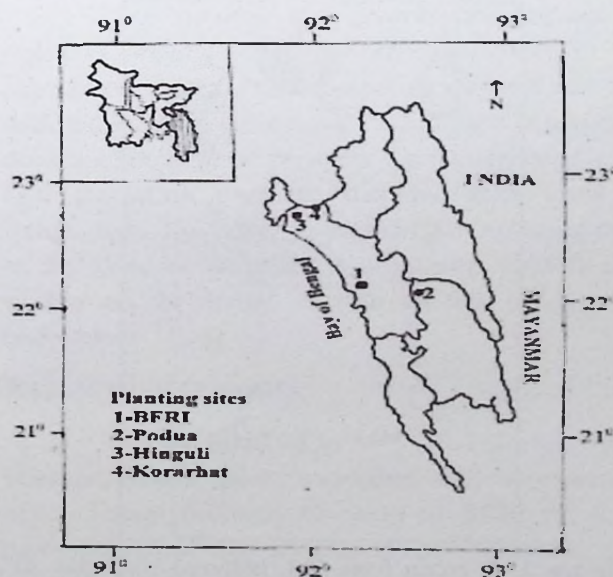


Figure 1. A map of Chittagong Division showing the locations of planting sites.

After weeding, climber cutting and jungle clearing a total of 2500 seedlings were planted in four locations (Fig. 1) covering an area of about 4 hectares. The planting spacing was 2.5m x 2.5m. At Podua the experiment was laid out in a Completely Randomized Design (CRD) along the slope of a hill. Prior to planting in July during the monsoon each planting pit was provided with 50g (1:1 TSP and Potash) of fertilizer. Weeding was made thrice a year. Gap filling was undertaken 10 months after initial planting with two-year-old seedlings. Last data on survival, seedling height and diameter (at breast height) were collected three years after outplanting.

Results and discussion

Fruit and Germination

The fruit is capsule, 3.5-5cm long, ovoid and brown when matured (Fig. 2). The pericarp is coriaceous, hard, woody and thinly velvety. A fruit contains 3-4 seeds. One kilogram (kg) contains 650-680 fruits, which provide approximately 1050-1100 seeds. The germination is epigeal. It started from seven days after sowing and continued up to 30 days. Average germination in three beds was 70 ± 1.5 percent as obtained from sowing 1 kg seeds.

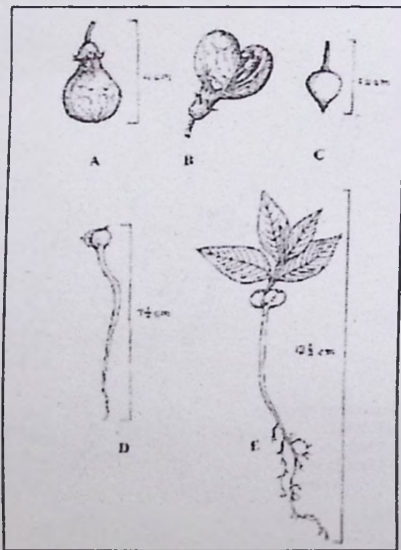


Figure 2. A green fruit (A), matured fruit (B), seed (C), germinating seedlings (D) and one month old seedling (E) of *Aquilaria malaccensis*.

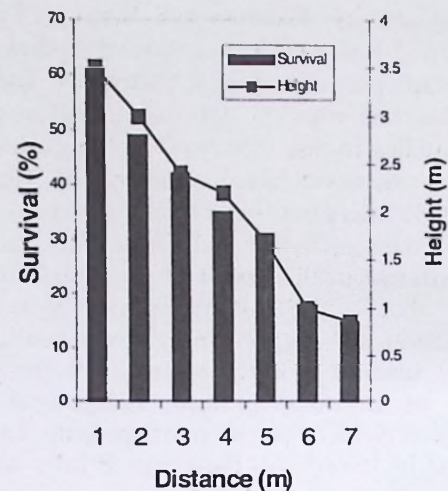


Figure 3. Survival and tree height on slope against distance from base to top hill at Padua.

Pricking and Seedling Growth

The seedlings attained a height of 6-8cm with 3-5 leaves in 15 days when they were suitable for pricking and transfer to the polybags (Fig.2). Pricking could safely be undertaken between 15 and 30 days following germination. Seedling mortality after pricking out was almost 15% usually due to fungal attack. According to the suggestion of the Forest Protection Division of BFRI the fungicide Cupravit (Copper-oxychloride) was sprayed. Afterwards the seedlings were not found to die in the nursery. The seedlings grew to a height of 40-60cm at the time of outplanting, *i.e.*, at the age of one year.

Survival and Growth after outplanting

It was possible to raise healthy seedlings of agar in the nursery. But initial mortality of seedlings was high during first year after outplanting in all the four locations. Average survivals at site 1,2, 3 and 4 were 40.7, 37.3, 29.5 and 31.4 percent respectively after 3 years (Table 1). Draught seemed to be one of the main causes of high mortality. At site-2 greater proportion of planted seedlings on the southern aspect of the hill died, possibility due to direct sunshine. Survival and vigour of seedlings on the northern aspect were satisfactory indicating preference of the species for certain level of shade at

Table 1. Height increment of planted seedlings of *Aquilaria malaccensis* at different sites and their diameter growth and survival rate when 36 months old.

Sites	Height (m) over time (months)							Diameter (cm)	Survival (%)
	0	6	12	18	24	30	36		
BFRI (Site-1)	0.5	0.7	0.8	1.0	1.5	1.9	2.4	2.72	40.7
Podua (Site-2)	0.5	0.6	0.7	0.9	1.0	1.3	2.1	2.04	37.3
Hinguli (Site-3)	0.5	0.6	0.9	1.1	1.1	1.2	1.3	0.92	29.5
Korerhat (Site-4)	0.4	0.5	0.7	0.9	1.1	1.3	1.6	1.98	31.4
Average	0.48	0.60	0.78	0.98	1.18	1.43	1.85	1.92	34.7

Table 2. Performance of 3 year old seedlings of *Aquilaria malaccensis* planted at different positions of hill slope (top, middle, base) at Podua (Site-2).

Location on the slope	Mean survival (%)	Mean height (m)	Mean diameter (cm)
Top	15.2±1.15 c	1.13±0.09 c	0.98±0.07 c
Middle	37.2±2.03 b	2.05±0.07 b	2.13±0.14 b
Base	59.4±2.31 a	2.77±0.17 a	3.01±0.24 a

Means followed by different letters differ significantly at 5 % level.

the initial growing stage. Again survival appeared to be related to soil moisture content. Thus mean survivals after 3 years for top, middle and base of the hill slope were significantly different ($F= 43.1$; $P< 0.01$) being 15.2, 37.2 and 59.4 % respectively (Table-2). However, it was noticed in all the sites that the seedlings also died due to water stagnation. This indicates that the species will not grow in waterlogged condition.

With regard to growth, mean heights of the planted seedling in four sites varied between 1.3 and 2.4m at the age of 3 years. However, some plants grew vigorously and attained a height of up to 4m. Mean diameter at breast height varied from 0.92 to 2.72cm. Here also in the same site, variation in diameter increment of different plants was remarkable. At site-2 the plants grew to a height of 2.77m at the base, 2.05m in the middle and 1.13m at the top of the hill slope. The corresponding values for diameter were 3.01, 2.13 and 0.98cm. With decreasing elevation there had been significantly increasing height ($F=145.0$; $P< 0.01$) and diameter ($F= 12.6$; $P< 0.01$). So the growth of the trees decreased with increase in height of hill slope apparently with gradual low soil moisture content

(Table 2, Fig. 3). Similar relationship with regard to increase in elevation and growth of tree species on hills of Chittagong was found by Temu *et al.* (1988).

Conclusion

The survival and growth performance of *Aquilaria malaccensis* was not satisfactory in the experimental sites. Planted seedling survival was low with slow initial increment. Preliminary assessment does not reveal good prospect for raising large-scale agar plantation over the denuded hilly areas of Bangladesh. Moreover, a method for inducing agar in the wood of the plant is unknown. Thus further studies on the future of this species need to be undertaken.

Acknowledgements

We are thankful to M/S Abul Bashar, Abul Hossain, Abdus Salam and other staff members of Minor Forest Products Division of BFRI for their participation in the execution of fieldwork and collection of data from the research plots, and to Mr. Md. Shahadat Hossain for typing the manuscript.

References

- Anonymous 1948. *The Wealth of India*. Vol.A.B.; CSIR, New Delhi. pp. 89-90.
- Anonymous 2001. Products and markets. *Non-Wood News* 8: 37- 40.
- Das, D.K. 1990. *Forest Types of Bangladesh*. Bulletin 6, Plant Taxonomy Series. Bangladesh Forest Research Institute, Chittagong. 9 pp.
- Das, D.K. and Alam, M.K. 2001. *Trees of Bangladesh*. Bangladesh Forest Research Institute, Chittagong. 342 pp.
- Gibson, I.A.S. 1977. The role of fungi in the origin of oleoresin deposits (Aguru) in the wood of *Aquilaria agallocha* Roxb. *Bano Biggyan Patrika* 6 (1): 16-26.
- Rahman, M.A. and Basak, A.C. 1980. Agar production in agar tree by artificial inoculation and wounding. *Bano Biggyan Patrika* 9 (1&2): 87-93.
- Rahman, M.A. and Khisa S. K. 1984. Agar production in agar tree by artificial inoculation and wounding. II. Further evidences in favour of agar formation. *Bano Biggyan Patrika* 13(1&2): 57-63.
- Temu, A.B.; Badruddin, A.Z.M. and Nur Ullah A.M.M. 1988. Effect of elevation on height and diameter growth for three broadleaf species. *Bano Biggyan Patrika* 18(1&2): 26-30.
- Troup, R.S.1921. *The Silviculture of Indian Trees*. Vol.3. Oxford University Press.785-1195 pp.