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SELECTION OF SUPERIOR RACES OF KHAMER *(GMELINA ARBOREA)* THROUGH CLONAL PROPAGATION

TREE IMPROVEMENT BRANCH

STATE FOREST RESEARCH INSTITUTE
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Preface

Gmelina arborea is a fast growing deciduous species tree with numerous branches forming large shady crown of tropical & subtropical regions of the country. It is an excellent timber and source of raw material in pulp and paper industries. It grows on wide variety of soils but prefers deep sandy loam and avoids clayey and badly drained soils. Khamer is suitable for reclamation of wastelands, marginal lands fallow lands and social forestry programmes of afforestation.

Considering the potential, the State Forest Research Institute, Jabalpur formulated a technical bulletin for improvement of the species to ensure availability of genetically superior planting stock with desirable characteristics.

This technical bulletin is compilation of research findings of project on **"Selection of superior races of Khamer (*Gmelina arborea)* through clonal propagation"** carried out at the State Forest Research Institute, Jabalpur. This bulletin is useful to the researchers, industrialists, foresters and students for production of quality planting material of *G. arborea*.

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SFRI, Jabalpur **Authors**

1. Introduction

Gmelina arborea, (in English Beechwood, Gmelina, Goomar teak, Kashmir tree, Malay beechwood, White teak, Vemane), locally known as Khamer (belongs to family verbenaceae), is a fast-growing deciduous tree, occurring naturally throughout greater part of India at altitudes up to 1,500 meters. It grows on different localities and prefers moist fertile valleys with 750–4500 mm rainfall. It does not thrive on ill-drained soils and remains stunted on dry, sandy or poor soils; drought also reduces it to a shrubby form. It also occurs naturally in Myanmar, Thailand, Laos, Cambodia, Vietnam, and in southern provinces of China, and has been planted extensively in Sierra Leone, Nigeria, Malaysia, and on experimental basis in other countries as well. It is also planted in gardens and avenues.

The *Gmelina arborea* tree attains moderate to large height up to 30 m with girth of 1.2 to 4, a chlorophyll layer just under the outer bark, pale yellow white inside. *Gmelina arborea* wood is pale yellow to cream coloured or pinkish-buff when fresh, turning yellowish brown on exposure and is soft to moderately hard, light to moderately heavy, lustrous when fresh, usually straight to irregular or rarely wavy grained and medium course textured. Flowering takes place during February to April when the tree is more or less leafless whereas fruiting starts from May onwards up to June. The fruit is up to 2.5 cm long, smooth, dark green, turning yellow when ripe and has a fruity smell.

The wood of this species is highly esteemed for different utililitarian aspect. It attains a height of 30 m or more with its largest dimension in the mixed forest of moist regions. Under optimum condition, the tree attains a girth upto 4.5 m in Assam. In West Bengal, it rarely exceeds 1.5 to 2 m in girth. It also extends into the comparatively drier reason of Madhya Pradesh, where the average girth of exploitable tree is not over 90 cm except in favourable localities, such as Mandla and sal forest of Raipur (CG). In Gujrat, Maharastra and in certain region of Karnataka, it attains girth upto 1.5 m and over with 6 m clear bole.

Gmelina arborea timber is reasonably strong for its weight. It is used in constructions, furniture, carriages, sports, musical instruments and artificial limbs. Once seasoned, it is a very steady timber and moderately resistant to decay and ranges from very resistant to moderately resistant to termites.

Its timber is highly esteemed for door and window panels, joinery and furniture especially for drawers, wardrobes, cupboards, kitchen and camp furniture, and musical instruments because of its lightweight, stability and durability. It is also used for bentwood articles. In boat building it is used for decking and for oars.

Gmelina arborea is the most important species for timber production and a popular timber for picture and slate frames, turnery articles and various types of brush backs, brush handles and toys also for handles of chisels, files, saws, screw drivers, sickles etc. The wood is also used for manufacturing tea chests and general purpose plywood, blackboards, frame core and cross bands of flushdoor shutters. In the instrument industry gambhar timber is widely employed for the manufacture of drawing boards, plane tables, instrument boxes, thermometer scales and cheaper grade metric scales. It is also used in artificial limbs, carriages and bobbins. It is an approved timber for handles of tennis rackets, frames and reinforcements of carom boards and packing cases and crates. Gamhar is used in papermaking and matchwood industry too. *Gmelina arborea* leaves are considered good for cattle (crude protein – 11.9%) and are also used as a feed to eri-silkworm. The root and bark of Gmelina arborea are claimed to be stomachic, galactagogue laxative and anthelmintic; improve appetite, useful in hallucination, piles, abdominal pains, burning sensations, fevers, 'tridosha' and urinary discharge. Leaf paste is applied to relieve headache and juice is used as wash for ulcers.

Flowers are sweet, cooling, bitter, acrid and astringent. They are useful in leprosy and blood diseases. In Ayurveda, it has been observed that Gamhar fruit is acrid, sour, bitter, sweet, cooling, diuretic tonic, aphrodisiac, alternative astringent to the bowels, promote growth of hairs, useful in 'vata', thirst, anemia, leprosy, ulcers and vaginal discharge. The plant is recommended in combination with other drugs for the treatment of snakebite and scorpion sting. In snakebite a decoction of the root and bark is given internally.

Unlike teak, not much of tree improvement work has been carried out for this important tree species. Identification of candidate "plus" trees of Khamer with different desirable traits like clear bole, fast growth, drought / disease / insect-pest resistance is also being taken up. A tree with all the desirable traits in nature can be identified and used for multiplication through clonal techniques. These plants not only enhance the forest

cover but also improve general economy of the society. So, an attempt was made to identify superior trees and to raise second generation superior races of Khamer through clonal propagation. This project focuses on the production of quality plants to meet the requirement of forest department.

2. Objectives

- To Identify superior germplasm of *Gmelina arborea* form natural forest and plantations of M.P. and Chhattisgarh.
- To prepare second generation of clonal plants of superior races.
- To establish clonal plants in the field.

3. Methodology

Selection of plus trees

A reconnaissance survey was carried out in different parts of the state of Madhya Pradesh and Chhattisgarh to identify suitable provenances and to select candidate "plus" trees of khamer which could be used for the collection of superior germplasm of these species to be later used as scion material for rooting. Candidate plus trees of Khamer are identified on the basis of different characters i.e. clear straight bole, fast growth, age of trees, branch habit, level of forking, flowering and fruiting habit, resistance against disease and insect- pest, absence of deformity (fluting, buttressing), etc.

4. Collection of scion material:

Special attention was given for selection, position of scion material (cutting) and activation of bud material. The phenological behavior of species differed for different species and this fact was also taken into consideration during the activation and collection of bud material.

The cuttings were procured in 2013, 2014 and 2015 from identified plus trees. These plus trees were young and healthy trees of plantations and natural forests of Madhya Pradesh and Chhattisgarh. The young branches were taken from the mother plant and these were cut into pieces of 20-25 cm in length with 1.5 to 2 cm in diameter. Care was taken to have 3-5 nodes per each stem cutting. These cutting were collected in January, February and March months in 2013 and 2014 while, cuttings were procured in nearly all the months for 2015.

5. Establishment for rooting

Collected cuttings were initially treated with 1% Bavistin to avoid fungal contamination. Then the treated cuttings were given dipping treatment with different concentration of IBA for 30 minutes. Controls were also maintained by treating them with distilled water. Later these cuttings were planted in the mist chamber filled with pure sand and water level was maintained by watering thrice a day up to 60 days to ensure optimum moisture, humidity, light, temperature and aeration for root and shoot development. Lal *et, al.* (1993) was recommended the similar treatment for rooting of Eucalyptus. The relative humidity (RH) inside the mist chamber was maintained at 75-85%.

A statistical designed experiment was laid out with four treatments and three replications to know the rooting response of Khamer cuttings in the first (2013) and second (2014) trials. These four treatments were cuttings treated with no IBA (T0-control), cuttings treated with 1000 ppm of IBA (T1), cuttings treated with 2000 ppm of IBA (T2) and cuttings treated with 5000 ppm of IBA (T3). In third trial (2015), three treatments i.e. cuttings treated with 1000 ppm of IBA (T1), cuttings treated with 2000 ppm of IBA (T2) and cuttings treated with 1500 ppm of IBA (T3) were experimented with three replication to know the rooting response in Khamer cuttings. These three treatments were also repeated to know the rooting response in different months. Then, observations on sprouting and rooting were recorded.

6. Result & Discussion

6.1 Selection of plus trees

First step in development of clonal plantations is the selection of CPTs, based on desirable superior phenotypic characteristics of tree species to be cloned from existing seed based plantations or even aged natural forests of tree species. Selected CPTs must be far superior to surrounding trees of same age in respect of diameter, height, bole form, total volume of merchantable bole, pest and disease resistance and other important considerations.

On the basis of above criteria, a total of 20 candidate plus trees were identified in different forest ranges as well as plantations of Madhya Pradesh and Chhattisgarh. The list of selected plus trees is given in table-1.

Table 1 : List of selected candidate plus trees and their details

S.No.	Name of candidate tree	Code	Girth (cm)	Height (m)	Age Year	Latitude & Longitude	Height of first branch (m)	Crown diameter	Health	Fruiting
1.	Korba Morga Candidate plus tree-1	KMC-1	114.5	26		N23°58'29.7" E 79°52'20.1"	6.5	4.5	Good	Yes
2.	Korba Morga Candidate plus tree-2	KMC-2	131	22		-do- Right side of Road	5.0	5.0	Good	Yes
3.	Korba Morga Candidate plus tree-3	KMC-3	113	25		-do- Right side of Road	7.0	3.5	Good	Yes
4.	Bilaspur (Tagemwada) Belghena Candidate	BBC-1	158.5	26		N23°58'29" E 79°52'20.2"	5.5	3.0	Good	Yes
5.	Ranga plantation Tilwara (Bargi) Jabalpur candidate-1	JBC-1	59	11	10	N 23° 06' 22.9" E 79° 52' 15.7"	6.0	3.0	Good	Yes
6.	Ranga plantation Tilwara (Bargi) Jabalpur candidate-2	JBC-2	41	10	10	N 23° 06' 22.9" E 79° 52' 13.9"	5.0	3.0	Good	Yes
7.	Ranga plantation Tilwara (Bargi) Jabalpur candidate-3	JBC-3	67	11	10	N 23° 06' 23.1" E 79° 52' 14.0"	4.5	3.5	Good	No
8.	Ranga plantation Tilwara (Bargi) Jabalpur candidate-4	JBC-4	71	12	10	N 23° 06' 22.8" E 79° 52' 13.8"	5.5	4.0	Good	Yes
9.	Rewa Churhat candidate-1	RCC-1	69	24	12	N24°24'07.9" E 81°44'36.4"	7.0	5.5	Good	Yes
10.	Rewa Churhat candidate-2	RCC-2	88	15	12	N24°24'07.1" E 81°44'32.9"	4.5	4.0	Good	Yes
11.	Simga plantation Raipur-1	RSC-1	94	22	15	-	8.0	4.0	Good	Yes
12.	Simga plantation Raipur-2	RSC-2	82	20	15	-	5.5	3.5	Good	No
13.	Simga plantation Raipur-3	RSC-3	86	21	15	-	6.5	3.0	Good	Yes
14.	SFRI 2002 Khamer plantation candidate-1	SFRIC-1	76	14.5	10	N 23°07'28.2" E 079°55'58.5"	6.5	4.5	Good	Yes

15.	SFRI 2002 Khamer plantation candidate-2	SFRIC-2	66	15.0	10	N 23°07'28.7" E 079°55'57.1"	6.0	4.0	Good	Yes
16.	SFRI 2002 Khamer plantation candidate-3	SFRIC-3	59	14.0	10	N 23°07'29.9" E 079°55'58.1"	5.5	3.0	Good	Yes
17.	Sinha Plantation Tewar candidate-1	JJC-1	147	23	19	N 23° 08' 09.2" E 79° 49' 37.9"	4.5	4.5	Good	Yes
18.	Sinha Plantation Tewar candidate-2	JJC-2	136	25	19	N 23° 08' 07.8" E 79° 49' 38.8"	7.5	7.0	Good	Yes
19.	Sinha Plantation Tewar candidate-3	JJC-3	122	24	19	N 23° 08' 07.9" E 79° 49' 39.2"	6.0	6.0	Good	Yes
20	West Chhindwara Sjhnjhot Tamia range comtt. no. PF-208	WcTC-1	210	20	30	N22°23'09.2" E 078°41'25.7"	7.0	8.0	Good	Yes

It was observed that sprouting was found to be significant in T2 treatment (cutting treated with 2000 ppm of IBA) in all the years and it is started from 6th day and is continued upto 40th days in maximum cuttings. Similar, observation was also recorded by Tiwari, S.K. et.al., (2014). This sprouting is believed to be intact food material. Significance of sprouting has observed no co-relation with rooting behaviour because only few sprouts are rooted. Similar, relationship is also observed on the effect of various months in sprouting behaviour of cuttings.

In case of rooting behaviour of cuttings, it was observed that T2 treatment was found to be significant over other tried treatments while, it was not economically feasible because survival is very poor i.e. 0.9 and 1.1% in 2014 and 2015 respectively, and no rooting is observed in 2013. Rooting is observed only in few cuttings from 4th week. It can be concluded that cuttings of Khamer is almost failed to root, even after application of different concentration of auxins. The hard to root behaviour of this species might be due to either some anatomical barriers present in the cuttings or absence of some rooting cofactors. Vekaria, B. R. *et. al.* (1996) has reported that Khamer cuttings were failed to root even after

the application of 1000, 2000, and 3000 ppm concentration of IAA, IBA and NAA rooting hormone. He has also emphasized on the presence of cofactors for rooting behaviour for this species. Another possible reason might be the presence of some rooting inhibitors, which are also reported to prevent root initiation (Gesto *et. al.*, 1967 and Fadl *et. al.* 1967).

Zobel (1965) has given his opinion on molecular aspect regarding rooting behaviour of clonal propagation. Rooting in clonal propagation may be due to change in action of mechanism of DNA by which DNA transcribes to RNA. This change is due to complementary strand of 5'-3' poly-diester poly peptide chain of DNA. However, this protein chain behaves differently in different species. Due to this fact, rooted cuttings of certain species root profusely while others moderately or do not root.

Talber *et. al.* (1982) stated that young trees root readily, but the same trees may be almost impossible to root when they become older. This is frustrating to the tree improver who works with proven desirable genotypes so trees are left to grow long enough to prove their genetic worth; it is then often too late to root them. Cyclophysis may be another cause for cuttings to not root. In this process, apical meristem becomes mature and does not produce juvenile cuttings (Olesen, P.O., 1978).

7- Conclustion:

1. Sprouting behavior of Khamer cutting has no significant effect on rooting. In other words, it has no correlation with its rooting behavior.
2. Cuttings of Khamer is almost failed to root in all the tried treatments.
3. March month favours to root but not economical feasible while May month supports profuse sprouting but fail to root.
4. Further study is recommended with various concentrations and combinations of root hormone i.e. IBA, IAA and NAA to find the sprouting and rooting behavior of mature cuttings of the species.

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