EP No: 25 / 2022-2023 AGARWOOD-BASED MULTIFUNCTIONAL AGROFORESTRY SYSTEMS FOR HIGH-INCOME GENERATION

Introduction

Agarwood (***Aquilaria malaccensis***) is a highly valued tree species known for producing aromatic resin used in perfumes, incense, and traditional medicine. Overharvesting and illegal trades have pushed the species to the brink of extinction, earning it a critically endangered status under IUCN and CITES regulations. Tamil Nadu presents an opportunity to cultivate agarwood commercially under agroforestry systems to reduce pressure on natural forests while boosting farmer incomes.

Agarwood is naturally distributed in semi-deciduous to evergreen forests at altitudes of 50 - 1200 msl on a large range of light- to medium textured soils of feralite, schist,granite and basalt. It also survives in well-drained soils with thick A-B layers, 0.6-1 m deep or more, 5-20 degrees of slope, with a yearly average temperature of 20- 80C and annual rainfall of 1500- 2500 mm. (It is observed that, this plant is coming up very well in some of the identified places like Neyveli, Nagapattinam, Cuddalore and Thirupatthur in tamilnadu. Eventhough these places does not comes under specified rainfall range, the trees are performing very well in terms of growth). Agarwood has been widely grown in the forests and agroforestry farms of the north east since 1990s. It is primarily grown to reduce soil erosion.

This experiment integrates agarwood cultivation with horticultural and medicinal intercrops in a Silvi-Horti Agroforestry system. The aim is to maximize land productivity, promote sustainable farming practices, and provide diversified income sources for farmers. Artificial inoculation techniques for resin production are explored as a faster alternative to natural infection, offering economic feasibility and high-value outputs in the later stage of experiment.

Objectives:

1. Assess the suitability of Agarwood under silvihorti Agroforestry systems.
2. Study the growth performance of Agarwood and intercrops under different spacing’s.

3. Examine fungal growth behavior in Agarwood after manual fungal inoculation.
4. Evaluate the economic feasibility of Agarwood cultivation through cost-benefit analysis.
5. Encourage research in artificial inoculation, sustainable harvesting, quality planting material development, and Agroforestry model establishment.

Materials and Methods

Superior Agar wood propagules purchased form local certified from the State of Tamil Nadu andseedlings were hardened at the Melchengam Research Centre..A 1-hectare experimental plot at Melchengam Research Centre was divided into four subplots.Land cleared of weeds and debris, ploughed twice before planting. Each subplot (0.25 ha) incorporated *Agar wood* with various horticultural and medicinal crops. Soil testing has been done initially. *Agar wood* plants have been planted at 4 different Espacement Viz., 5m x 5m, 5m x 4m, 4m x 4m , 4m x 3 m, with horti intercrop at an Espacement of 4m x 5m and medicinal crop planted at Espacement of 1.5 m x1.5m. The pit size is 50 cm^3 and each pit was filled with inputs such as Vermicasting 1/2 Kg, Vam 25 gm FYM, tank silt (1m^3 per 50 plants) and microbial cultures (Azospirillum and Phosphobacteria 10 gm each) as per the write-up. Each subplot 148 numbers of Agar wood seedlings have been planted and A total of **590 agarwood trees**, **1000 horticultural plants**, and **2500 medicinal plants** were planted. Horticultural intercrops & medicinal intercrops as detailed details as detailed below.

Table 1: Experimental Design:

Area	**1 ha.**
Spacing	5m x 5m, 5m x 4m, 4m x 4m , 4m x 3 m (for tree crop)
No. of trees planted	590 trees / ha.
Size of the pit	50 cm^3 for tree crop
Size of the pit	30 cm^3 for intercrop
Spacing	4m x 5m (for tree inter crop)

Spacing	1.5m x 1.5m (for medicinal crop)

Table 2: Sub-Plot Details:

Sub Plot Name	**Horticulture crop (125 no's each)**	**Intercrop (625 no's each)**
Sub Plot 1	*Areca catechu*	*Withaniasomnifera*
Sub Plot 2	*Artocarpus heterophyllus*	*Adathodavasica*
Sub Plot 3	*Syzigiumcumini*i	*Decalepishamiltonii*
Sub Plot 4	*Emblica officinalis*	*Alpinia officinarum*

OBSERVATION TO BE RECORDED:

1. Soil test will be done before planting and at the end if the experiment.
2. Initial height of the plants will be recorded.
3. Initial collar girth of the plants will be recorded.
4. Annual height will be recorded up to 5 years.
5. Survival percentage will be recorded with respect to various Treatments.
6. Phenological character will be recorded.
7. Meteorological data will be recorded.
8. Documentation will be done with photographs at every stage.
9. The seeds collected from respective tree will be recorded.
10. Fruits yield will be recorded and fruit yield table will be prepared from the horticultural crops.
11. Documentation will be done with photographs at every stage of fungal inoculation.
12. Cost-benefit analysis will be done to find best Agro-forestry combination.

Table 3 - Details of Morphometric data (Initial):

Sl. No.	Treatment	Planted	Survival		Avg. height
		(No.)	(No.)	(%)	(cm)
1.	Sub plot -1	80	80	100 %	65.72
2.	Sub plot -2	102	102	100 %	65.46
3.	Sub plot -3	135	135	100 %	64.93
4.	Sub plot -4	125	125	100 %	64.32
5	Sub Plot -5	80	80	100 %	65.21
	Total	**522**	**522**	**100%**	

***Aquilaria malaccensis* Nursery - 2023**

Field Preparation

Birds eye view of the experimental plot – November 2024

Table 3 - Details of Morphometric data (March 2024):

Sl. No.	Treatment	Planted	Survival		Avg. height
		(No.)	(No.)	(%)	(cm)
1.	Sub plot -1	80	80	(%)	(cm)
2.	Sub plot -2	102	102	100 %	94.41
3.	Sub plot -3	135	135	100 %	94.61
4.	Sub plot -4	125	125	100 %	95.96
5	Sub Plot -5	80	80	100 %	96.29
	Total	**522**	**522**	**100%**	

FINDINGS/INTERIM FINDINGS

1. **Agar wood survival rate:** 66.67% across all sub-plots, with the highest survival (73.6%) had registered in **Sub-Plot 4**with*Emblica officinalis* as intercrop.

2. **Horticultural crop survival rate:** 32.92% and highest survival percent had registred in *Syzigiumcuminii (*89%) is performing the best and *Areca catechu*had registered lowest survival 0%

3. Closer spacing (4x4 m and 4x3 m) improved agarwood survival compared to wider spacing.

4. Intercrops were prone to damage by wildlife (e.g., chitals), while agarwood remained unaffected.

5. Medicinal crops not planted and waiting for second-year funding for assembly and evaluation.

6. Artificial inoculation expected to enhance resin production in later stages of the study.

7. Agarwood with *Syzigiumcuminii and Emblica officinalis*had exhibited highest agarwood survival and growth compared to other different intercrops.

8. The experiment is ongoing.