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Vegetative propagation of selected medicinal plants for enrichment of resources

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Contents

Abstract of the Project Proposal

Title of the project	:	KFRI/434/2004 Vegetative propagation of selectedmedicinal plants for enrichment of resources
Principal Investigator	:	Dr. T. Surendran
Objectives	:	1.To prepare a state of the art report on the propagation methods and techniques of the selected medicinal plants 2. To standardize propagation techniques for the selected medicinal plants
Duration	:	Three Years (April2004 –March 2007)
Funding Agency		Kerala Forest Department(Social ForestryWing)

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ABSTRACT

Medicinal plants have played a significant role in many ancient traditional systems of medication and still do today in both developed and developing countries Medicinal plants are one of the most sensitive commodity areas of research in the world today. In India alone, less than 10 % of the medicinal plants traded in the country are cultivated, about 90% are collected from the wild, very often in a destructive and unsustainable manner. From the different studies and observations, it is clear that there is over-exploitation of these plants in nature and relatively less effort have been made to conserve this valuable natural resource for its sustainable use. Habitat destruction is the major threat for the survival of medicinal plants.The conventional propagation method is the principal means of propagation and takes a long time for multiplication because of a low rate of fruit set, and/or poor germination and also sometimes clonal uniformity is not maintained through seeds. It is important that enrichment efforts should be taken imminently with importance in order to ensure availability of genuine row materials of these species. A clear understanding is necessary for increased cultivation all these plants. Seed propagation is the conventional methods, but till recently very little efforts were taken to cultivate most of the medicinal plants on a large scale. The present investigation provides a brief account of the conventional propagation methods by utilising seeds or rhizome/ root tubers. Vegetative propagation, being the best acceptable method, was tried for all selected species. IBA in varying concentrations of 1000-6000 ppm were found suitable for induction of rooting on stem cuttings of the selected species in different seasons; the concentration of hormone and the successful season varied with the species. The methods were standardised and could be practised for large scale cultivation and enrichment of these valuable species.

INTRODUCTION

India is endowed with a rich wealth of medicinal plants. Medicinal plants are the sources of many substances that can be used for therapeutic purpose or which act as precursors for synthesis of useful drugs. One of the earliest treatises on Indian medicine, the Charaka Samhita (1000 B.C), records the use of over 340 drugs of herbal origin. Each medicinal plant is a biosynthetic laboratory. It is now established that the plants which naturally synthesise and accumulate some secondary metabolites like alkaloids, glycosides, tannins, volatile oils and contain minerals and vitamins, possess medicinal properties which encompasses physiological and therapeutic effect.

Medicinal plants address not only the need for access to medicine as a component of health services but also to the need for increased income for farmers and as a significant contribution to the national economy. Medicinal plants offer alternative remedies with tremendous opportunities. They not only provide access and affordable medicine to poor people; they can also generate income, employment and foreign exchange for developing countries. Many traditional healing herbs and plant parts have been shown to have medicinal value, especially in the rural areas and that these can be used to prevent, alleviate or cure several human diseases. The WHO estimates that more than 80 percent of the world's population rely either solely or largely on traditional remedies for health care.

Due to ever increasing demand for the crude drugs, the medicinal plants are being over exploited which threatens the resource base and survival of many rare and endangered species. Continuous exploitation of several medicinal plant species from the wild and substantial loss of their habitats during the past 15 years have resulted in the decline of population of many high value medicinal plant species over the years (FAO, 2003). Moreover,many medicinal plant species are disappearing at an alarming rate due to rapid agricultural and urban development, uncontrolled deforestation, and indiscriminate collection (Nalawade and Tsay, 2004).

Sincea major chunk of the world population even today relies on plant derived drugs, the large scale cultivation of important medicinal plants are to be initiated to meet the growing demand of industries, to conserve natural population, to facilitate availability of standardized raw material and to regulate market supply in the long run. Although, propagation of medicinal plants through seeds is the cheapest method,

because of low rate of fruit set, and/or poor seed germination, only vegetative propagation methods can cater to meet the requirements of the planting stock production. The non availabilityand/or failure of seeds to germinate as result of a natural, chemical or a physical inhibitors aggravate the problem of production of quality planting stock (Amponsah*et al*.2004).

Forests of Kerala are rich habitats of a large number of medicinal plants. Due to increased human pressure on land, like encroachment of forests and marginal lands, the habitats of a large number of plants are shrinking and due to consequent changes in the ecosystem many important plants have almost disappeared and many have become extinct (KFRI, l98l). This has resulted in acute shortage of these valuable raw materials. With scarcity coupled with the ever increasing demand, users experience much difficulty in getting sufficient supply of genuine materials. Due to springing up of a large number of pharmaceutical companies in recent times and due to the undue profit motives of the merchant community, large scale adulteration in raw materials occurs and this has further rendered the availability of genuine materials more difficult. These problems generally lead to over exploitation of raw material resources, finally leading to degradation and destruction of natural habitats of the medicinal plants. The safe habitats of most of these plants are forest areas and protection of these spots and practicing other conservation measures are highly essential for the sustained supply of our existing resources. Moreover, identification of candidate species, which are more liable to become rare and endangered, and artificially regenerating them on a large scale for enrichment planting in their natural habitats, appears to be an immediate alternative to encounter the scarcity of these plant resources (Krishnan Nambiar*et a1*.,1985).The project is proposed to prepare a state of the art report on the propagation methods and techniques of some selected medicinal plant species and to standardize the vegetative propagation methods. These species resources are fast reducing, but they are commercially in very good demand. The propagules thus produced will be used for enrichment planting in their natural habitats and maintained for sustained availability of these species. The main objectives of the project are,

1. To prepare a state of the art report on the propagation methods and techniques of the selectedmedicinal plants.
2. To standardize propagation techniques for the selected medicinal plants.

REVIEW OF LITERATURE

The rooting of stem cuttings is one of the best, economically viable and most commonly adopted methods in vegetative propagation in order to get plants of desired genetic types. The proper formation of adventitious roots at the base of stem cuttings is an important developmental phenomenon in the growth and survival of cuttings and it involves the initiation of several new meristematic areas in the differentiated tissues of stem cuttings and their subsequent development in to mature root structures. This appears to be governed by an array of endogenous physiological factors, among the endogenous factors; auxin is generally credited as the prime trigger for root initiation.
In India medicinal plants are one of the largest and most important group of plants comprising more than 8000 species. For majority of the species conventional seed propagation methods are suitable. But species like *Aceriuscalamus, Adhatodabeddomei* are propagated either by rhizome or stem cuttings. For other species proper method should be developed for their large scale artificial propagation.

Vegetative propagation couldbe simple and cheaper involving planting of stem cuttings orrhizome pieces. Special methods requiring expertise such as layering, grafting ormicropropagation are also employed in many cases.Artificial propagation of many medicinal plant species was attempted in India byseveral workers. The methods: include seed pretreatment and germination, grafting layering orvegetative multiplication through rooting of cuttings and tissue culture.There are few reports of propagation of medicinal plants by grafting techniques.Vegetative propagation of Soap nut (*Sapindusmukorossi*Gaertn.) was successfully carried out bychip-budding (Kamal Sharma *et a1.*,1999), while that of *Terminalia chebula* was done by cleftgrafting by Srivastava (2000).

The propagation of medicinal plants are attempted by several workers by rootingof stem cuttings as this methods is the most popular and economical to use.The nursery propagation of nine species of *Paulonia* which is ecofriendly,aredescribed by Dhiman (1991), through rooting of cuttings. Vegetative propagation of Indian buttertree (*Aisandrabutyracea* (Roxb.) Baehni) by treating the cuttings with hormones (IBA+NAA)was reported by Tewari and Dhar(1996). A maximum of 55% rooting success was obtained ingarden rue (*Rutagraveolers* L) cuttings by Kumar and Farooqui.(1996) by treating the cuttingswith paclobutrazol. Similarly vegetative

propagation of *Ochrienancleamissionis* (Wall. ex G.Don) Ridsd.which is a rare and threatened tree species of Western Ghats was reported by Jose *et al.* (1995) with application of hormones. Rapid multiplication of *Wedeliaelununsis* (Osheak) Merr.which is a valuable medicinal herb, by applying IBA (100ppm) was reported by Madhavan andBalu (1995). Propagation of *Enterolobiumyclocarpum* (Jacq.) Griseb by rooting of coppiceshoot cuttings with the application of rooting hormone (IBA-500ppm) was reported byThirunavukarasu and Brahmam (1999). Cuttings of *Andrographisalata*Neestreated with IBA or Keradix powder was reported to root well by Algesaboopathi and Balu (2000). *Costusspeciosus* (Keon) Sm. which is an important medicinal plant was propagated successfully byrooting stem cuttings inside the mist chamber by Homkar*et al.*(1999). Stem cuttings of 2nd and 3rddyear branches having 0.5 cm diameter and 20 cm long leafy cuttings was found suitable forpropagation of *Taxusbaccata* Linn. (Harsh- Milter*et al,* 1999). IBA treatment (500ppm) was alsofound suitable for propagation by rooting of stem cuttings of *Wrighteatinctoria* (Roxb.) R.Br.,which is an important medicinal plant species (Rao *et al.*,2000). Similarly IBA trearment atdifferent concentrations helped in rooting of *Gymnenasylvestre*shoot cuttings (Subbaraj*et al.*, 1997).Sumy *et al.* (2000) described propagation methods for more than 160 tropicalmedicinal plant species recently. They have reported conventional seed propagation,grafting and rooting of cuttings as suitable method for propagation for many species, including*Embeliaribes, Rauolfiaserpentina, Aeglemarmelos* etc. Successful vegetative propagationmethods for large-scale propagation are yet to be reported in the case of many species.

MATERIALS AND METHODS

The following medicinal plants wereselected for the study.

1.*Aeglemarmelos*(Koovalm)
2.*Adathodavasica*(Adalodakam*)*
3. *Asparagus racemosus*(Sathavari)
4. *Caesalpeniasappan*(Pathimugam)
5. *Clerodendrumserratum*(Cheruthekku)
6. Cosciniumfenestratum(Maramanjal)
7.*Embeliaribes*(Vizhal)
8.*Gloriosasuperba*(Menthonni)
9.*Oroxylumindicun*(Palaka-payyani)
10. *Raulfiaserpentina*(Sarpagandhi)
11.*Saracaasoca*(Asokam)
12. *Terminalia arjuna*(Nirmaruthu)

The information available on conventional methods of propagation practised for each of these species of medicinal plants were collected and presented separately in order to have a state-of-the-art knowledge.

Vegetative propagation studies

Collection and preparation of cuttings : Fresh leafy branch cuttings were collected from mother plants of each species of medicinal plant and brought to the mist chamber. They were further processed and leafy cuttings having 8-10 cm length and two or three nodes were prepared. The leaf areas of the cuttings were reduced to half for minimising evapo- transpiratory loss of water from the cuttings during the period of rooting inside the mist chamber.

Pre-treatment of cuttings: Immediately after the preparation, the cuttings were given prophylactic treatment with Bavistin (0.05%) solution by dipping the lower part of the cuttings for about 45 minutes. The pretreated cuttings were then subjected to hormone treatment for induction of rooting. Indole butyric acid (IBA) at various concentrations(500, 1000, 2000, 3000, 4000, 5000, 6000) prepared in talc were used for the treatment. Cuttings were grouped homogeneously

into batches of 10 for each treatment and treated by dipping the lower 2cm portion in the prepared hormone powder. Each treatment was replicated three times.

*Planting***:**The cuttings, immediately after receiving the treatments with hormone powder were inserted in to the wet vermiculite contained in root-trainers kept inside the mist chamber. Care was taken not to remove the hormone powder sticking at the bottom part of the cuttings during the insertion in to the vermiculite.

Rooting :The treated and planted cuttings were kept for rooting inside the mist chamber for 45 days, in order to allow them to sprout and root properly. During this period of rooting the cuttings were provided intermittent misting for 15 seconds at intervals of half an hour. The frequency of misting was reduced at nights in order to avoid excess humidity. The temperature was maintained at 28$\pm$ 2^{o}C and humidity at 85-90%.

Hardening : After the expiry of 45 days inside the mist chamber the sprouted and rooted cuttings were removed to the hardening chamber adjacent to the mist chamber. All the successfully rooted cuttings were re-bagged after recording the data on sprouting and rooting and kept inside the hardening chamber for about 45 days for proper hardening. During this period the intensity of misting was reduced and temperature and humidity regulated so that the cuttings got acclimatized to the external conditions.

Field planting: The rooted and well hardened cuttings of each medicinal plant were out planted in the KFRI campus for studying the survival.

Seasonal Influence on rooting:The rooting trials were repeated in three seasons(Season-I : January – April; Season II : May-August; Season III: September - December) for two years and data recorded for the variation in rooting.

RESULTS

1. ***Aegle marmelos*(Linn.) Corr. (Koovalam)**

Family : Rutaceae

This is a small to medium sized spinescent tree with grey, corky bark and 3-5 foliate leaves. The tree is seen distributed in dry and mixed deciduous forests. Also seen grown in temple compounds and homesteads.

Conventional propagation: The tree flowers during September to November and white flowers are produced in panicles. The fruits mature by December to January. Fruits are globose, 5-12 cm in diameter with woody rind. Seeds are seen embedded in orange coloured pulp. The seeds are extracted from the fruits and dried in the sun. The dried seeds are dipped in water for 6 hours in order to soften the seed coat and encourage germination. The seeds will germinate within 15-20 days after sowing. When the seedlings attain 5-6 leaf stage they are transplanted in polythene bags. Two months old seedlings could be used for field planting.

Vegetative propagation:

Maximum percentsge of rooting (90%) was obtained with 6000 ppm IBA treated leafy stem cuttings of the species, during season (January – April), followed by 85% in the other two seasons. Rooting was obtained in all seasons, especially when cuttings collected were from younger trees (plate 1)or juvenile coppies shoots emerged on stumps (Table 1).

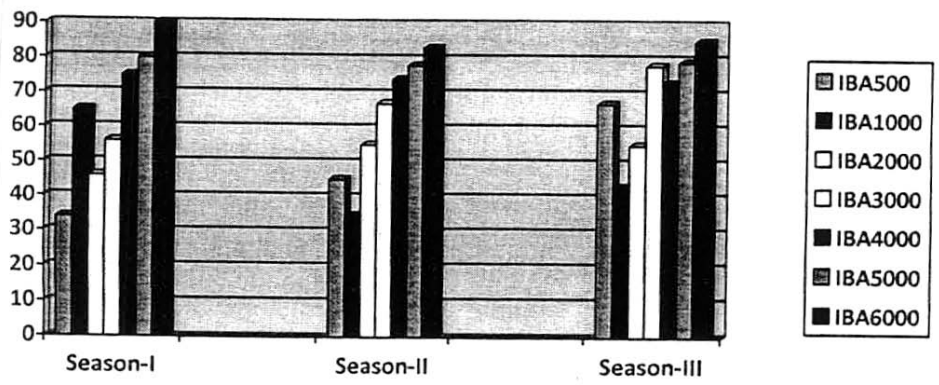

Fig.1 .Percentage of rooting recorded in different treatments of IBA

Plate.1.Rooted cutting of*Aeglemarmelos*

2. *Adhatodazeylanica*Nees (Adalodakam)

Family : Acanthaceae

This plant is a shrub usually seen growing in plains and they are often found planted in homesteads. Roots and leaves are used for various medicinal preparations.

Conventional propagation: The propagation of the plant is conventionally carried out through planting leafy cuttings. Cuttings of length 10-20 cm are collected from the mother plants. Leaf area could be reduced by trimming away the distal parts and retaining around 100 cm^2. Cuttings are planted in the nursery beds,vertically and irrigated sufficiently after providing shade. Within 7-10 days cuttings will sprout and root. These can be transplanted to polythene bags and kept for few days for proper hardening after which they could be field planted (Plate.2.)

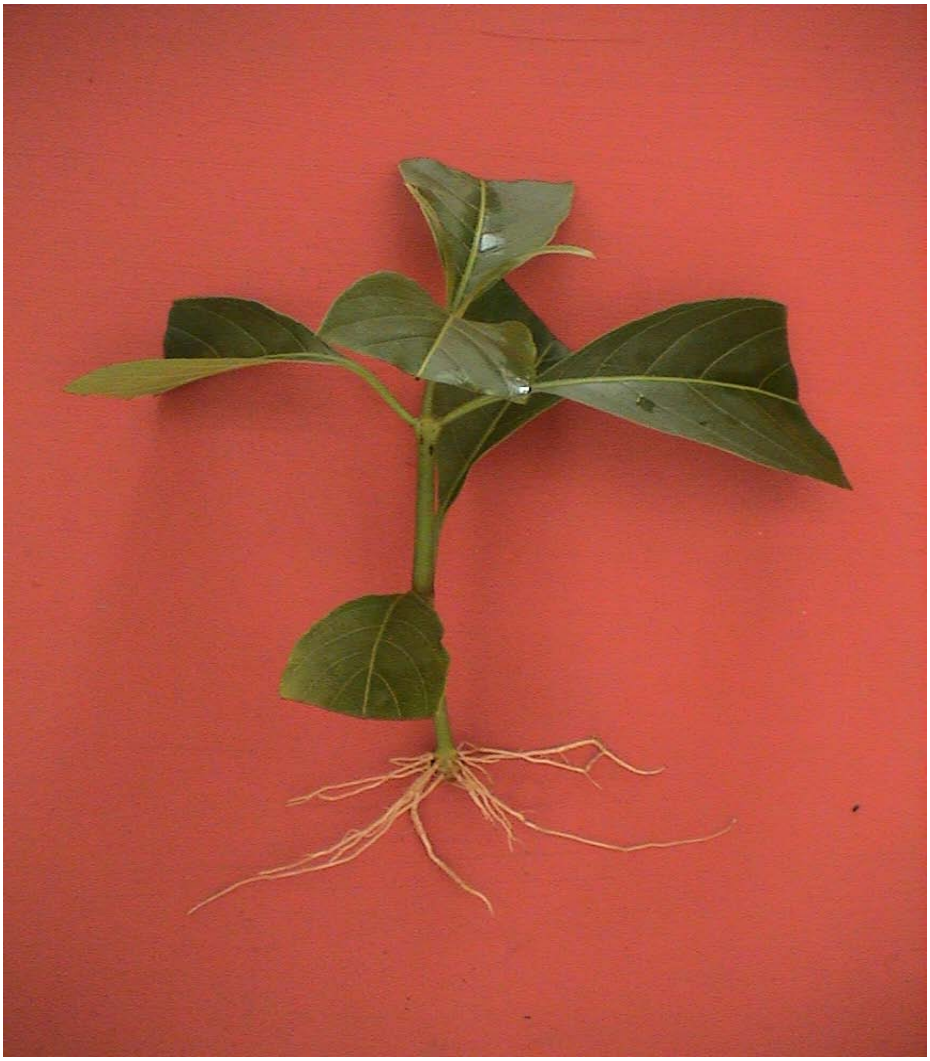

Plate.2.Rooted cutting of*Adhatodazeylanica*

3.*Asparagus racemosus*Willd.(Sathavari)

Family: Liliaceae

This is a perennial climber with small thorns and green leaf-like cladodes on the stem. The plant is seen growing along hedges, scrub jungles and waste lands. They usually make use of nearby trees or shrubs to climb on.

Conventional propagation: The plants are propagated through seeds or root suckers. The plants produce dark red fruits during December to January. The seeds are extracted by washing the fruits, and dried in the sun.The seeds are soaked in water over night prior to sowing to enhance germination.The germinated seedlings are carefully planted in polythene bags filled with soil, sand and farmyard manure and kept in shade for about a month before planting.

The plant produces suckers profusely; they are carefully separated from the mother plant and potted in 15 X10 cm polythene bagsfilled with soil, sand and farmyard manure and kept in shade for about a month before planting.

Vegetative propagation: Attempts to root stem cuttings by hormone treatments was not successful, since the stem cuttings lack axillary buds.

4.CaesalpiniasappanL. (Pathimugham)

Family : Caesalpiniaceae

The plant is medium sized tree usually cultivated. It can be grown in any type of soil except in water logged areas. The stem is having thorns, the heartwood is the useful part.

Conventional propagation: The plant after attaining growth of two years in the field will start flowering and seeds will be produced in pods. The seeds will be ready for harvest by January to February. They are dried in the sun and stored. Before sowing, the seeds are kept dipped in water for 12 hours and then sown in the nursery beds. Germination of seeds will start after 10 to 15 days of sowing. The seedlings are transplanted in polythene bags at 2-leaf stage and kept under shade. The seedlings could be planted in the field by the onset of monsoon.

Vegetative propagation:

Cuttings having a length of 15-20 cm and two or three leaves treated with 4000 ppm IBA prepared in talc recorded maximum percentage (90%) of rooting during season I, especially during the months of March and April(Fig-2)

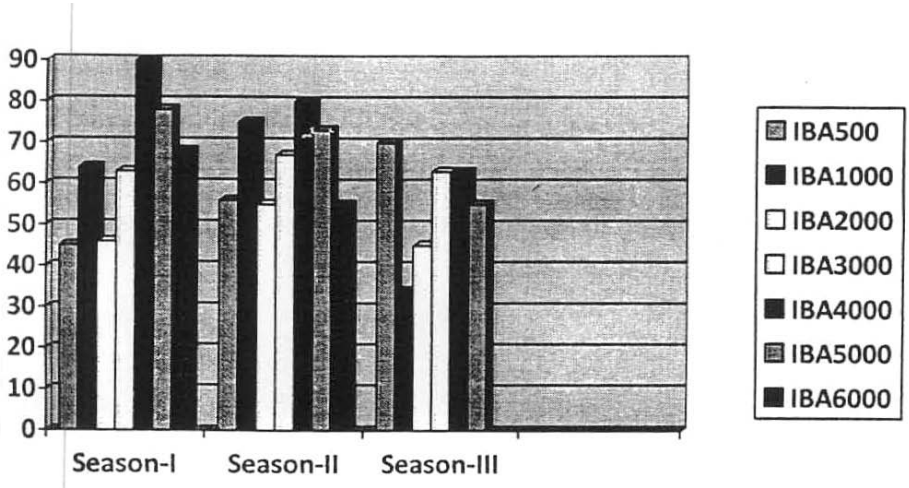

Fig.2 .Percentage of rooting obtained in various concentrations of IBA

5. *Clerodendrumserratum* (Linn.) Moon (Cheruthekku)

Family : Verbanaceae

This is an erect, less branched shrub, seen growing throughout India in the moist deciduous forests.

Conventional propagation: Flowering starts during January to March. Fruits are dark bluish green or black drupes and is seen in an enlarged red fleshy calyx. Seeds could be collected during April to May. Fruits are collected and washed thoroughly for removing the pulp and seeds dried in the sun. These are in prepared polythene bags for obtaining the seedlings.

Vegetative Propagation: Juvenile leafy cuttings with two pairs of leaves and apical buds intact are ideal for propagation by rooting the cuttings. Leafy cuttings *treated* with 2000ppm IBA recorded 100 percent rooting in season-1 (January-April).

6. *Cosciniumfenestratum* (Gaertn.) Colebr. (Maramanjal)

Family : Menispermaceae

This is a woody climber having thick cylindrical stem which is longitudinally fluted, yellowish brown externally and yellow internally. The plant is seen growing in Western Ghats, in Tamilnadu and Kerala. Due to over exploitation this species has now become extremely rare and critically endangered.

Conventional propagation: Usually through seeds. The plants produce single seeded fruits which are collected during September to November and seedlings are raised in polythene bags.

Vegetative Propagation : Vegetative propagation by rooting stem cuttings is also possible with very poor success rate .

In the case of *Cosciniumfenestratum*the maximum rooting percentage (20%) was obtained with 4000 ppm IBA as compared to other treatments in season-I(January-April).Therooting percentage was very poor with lower concentrations of IBA. The overall rooting response was better in the treatment with IBA.

7. *Embeliaribes*Brum.f. (Vizhal)

Family : Myrsinaceae

The plant is a climbing shrub with rough stem having conical protuberances. This species is found growing in restricted patches of evergreen and moist deciduous forests.

Conventional propagation: The plant while flowering produces numerous white or greenish yellow flowers in panicles. The fruits will ripen within three months and they are small and globose in shape. These berries are made use in a number of ayurvedic preparations.

The dried seeds are sown in trays filled with sand and soil (1:1) or vermiculite. After sowing the seeds, it should be covered with a thin layer of fine soil. Watering is to be done two times daily taking care to maintain the moisture level to the optimum. Within a period of 10-15 days the germination begins and it will be completed by a month. Seedlings arepoly-potted when they attain four leaved stage and kept under shade. Six month old seedlings could be field planted.

Vegetative Propagation:Vegetative propagation trials by rooting stem cuttings carried out at KFRI in different seasons were without rooting success. The juvenile shoot cuttings treated with different concentrations of IBA recoded sprouting of the shoots.

8.*Gloriosasuperba*Linn.(Menthonni)

Family :Liliaceae

This is a large herbaceous climbing annual. Leaves terminate in to tendril-like long curling tips which helps the plants to climb on to the nearby shrubs. Flowers produced in axils are large solitary with long floral segments, narrow, margins crisply waved, at first greenish, after that a mixture of scarlet and bright red. Fruits are produced as linear, long capsules.

Conventional propagation: The natural way of propagation is through root tubers which are solid, fleshy, cylindrical, white, usually very long. Suckers are produced on the tubers which can be separated conveniently and planted.

Vegetative Propagation:Propagation trials carried out using stem cuttings did not root, since the plant belongs to liliaceae family and most of the stem cuttings lack axillary buds and posses inherent inability to sprout. Root tubers could be made into small pieces and planted separately would produce buds on them and could grownas

newplants (Plate 3).

Plate.3. a.*Gloriosasuperba*plant in flower

Plate.3.b.Propagules of*Gloriosasuperba*produced through root tubers

9.*Oroxylumindicum* (L.) Benth.exKurz (Palakapayyani)

Family : Bignoniaceae

This is a medium sized tree seen in dry and moist deciduous forests. The tree has shallow root system and usually produces a large number of root suckers. Roots, leaves and fruits are useful components in traditional Indian ayurvedic medicines. It is one of the constituents of the popular ayurvedic tonic “Chyavanaprasham”.

Conventional propagation: The plant is propagated through seeds or root suckers. The flowering of the trees is during July to September. The flowers are produced in large erect racemes, reddish purple in colour. Fruits are long flat, sword-like pods containing many winged seeds. Pods are collected from the trees when they become brown in color and still not open. Care should be taken to see that the winged seeds are not lost during collection. The seeds are extracted by drying the pods in the open sun While drying, the pods are to be covered with a net in order to prevent the light winged seeds prone to be carried away by wind.

Since the seeds lose their viability quickly, fresh seeds are sown for germination. They are soaked in water for 12 hours before sowing in the prepared nursery beds. After sowing, the seeds are covered with a thin layer of soil and irrigated twice daily. The germination of seeds will be completed within 20 days. The seedlings after attaining growth of about a period of six months could be field planted.

Vegetative Propagation :The maximum percentage (100%) of rooting was achieved in semi hardwood cuttings treated with 1000 ppm IBA in season 1, followed by 1000ppm IBA treated cuttings in season III (90%) and next 2000ppm IBA treated cuttings in season I. Semi hardwood cuttings collected from young trees showed very good success irrespective of seasons. NAA treated cuttings show poor rooting irrespective of the season and type of stem cutting. Semi hardwood cuttings with two or three leaves, treated with IBA in 1000ppm concentration prepared in talc appears to be a successful treatment for vegetative propagation, for producing sufficient number of propagules of this valuable species.

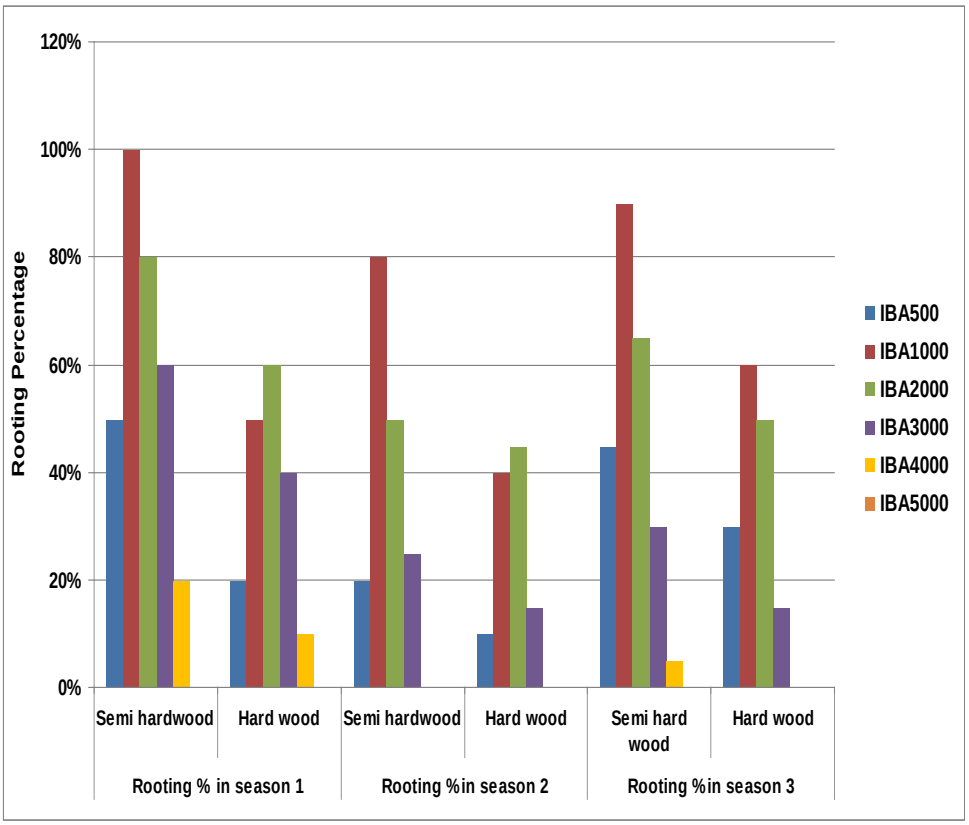

Fig. Percentage of rooting in *Oroxylumindicum* using hard wood and semihard wood stem cuttings treated with various concentration of IBA in different seasons.

10. *Rauvolfiaserpentina* (Linn.) Benth. ex K. Schum. (Sarpagandhi)

Family : Apocyanaceae

The plant is an under shrub mostly seen growing in Southern moist mixed deciduous forests and teak bearing forests.The roots of the plants are important being the natural source of reserpine which has a depressive action on the central nervous system and produces sedation and lowering of blood pressure.

Conventional propagation:

The plant can be propagated by seed and root cuttings.

Seeds germination in Rauvolfia is highly variable. It is reported to vary from 5 to 30 percent even when only heavy seeds are chosen for sowing purpose. Light and heavy seeds can easily be separated by simple water floatation. Germination of heavy seeds during May - June after soaking them in water for 24 hours was 20-40 percent and maximum 63 percent germination was recorded in freshly collected heavy seed lot. The seeds sown, 2-3 cm apart in rows in shallow furrows during April end. The furrows are then covered with a fine mixture of soil and FYM. Keep the beds just moist by light watering. Germentation starts after 15-20 days and continues up to 30 to 40 days. Seedlings are ready by mid-July for transplanting. The seedlings ate transplanted at 30 cm distance within the rows spaced at 45 cm. If rains are not received during or immediately after transplantation, irrigation is necessary for better stand.

By root cuttings: Nearly 5 cm long root cutting are planted during March- April closely in nursery beds. The beds are kept moist through watering. The cuttings begin to sprout within 3 weeks. These can be planted in field during rainy season (plate 4).

Vegetative Propagation :

Semi hard leafy cuttings of *Rauvolfiaserpentina* treated with 6000ppm IBA showed 100 percent rooting throughout the year. Hard wood stem cuttings planted during June showed 90 percent rooting with the same concentration of IBA.

Plate.4.Propogulesof *Rauolfia serpentine*produced through root tubers.

11. ***Saracaasoca*** **(Roxb.) de Wilde (Asokam)**

Family : Caesalpiniaceae

This is a small tree in habit found growing in West coast tropical evergreen forests. The bark is brown in colour and is the main constituent of 'Asokarishtam'. Often the plants are seen grown in homesteads.

Conventional propagation : The propagation practised popularly is through seeds. The tree starts flowering during November to January. The flowers are produced in very attractive orange-red dense racemes. The fruits are oblong, compressed pods having 4-8 seeds. The pods are collected during February to April and the seeds separated;they are sown in nursery beds. The seedlings will be ready for field planting when they are about 2 months old.

Vegetative Propagation

In *saracaasoka*maximum percentage (100%) of rooting was achieved in semi hardwood cuttings treated with 4000 ppm IBA in season 2, followed by 3000ppm IBA treated cuttings (95%). Semi hardwood cuttings collected from young trees showed very good success irrespective of seasons (Plate 5; plate 6).

Plate.5. Rooted cutting of *Saracaasoca*

Plate.6. Rooted and hardened cuttings of *Saracaasoca* ready for planting.

12.*Terminalia arjuna* (DC) Wt. &Arn. (Neermaruthu)
Family : Combretaceae

This is a large tree seen growing in deciduous forests of Peninsular India, Madhya Pradesh, and Bihar.The tree is having characteristic buttressed trunk and spreading crown with drooping branches. Dark coloured bark usually flake off in large pieces.

Conventional propagation : Seeds are used for propagation.The tree flowers during the months of March to June. The fruits are five-winged drupes and the ripe ones are collected during the months of December to February. Soaking the seeds in water for 24 hours before sowing improves germination percentage. The pre-treated seeds are put in polythene bags keeping half of the seeds above the soil level. Germination begins within 12days and it takes about 50 days to complete. When the seedlings attain six months' growth they could be used for field planting.

Vegetative Propagation :

Leafy cuttings of *Terminalia arjana* treated with 4000ppm IBA showed 100 percent rooting in all seasons(Plate7). Since the rooted cuttings shows plateotropic behaviour if they originate from side branches. Care should be taken to collect from orthotropic branches (plate 8).

Plate.7.Rooted cutting of*Terminalia arjuna*

DISCUSSION

The present project has one of the main objectives as providing a state-of-the-art report on the existing and conventional methods of propagation of the selected medicinal plants. Since some of the plants are not extensively cultivated, the known propagation methods are not practised extensively by the people. The raw materials of these plants, instead of cultivating are generally collected from the wild or from the areas where they grow, by the people, leading to the loss of these valuable resources; some of them have already become extremely rare and endangered due to the unscientific collection methods practised. In India alone10percent of the medicinal plants are cultivated, about 90 percent are collected from the wild, very often in a destructive and unsustainable manner.

The existing information about the conventional methods of propagation are presented for each species. Even though, these methods are the principle means of propagation these may take long duration to establish populations because ofproblems related to seed germination and growth.

Of the twelve species selected, Aeglemarmelos (Koovalm) . *caesalpiniasappan* (pathimugam), *Clerodendrumserratum* (cheruthekku), *Cosciniumfenestratum* (Maramangal), *Embeliaribes* (Vizhal), *Oroxylumindicun* (Palaka-payyani), . *Rauolfiaserpentina*(Sarpagandhi), *Saracaasoca* (Asokam) and . *Terminalia arjuna* (Nirmaruthu) are conventionally propagated by seeds, while in Adhalodazeylanica natural method of propagation is by rooting cuttings. In this species the application of rooting hormones to induce rooting on cuttings assure profuse rooting and 100 percent success. Twiners like *Asparagus racemosus* and *Gloriosasuperba* are propagated conventionally either by root suckers or by cuttings of root tubers.

Vegetative propagation of these selected medicinal plant species was the second main objective of the project. The propagation trials were attempted for each species and most of the species showed very good success especially in summer months (January to April). Indole butyric acid (IBA) applied in higher concentrations (1000 – 6000 ppm) was found useful in rooting the cuttings of these medicinal plants. *Aeglemarmelos* cuttings rooted with application of IBA-6000 ppm in season-I while in *Caesalpiniasappan* 90 percent rooting was obtained

with the application of IBA-4000 ppm in the same season. Juvenile cuttings of *Clerodendrumserratum* rooted with application of IBA 4000 ppm it) Season-I and maximum percentage (90%) was recorded. This species is critically endangered since this is extracted from the wild for roots, leaving the shoots without any consideration for the sustainability of the species.

In *Oroxylumindicun* the vegetative propagation was standardized by rooting semi-hard leafy cuttings through the application of IBA-6000 ppm in Season-I. In general, these type of cuttings rooted in all the seasons. *Rauolfiaserpentina* is also an important herbaceous medicinal plant, which is fast reducing their resources from the wild due to indiscriminate extraction for the medicinally valuable rootstock. The species could be propagated by the use of IBA-6000 ppmfor induction of roots on semi-hard leafy cuttings. The rooting response is very good in all the Seasons with the application of hormone, inside the Mist Chamber.

Saracaasoca is one of the very important medicinal plants, bark of which is in great demand as a raw material for many Ayurvedic preparations. Unscientific methods of extraction of bark of this pleasant tree destructive and leave the species in a critical condition of rarity. The plant could be easily propagated in almost all seasons with the application of IBA-4000 ppm to semi-hard leafy cuttings and providing mist chamber conditions. Trials carried out in KFRl recorded 100 percent rooting success in summer months.

Terminalia arjuna leafy branch cuttings treated with IBA-4000 ppm recorded successful rooting in all the seasons, with maximum rooting in summer months under mist chamber conditions. Cuttings collected from young trees orfrom coppice shoots were found rooting readily than those from mature trees.Caution should be taken while collecting cuttings in order to avoid side branches since the rooted cuttings of this species could exhibit plagiotropism.

Stem cuttings of *Asparagus racemosus* could not be rooted even with the application of different concentrations of hormones. This may be due to the inherent disability of the cuttings because of the lack of sufficient number of
axillary buds on them, since the plant belong to Liliaceae family. Similarly it was very difficult to root the stem cuttings of Gloriosasuperba also, since same peculiarities was confronted with this Liliaceae member. Other methods like root tuber cuttings or tiller separation could be ideal for these species. More studies in these directions are necessary.

Cosciniumfenestratum and *Embeliaribes* were also difficult to root their stem cuttings. Since these plants were rare and restricted to certain locations of the Western Ghat areas, availability of the plants for extensive rooting trials wasa limiting factor during the trials carried out at KFRI. It appears that more studies are necessary for these species in order to come out with successful methods.

In general, out of the 12 species subjected to vegetative propagation studies, 8 species could be successfully propagated by applying rooting hormone and the methods are standardized for these species. The remaining 4 species require more detailed studies in order to standardize vegetative propagation methods suitable for them.

CONCLUSIONS

Medicinal plants are important raw material resources, which are in great demand and the availability of which is fast reducing due to various reasons. Attempts have been initiated to enrich the resources by cultivation and rehabilitation by several agencies. As a beginning, project has been identified and initiated to prepare an account of state-of-the-art knowledge of propagation methods prevailed so far for the selected medicinal plant species. Besides this, artificial propagation methods, mainly vegetative propagation by rooting stem cuttings were carried out for all these selected medicinal plants.

Information available on existing propagation methods by using seeds or pieces of rhizome! root tuber were briefly described for each species. All the seed producing tree species could be easily propagated through seedswhen they are available. Plants like *Gloriosasuperba,Asparagus recemosus*and *Rauolfiasurpentina* may be propagated rhizome pieces or root tubers, rather than using seeds, the method has limitations. The cumbersome extraction procedure for underground parts like rhizome or root tubers and also limited number of propagules produced render these methods unsuitable for large scale multiplication.

By adopting vegetative propagation, which is the cheapest and quick, has the advantage of production of plants in sufficient number irrespective of seasons.

The results of the investigation clearly showed that most of the selected species of medicinal plants *Viz. Adhatodazeylanica, Aeglemarmelos, Caesalpiniasappan, Clerodendrumserratum, Oroxylumindicun,. Rauolfiaserpentina , Saracaasoca*and *Terminalia arjuna* are conventionally propagated by seeds, could be propagated through rooting of stem cuttings.IBA is found suitable for induction of rooting, but in different concentrations, depending on the species and seasons.

The plant species like *Cosciniumfenestratum, Embeliaribes , Gloriosasuperba*and *Asparagus recemosus* responded with either partially or no rooting.For these species more intensive studies in this direction are necessary. For all other species, the vegetative propagation methods standardized may be practiced for large scale production of propagules of these species.

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