Government of West Bengal

DIRECTORATE OF FORESTS,
Office of the Principal Chief Conservator of Forests
(Head of Forest Force), West Bengal
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NO. 9748 /CS/2M-282/15(Pt.V) Date: 15-12-17

To :

1. The Principal Chief Conservator of Forests, Wildlife
2. The Managing Director, WBFDC Ltd
3. The Chief Project Director, WBFBCP
4. All Addl. PCCFs / Director, SBR
5. All CCFs / FDs
6. All CFs / Jt. Director, SBR
7. All DFOs / DCFs / DFDs

Sub : Nursery Protocol of Tall Seedlings.

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Sir,

A copy of the Nursery Protocol of Tall seedlings developed by RMD Wing is enclosed for your necessary action. The field officers particularly those **who are serving in Territorial and Social Forestry Divisions are requested to identify some exclusive areas or some space in the existing central nurseries and implement the protocol by creating tall seedling nursery in their respective territories**. You are aware that it has been decided that from next year onwards, all plantations undertaken outside normal plantations within the forest areas will be done with 2 years old tall seedlings. So all the units must have ready stock of tall seedlings in their respective nurseries. They can follow the protocol as much as possible. However the financial details given in the protocol seems to be ON higher side. But the items given in the estimates can be used in preparing site specific estimates where few thousand tall seedlings can be raised. Other protocol details related to shifting, bags, compost etc., can be followed while implementing the creation of tall seeding nursery.

Yours faithfully,

(N K PANDEY)
Principal Chief Conservator of Forests &
Head of Forest Force, W.B.

Encl. as stated

NO. 9749 /cs/2m-282/15(Pt.V) Date: 15-12-17

Copy forwarded for information and necessary action to the DFO, Publicity. He is requested to distribute the publication as per the list given above and if required the publication can be sent by post. A compliance report of distribution should be given to the undersigned in due course.

(N K PANDEY)
Principal Chief Conservator of Forests &
Head of Forest Force, W.B.

DIRECTORATE OF FOREST

GOVT. OF WEST BENGAL

NURSERY PROTOCOL FOR TALL SEEDLINGS

Acknowledgement

The committee acknowledges the contribution of Sri Pradeep Shukla, IFS, PCCF/WB & HOFF for guiding at every step by way of informing about resource persons and providing other related information, specially given in annexure I, II & III related with characteristic and behavior of different species. The committee also acknowledges the contribution of Sri J. T. Mathew, IFS, APCCF/R&M for analyzing the finer points like choice of potting mixture, root coiling & container specification etc. Committee acknowledges the contribution of Sri S. K. Moley, IFS for providing the general material on Tall seedlings nursery.

Other members of the committee are 1) Sri Raju Das, IFS, 2) Dr Sudhir Das, IFS, 3) Dr S. Kulandaivel, IFS & 4) Sri N. Saha, WBFS. The committee visited various private & Government nurseries and analysed various related aspects and discussed with senior officers before concluding these findings. The guidelines are based on information available as on date and committee recommends that further research is needed to improve the quality and shortening the time in raising tall seedlings.

Rajesh Kumar, IFS,
CCF, R&D
&
Chairman of the committee

NURSERY PROTOCOL FOR TALL SEEDLINGS :-

Introduction:

Nursery protocol for raising tall seedlings is the layout of complete procedure for raising tall seedlings in nursery in effective & efficient manner. Tall seedlings are to be raised depending upon the scheme, objectives and type of plantations. To have 5" to 8" high tall seedlings, two and half year old seedlings may preferably be used for plantations. In few fast growing species, even one and half year old seedlings may acquire 5" to 8" height. Scientific experiments, field trials and standardization of the most suitable methodology are still on but to start with, a procedure needs to be prescribed for time being.

Main benefits :-

The main benefit of planting tall seedlings are-

- Quick establishment and crown development.
- Insurance against problems like grazing/browsing and weed infestations.
- Relatively more resistant to diseases and pests as well as more likely to withstand adverse climatic conditions.
- Reduction in plantation cost in terms of barbed wire fencing, watch and ward & yearly maintenance cost etc.
- Overall benefit and success rate are high than current year seedlings.
- Less number of seedlings are required to be planted in a area thus saving cost.

Target places: Following are preferable target places

- Strip plantations along road side, Canal side, Railway side.
- Avenue plantations.
- Current year Forest plantations, Enrichment plantations and Block Plantations etc. where there are requirements of tall seedlings beyond grazable or browsable limit.

Species suitability :-

Choice of species depends on the Working Plan prescriptions in forest areas and in other places it depends on objectives. List is attached as annexure I, II, III & IV of suitable species to be planted in Hills, North Bengal, South Bengal & Avenue plantations.

Pot Size & Type:- The volume of the container dictates how large a plant can be grown in it at nursery. Optimum container size is related to the species, target plant size, growing density,

length of the growing season, and growing medium used. For example, to grow large woody plants for an out planting site with vegetative competition, chances of grazing in field - a nursery would choose large volume containers with low growing densities. This methods creates taller plants with larger stem (coller) diameters, which have soon to survive and grow better under these stressed conditions.

In all nurseries, container size is an economic decision because production cost are a function of how many plants can be grown in a given space in a given time. Larger containers occupy more growing space and take longer time to produce fibrous root system. Therefore plants in larger containers are more expensive to produce, store, ship and out-planting. The benefits however, may outweigh the cost if the out-planting objectives are more successfully satisfied.

Height of the Container:- Container height is important because it determines the depth of the root plug, which may be a consideration on dry out-planting sites. Height is important because it determines the proportion of freely draining growing medium within the container. When water is applied to a container filled with growing medium, gravity percolates it downward until it reaches the bottom and runs out of the drain holes in the bottom of the container, there, it stops because of its attraction for the growing medium, creating a saturated zone that always exists at the bottom of any container. Container height and the type of growing medium control the depth of this saturated layer. With the same growing medium, the depth of the saturation zone is always proportionally greater in shorter containers, for example, a 4-inch (10cm) tall container will have the same depth of saturation as a 10-in (25cm) tall container, but the 4-inch tall container will have a smaller percentage of freely drained medium.

Container Diameter :- Container diameter is important in relation to the type of species being grown. Broad-leaved trees, shrubs, and herbaceous plants need a larger container diameter so that irrigation water applied from above can penetrate the dense foliage and reach the medium. Diameter also affects growing density in the nursery. Collar girth is directly related to container diameter.

Shape of the Container :- Containers are available in a variety of shapes and most are tapered from top to bottom. Most containers are round but some are square and maximize the growing space used in the greenhouse. Container shape is important as it relates to the type of out-planting tools used and the type of root system of the species grown.

Types of Containers :- Many types of containers are available, and each has its advantages and disadvantages. It is a good idea to try new containers for each species on a small scale before buying large quantities. Several containers types are used in container plant nurseries and can vary considerably in size.

One-Time-Use Containers:- One of the first major distinctions in container types is whether they will be used once or whether they can be cleaned and used again. Some one-time-use containers, such as Jiffy® products, can be out-planted directly whereas others, such as Zipset™ Plant Bands, are removed and discarded at the time of out-planting. The idea of growing a plant

in a container that can be transplanted or out-planted directly into the field is attractive, and many designs have been tried. Most of these early attempts failed because the container material broke down in the nursery before the plants were ready or they failed to decompose after out-planting.

Plant Density :- The distance between plants in nursery is another important factor to consider. Spacing affects the amount of light, water, and nutrients that are available to individual plants. In general, plants grown at closer spacing grow taller and have smaller stem diameters than those grown further apart. Plant leaf size greatly affects growing density. Broad-leaved species should be grown only at fairly low densities, whereas smaller leaved and needle-leaved species can be grown at higher densities. Container spacing will affect height, stem straightness, stem diameter, and bushiness. Container spacing also affects nursery cultural practices, especially irrigation. Trays holding individual containers provide some flexibility in spacing because, as the plants grow, one-half of the containers can be moved to another tray, thereby allowing greater space between plants.

Root Pruning :- Spiraling and other types of root deformation have been one of the biggest challenges for container growers, and nursery customers have concerns about potential problems with root-binding after out-planting. Research shows that root coiled seedlings are more likely to perform poorly after out-planting. In addition to holes on the bottom of the container for air root pruning, many containers have vertical ribs within the container to force the roots to grow downward. Spiraling and other types of root deformation matters more where timber is the target. In such situation long root trainers with one hole at bottom should be used.

Ease of Handling :- Containers must be moved several times during crop production, so handling can be a major concern from logistic and safety standpoints. Large containers are increasing in popularity, but they become very heavy when saturated with water. Weight must also be considered for shipping and field planting. It is easier for a tree planter to carry and plant hundreds of trees if the seedlings are small. With large containers, the out-planting may go slower, but survival and ability to out-compete other vegetation is likely being greater. If containers are to be shipped or trucked to the out-planting site, then the type of shipping and storage system must be considered during container selection.

Poly bags and Poly tubes :- Bags made of black polyethylene (poly) plastic sheeting are the most commonly used nursery containers in the world because they are inexpensive and easy to ship and store. It is unfortunate but poly bags generally produce seedlings with poorly formed root systems that spiral around the sides and the bottoms of the smooth-walled containers. This problem worsens when seedlings are held over and not out-planted or transplanted at the proper time. In cases in which converting to hard plastic containers would be operationally or financially impractical, ways exist to improve container production using poly bags. Some of these cultural modifications include.

- Managing container seedlings as a perishable commodity with a limited "shelf life." This concept is particularly critical in tropical nurseries where seedlings grow year round. If seedlings cannot be out-planted when their roots fill the container, then they must be transplanted into a larger container. Holding over poly bag seedlings is not an option.

- Using poly tube containers (a poly bag open at both ends, sometimes called a poly sleeve also) instead of poly bags. These containers can usually be obtained from the same supplier as poly bags. Poly tubes eliminate much of the root spiraling. Poly tubes will hold growing media if they are properly filled and placed on elevated screen-bottomed trays to promote air pruning of roots.

- Carefully transplanting germinated seeds or direct-seeding into the poly bag or poly tube containers to avoid root deformations from improper transplanting of newly emerged seedlings.

Other Natural Fiber Containers :- Containers made of fiber, such as jute, coir or compressed paper, come in a variety of sizes and are popular with gardeners for vegetable seedlings. The roots can develop without the potential deformity problems of solid walled containers, and natural fiber pots can be transplanted or out-planted with minimal root disturbance or transplant shock. When they are out planted, roots penetrate the container as it breaks down. These containers have a few problems, however, when used in tropical nurseries. They may break down too quickly in warm, humid climates to be suitable for growing native plants. They tend to become coated with algae over time, which makes them slippery to handle and nearly impossible to store, so they present challenges for shipping and handling. If a nursery is growing some fast growing species that will not need to be transported very far before out-planting, natural fiber containers may be a suitable option. Natural fiber pots need to be tested before use to ensure they will not break down or become coated with algae too quickly for the growing cycle of the species propagated in them.

Potting Media :- A growing medium can be defined as a substance through which plant roots grow and extract water and nutrients. Selecting a good growing medium is fundamental to good nursery management and is the foundation of a healthy root system. Growing media for use in container nurseries is available in two basic forms: soil based and organic based. Compared with soil based media that has field soil as a major component, organic based media (a base of organic materials that may be compost, peat, coconut coir, or other organic materials, mixed with inorganic ingredients) promotes better root development. In temperate areas, nurseries can choose from a wide range of commercial products for their growing media, including moss, vermiculite and premixed blends of these ingredients. Most nurseries in the tropics, however, do not have easy and affordable access to these materials, and even nurseries in temperate areas are seeking to replace some of these ingredients with more local and sustainable materials. In the tropics, growers often create their own media using locally available ingredients. A favorable growing medium consists of two or more ingredients. Growers must be familiar with the positive and negative characteristics of the various ingredients and how they will affect plant growth when creating a suitable growing medium.

Functions of Growing Media :-

A growing medium serves four functions:-

(i) Physical Support:- The growing medium must be porous yet provide physical support. Young plants are fragile and must remain upright so that they can photosynthesize and grow. With larger nursery stock in individual containers, a growing medium must be heavy enough to hold the plant upright against the wind.

(ii) Aeration :- Plant roots need a steady supply of oxygen to convert the photosynthate from the leaves into energy so that the roots can grow and take up water and mineral nutrients. The byproduct of this respiration is carbon dioxide that must be dispersed into the atmosphere to prevent the buildup of toxic concentrations within the root zone. This gas exchange occurs in the large pores (macro pores) or air spaces in the growing medium. Because nursery plants grow rapidly, they need a medium with good porosity.

(iii) Water Supply:- Nursery plants use a tremendous amount of water for growth and development, and this water supply must be provided by the growing medium. Growing media are formulated so that they can hold water in the small pores (micro pores) between their particles. Many growing media contain a high percentage of organic matter such as peat moss and compost because these materials have internal spaces that can hold water like a sponge. Therefore, growing media must have adequate porosity to absorb and store the large amounts of water needed by the growing plant.

(iv) Supply of Mineral Nutrients :- Most of the essential mineral nutrients that nursery plants need for rapid growth must be obtained through the roots from the growing medium. Most mineral nutrients are electrically charged ions. Positively charged ions (cations) include ammonium nitrogen (NH4+), potassium (K+), calcium (Ca+2), and magnesium (Mg+2). These cations are attracted to negatively charged sites on growing medium particles up to the point when the roots extract the cations. The capacity of a growing medium to adsorb these cations is referred to as cation exchange capacity (CEC). Different media components vary considerably in their CEC, but peat moss, vermiculite, and compost have a high CEC value, which explains their popularity in growing media

The different potting may be used in forest nursery like:-

- Loamy Soil : Sand : FYM : Vermi-compost
- Loamy Soil : Sand : FYM : Bio-fertilizers.
- Loamy Soil : Sand : Vermi-compost : Bio-fertilizers.
- Loamy Soil : Sand : Vermi-compost : Oil Cakes : Bio-fertilizers.
- Loamy Soil : Sand : Compost : Bio-fertilizers
- Loamy Soil : Sand : FYM : Oil Cakes.
- Loamy Soil : Sand : FYM : Oil Cakes : Bio-fertilizers.
- Loamy Soil : Sand : Leaf Mould : Oil Cakes.
- Burnt Rice Husk : Sand : Cow Dung. (1:1:1)

RECOMMENDATIONS OF THE COMMITTEE REGARDING NURSERY PROTOCOL FOR TALL SEEDLINGS

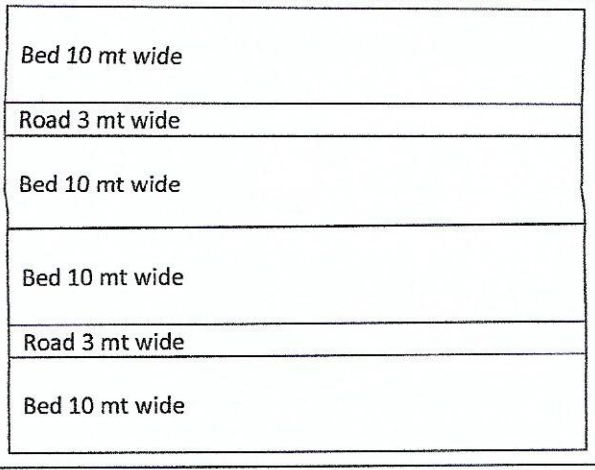
Nursery Calender:

Nursery preparations should start from the first day of February every year to grow a 2½ year old seedling. In 1st year (say Y1) seedlings to be grown in 5"x10" flat Plastic Gunny bag (from 1st Feb to 14th Aug). From 15th Aug to 14th Sept, seedlings to be shifted in 12"x14" flat Plastic Gunny bag, where it should be kept till 14th Aug of next year (say Y2). Again from 15th Aug to 14th Sept, seedlings to be shifted again to 18"x18" flat Plastic Gunny bag, where those are to be kept till 30th June in North Bengal and 31st July in South Bengal (say Y3). So it will take 2 year 5 months in North Bengal, 2 year 6 months in South Bengal to grow a tall seedling (apprx 5ft-8ft).

	1st Feb Y1	15th Aug Y1	15th Sep Y1	15th Aug Y2	15th Sep Y2	30 Jun Y3	31st Jul Y3
Hill	Start in 5"x10" Polythene Gunny bag	Transplant in 12"x14" Polythene Gunny bag	Transplant complete	Transplant in 18"x18" Polythene Gunny bag	Transplant complete	Seedlings ready	
North Bengal	-do-	-do-	-do-	-do-	-do-	-do-	
South Bengal	-do-	-do-	-do-	-do-	-do-		Seedlings ready
Avenue	-do-	-do-	-do-	-do-	-do-	-do- (North)	-do- (South)

Beds: For 5"x10" Polythene Gunny bag, 1mtx10mt beds are to be made as shown below (left). Gap between two beds from all sides should be 0.75 mt. For 12"x14" & 18"x18" Polythene Gunny bag Continuous 10mt wide beds to be used as shown below. 4" Brick edging is to be done all along to hold sand. Water logging inside beds is to be avoided compulsorily by making opening at proper places for drainage. A polythene sheet is to be placed inside the bed to avoid the contact of sand with earth.

Beds of size 1mtx10mt for 5"x10" Poly Gunny Bags



Continuous 10mt wide beds for bigger Poly Gunny Bags

Sand is to be filled inside the bed, up to 4 inch, above polythene sheet. The purpose of sand is to allow tap root to come out from Plastic Gunny bag and enter sand area and remain in dry and zero nutrient zone till shifting schedule. At the time of shifting it will be easy to lift the seedling and cut the root coming out of Plastic Gunny bag because of use of sand.

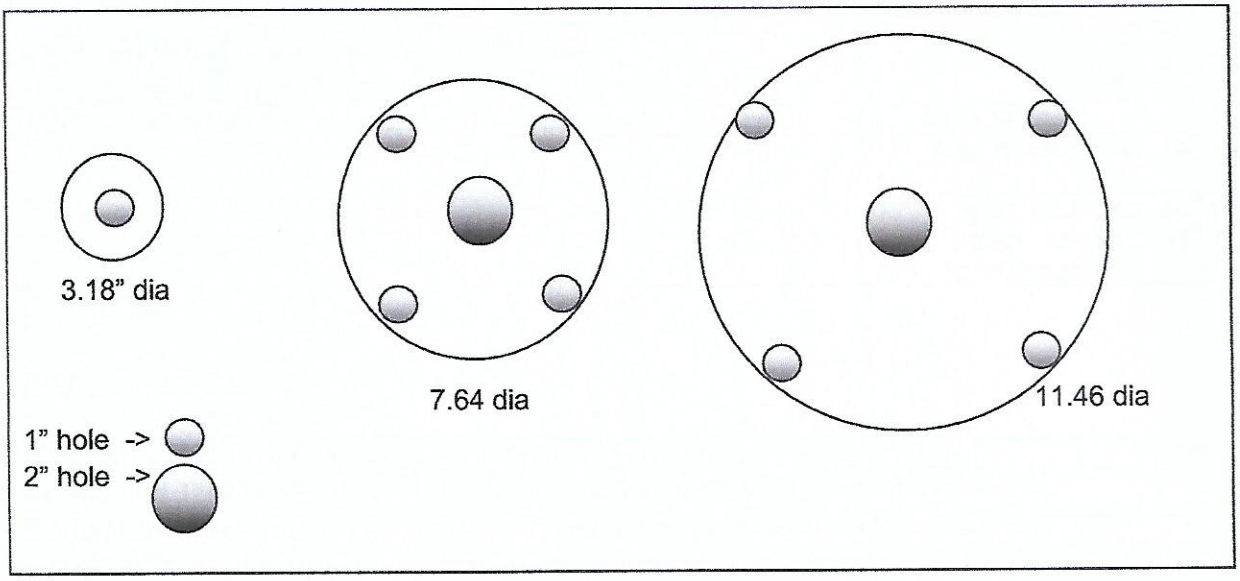
Raised beds not prescribed

Note: If seedlings are kept on raised beds, root coiling may develop inside Plastic Gunny bags and desiccation will also happen. So it is advisable to avoid raised beds. Sand filled beds are prescribed as Plastic Gunny bags are used.

Container:

Three types of Plastic Gunny bags are prescribed during the total period of approximately 2 years and 6 months

1. Plastic Gunny bag of size 5"x10" flat (dia 3.18") with 1 hole of 1" dia at the centre.
2. Plastic Gunny bag of size 12"x14" flat (dia 7.64") with 4 holes of 1" dia near perimeter and 1 hole of 2" dia at the centre
3. Plastic Gunny bag of size 18"x18" flat (dia 11.46") with 4 holes of 1" dia near perimeter and 1 hole of 2" dia at the centre



Size of Plastic Gunny bag (closed at one end):

Flat view

Side view

Top view

1 inch gap at top

Flat measurements	Gap at the top	effective (dia, length)	Volume (cc)	Weight of the potting mixture	Period
5"x10"	1"	3.18", 5"	650	0.8 kg	1st Feb to 14th Aug
12"x14"	2"	7.64", 7"	5250	6.6 kg	15th Aug to next year 14th Aug
18"x18"	2"	11.46", 9"	15200	19 kg	15th Aug to next year 30th June (North Bengal) /31st July (South Bengal)

Potting medium:

(Top Soil : Burnt rice husk : Compost) :: (1:1:1) to be prepared by breaking clods in soil then sieving and THOROUGHLY mixing with Burnt rice husk and Compost in mixture machine. Add Bio fertilizer if required. Potting mixture should not be pressed while filling Plastic Gunny bags to avoid water logging. Top soil is necessary to provide micro nutrients and to finally make a ball of

earth. Burnt rice hush will provide aeration, water holding capacity and drainage and keep the final weight low of ready seedlings. Compost is necessary for nutrients.

Shifting:

First shifting is to be done after 2 months of transplanting in 5"x10", 12"x14" or 18"x18" Plastic Gunny bags. After that regular shifting is required to be done, to disturb the establishment of root coming out of bag, by cutting it. Schedule may be followed as mentioned below.

Rainy season: every 1 month Dry season: every 2 months

Year 1				Year 2					Year 3		
1st April	1st Jun	1st Jul	1st Nov	1st Jan	1st Mar	1st May	1st July	1st Nov	1st Jan	1st Mar	1st May

Watering:

Period	North Bengal	South Bengal	frequency
Dry	Feb-May	Feb-Jun	Twice daily
Rainy	Jun-Sep	Jul-Sep	On no rainy days once daily
Winter	Oct-Jan	Oct-Jan	Once daily

Shade:

Year 1	75% close	1st April to 30th June
Year 2	50% close	1st April to 30th June
Year 3	No shade	

Gaping to be maintained between seedlings :

Period	Spacing between seedlings
1st Feb (Y1) to 15th Aug (Y1)	Close spacing
16th Aug(Y1) to 31st Mar(Y2)	5" to 8" apart depending upon crown
1st April (Y2) to 15th June (Y2)	Close spacing
16th Jun (Y2) to 31st Mar (Y3)	1' to 1.5' apart depending upon crown
1st April (Y3) to final planting	Close spacing

Spacing 18" apart

Close Spacing

Pruning:

Pruning of side branches to be done as and when required.

Area requirement for 50000 seedlings

Dia	Per bed seedlings	Number of Beds required for 50000 seedlings	Area of nursery if there is no gapping between seedlings (ha)	Area of nursery if gapping between seedlings is maintained (ha)
5"x10"	1480	34	0.06	0.06
12"x14"			0.20	0.80
18"x18"			0.45	2.50

Gap between two beds for 5"x10" seedlings should be 0.75 mt. from all sides for ease of walk and conducting all nursery operations. For 12"x14" & 18"x18" seedlings, continuous sand beds are prescribed, however, working path for watering & other nursery operations may be made over sand and continuity may be broken if required due to slope etc.

Note 1: For basic information on nursery manual like making of composting, hygropit, use of pesticide, fungicide, insecticide etc. & criteria and prescriptions for site selection, layout and development, planning, production and Management of the nurseries (which is not covered here) can be referred from nursery manual developed by West Bengal Forest and biodiversity conservation society. The said manual is to be referred first.

Note 2: In case of fast growing species, if height of 5" is achieved in one & half year (i.e. by 30th June in North Bengal and by 30th July in South Bengal), those can be used as tall seedlings for out planting.

Note 3: In case of slow growth additional nutrients should be added.

Note 4: Gap between two seedlings at out planting site can vary from 4 mt to 8 mt.

RECOMMENDED SPECIES FOR SOUTH BENGAL

Annexure I

Sl No.		Local Name	Botanical Name	Primary, Associate, Rare, Endangered	Root character	Sugested planting to be done Y2/Y3	Remaks	Recommendation for obtaining maximum Germination of Seed
2		Bahera	Terminalia bellerica	AE	L	2	LD	DD
3		Haritiki	Terminalia chebula	ARE	L/F	3	MSB	HP
4		Amloki	Phyllanthus emblica	A	F	2	SB	HP
5		Arjun	Terminalia arjuna	A	L	3	MSB	DD
6		Asan	Terminalia alata	A	L	2	MSB	DD
10		Karanj	Pongamia pinnata	A	F	2	MSB	HP
12		Mahul	Madhuca latifolia	AE	L	3	LD	DD
13		Pial	Buchanania lanzan	ARE	F	3	SB	HP
16		Haldu	Adina cordifolia	ARE	L	3	LD	HP
18		Kend	Diospyrus melanoxylon	R	L	3	MSB	DD
20		Challa	Holoptelea intigrefolia	R	L/F	3	LD	DD
21		Setisal	Dalbergia latifolia	ARE	L/F	2	LD	DD
22		Piasal	Pterocarpus marsupium	ARE	F	3	LD	DD
25		Chandan (Seth)	Santalum album	A	F	3	LD	DD
26		Jam	Syzygium operculatum	A	F	3	LD	DD
30		Neem	Azadirachta indica	A	L	3	MSB	DD
31		Ritha	Sapindus detergent	A	L	3	SB	DD
34		Kadam	*Anthocephalus cadamba*	A	L/F	2	LD	HP
36		Radhachura	*Peltoforum feruginum*	RE	L	2	LD	HP
38		Mahagoni	*Swietenia mahogonii*	ARE	L/F	3	LD	DD
39		Sonalu	*Cassia fistula*	ARE	F	3	LD	DD
40		Jhaw	*Casuarina euuisitifolia*	R/E	L	2	LD	HP/DD
42		Debdaru	*Polyalthia longifolia*	A	F	3	LD	DD
44		Kathal	*Artocarpus heterophyllus*	A	L	2	MSB	DD
45		Rudrapalas	*Spathodia campanulata*	ARE	L/F	2	SB	DD

L/F-LONG/FIBROUS LD-Light Demander SB-Shade Bearer MSB-Moderate Shade Bearer PSB-Partial Shade Bearer

RECOMMENDED SPECIES FOR HILLS

Annexure II

Sl No.	Local Name	Primary, Associate, Rare, Endangered	Root character	Sugested planting to be done Y1 = 1 season /Y2/Y3	Remaks	Recommendation for obtaining maximum Germination of Seed
1	Machilus edulis (Lapche Kawla)	A/E	L	3	MSB	D
2	Cinnamomum ceicidodaphne (Malagiri)	P/E	L/F	3	LD	MB/HP
3	Bucklandia populnea (Pipli)	P/A	L/F	3	LD	HP/MB
4	Castanopsis hystrix (Musre Katus)	P	L	3	LD	D
5	Quercus lamellosa (Buk)	P/R/E	L	3	MSB	D
6	Quercus lineata (Phalant)	P/R/E	L	3	MSB	D/HP
7	Betula alnoides (Saur)	P/R/E	L/F	3	LD	MB/HP
8	Cupressus cashmeriana (cupressus)	P/A	F	3	LD	MB/HP
9	Abies densa (Gobre salla)	A/R	L/F	3	MSB	MB/HP
10	Tsuga dumosa (Thingre salla)	A/R	L/F	3	MSB	MB/HP
11	Taxus baccata (Dhyangre salla)	R	L	3	LD	MB/HP
12	Juglans regia (Okhar)	A/R	L	3	LD	D

L/F-LONG/FIBROUS LD-Light Demander SB-Shade Bearer

MSB-Moderate Shade Bearer PSB-Partial Shade Bearer

RECOMMENDED SPECIES FOR NORTH BENGAL PLAINS

Annexure III

Sl No.		Species	Primary, Associate, Rare, Endangered	Root character	Sugested planting to be done Y2/Y3	Recommendation for obtaining maximum Germination of Seed	Remarks
1		Michelia champaca (Champ)	A	LF	2	MB/HP	LD
2		Chukrasia tabularis (chikrase)	A	LF	2	MB	MSB
3		Cedrela toona (Toon)	A	LF	2	MB	MSB
4		Schima wallichii (Chilaune)	A	L	3	HP	LD
5		Terminalia belerica (Behera)	P/E	L	2	D	LD
6		Terminalia chebula(Haritaki)	P/E	LF	3	D	MSB
7		Phyllanthus emblica (Amloki)	R/E	F	2	MB/HP	SB
8		Terminalia tomeatosa (Pacasaj)	A	L	2	D	LD
9		Terminalia myriocarpa (Panisaj)	A	L/F	2	MB	MSB
11		Cinnamomum cecidodaphne (Malagiri)	R/E	L/F	2	MB/HP	MSB
12		Michilus villosa (Kawla)	R	L/F	3	HP	MSB
13		Acrocarpus fraxinifolius (Mandane)	A	L	2	MB	LD
14		Gmelina arborea (Gamar)	A	L/F	2	MB/HP/D	LD
17		Artocarpus chaplasha (Lator)	A	L/F	2	MB/HP	MSB
18		Amoora wallichii (Lali)	A	L/F	3	D/HP	MSB
19		Dysoxylum procerum (Lahsune)	A	L/F	3	D/HP	MSB
21		Tetrameles nudiflora (Maina)	A	L	2	D/HP	MSB
22		Adina cordifolia (Haldu)	R	L/F	3	HP	LD
23		Sterculia alata (Narkali)	A	L/F	2	MB/HP	LD
26		Dalbergia latifolia (Setisal)	R	L/F	2	MB/HP	LD
28		Dillenia indica (Chalta)	A	L/F	3	MB	MSB
30		Mesua ferrea (Nageswar)	A	L	3	HP	MSB
31		Bischofia javanica (Kainjal)	A	F	2	MB	SB
32		Terminalia arjuna (Arjun)	A	L/F	2	D	LD
34		Ailanthus grandis(Gokul)	A	L/F	2	MB	LD
35		Lagerstroemia parviflora (Sidha)	R	L	2	MB/HP	LD
36		Lagerstroemia flos regina (Jarul)	A	L/F	2	MB	LD

L/F-LONG/FIBROUS LD-Light Demander SB-Shade Bearer MSB-Moderate Shade Bearer PSB-Partial Shade Bearer

RECOMMENDED SPECIES FOR MUNICIPAL CORPORATION AREA Annexure IV

Sl.	Sl.	Common Name	Botanical Name	Family
1.	3	Asok	Saraca asoca	(Caesalpiniaceae)
2.	2	Radha Chura	Peltophorum ferrugineum	(Caesalpiniaceae)
3.	3	Putranjiba	Putranjiva roxburghii	(Euphorbiaceae)
4.	3	Karanj	Pongamia pinnata	(Fabaceae)
5.	3	Muchkunda	Pterospermum acerifolium	(Sterculiaceae)
6.	3	Jarul	Lagerstroemia thorellii	(Lythraceae)
7.	3	Kamala Baheri	Cordia Sebestina	(Boraginaceae)
8.	3	Amalthus	Cassia fistula	(Caesalpiniaceae)
9.	3	Mandar	Erythrina indica	(Fabaceae)
10.	2	Rose Trumpet Tree	Tabebuia rosea	(Bignoneaceae)
11	2	Swarna champa	Michelia champaca	(Magnoliaceae)
12.	3	Bakul	Mimusops elengi	(Sapotaceae)
13.	3	Pink Kanchan	Bauhinia purpurea	(Caesalpiniaceae)
14.	2	Pink cassia	Cassia renigera	(Caesalpiniaceae)
15.	3	Palash	Butea monosperma	(Fabaceae)
16.	3	Golden Trumpet Tree	Tabebuia chrysantha	(Bignoneaceae)
17.	3	Neel Parul	Jacaranda mimusifolia	(Bignoneaceae)
18.	3	Rudra palash	Spathodea companulata	(Bignoneaceae)
19.	3	Neel Lohit	Millatia ovalifolia / Peguensis	(Fabaceae)
20.	3	Kurchi	Holarrhena antidysentarica	(Apocynaceae)
21.	2	AkashNeem	Melingtonia hortensis	(Bignoniaceae)
22.	3	Fern Tree	Filicium descipiens	(Sapindaceae)
23.	3	Lal Kanchan	Bauhinia blakinia	(Caesalpiniaceae)
24.	3	Neem	Azadirachta indica	(Meliaceae)
25.	3	Silver Oak	Grevillea robusta	(Proteaceae)
26.	3	Sultan champa	Calophyllum inophyllum	(Guttiferae)

Estimate For establishment of tall seedlings nursery Capacity 50000 / year
total area 3 ha for seedlings kept mostly in close spacing

	For making 50000 seedlings, 3.3 ha area would be required and for continous supply of 50000 seedlings per year, double of it. So initially gaping is not prescribed as cost will go very high and therefore for making 50000 seedlings, 0.80 ha (0.70 for beds)+(0.10 other than beds)area would be required and for continous supply double of it i.e. 1.5 ha. Provision for Extensin of nursery up to 6 ha to be kept for future use.	
1	Barbed wire fencing with RCC pillers - around the administrative area & nursery-1.5 ha, 500mt @650	325000
2	Sinking deep tube-well	170000
3	Composting area	20000
4	Chopping machine & fixing the same at the location	30000
5	Shed for storage purpose (compost heap,potting media storage, scrap material etc)	150000
6	Labour Shed	20000
7	Raised 8000 lit. PVC water tank with pump generator house including 1no.Generator	300000
8	Drying plartform & platform for seed treatment -	30000
9	Cleaning Site, Filling depressions & Land Devlopment	150000
10	Road	250000
11	Drainage	50000
12	Laying of Water Pipe line network	200000
13	Hygropits 2 Nos for seed germination	15000
14	Shed area in first & second year	700000
15	Van and other equipments for carriage of big seedlings	50000
16	Ramp for loading & un-loading-	25000
17	Cost of making of sand beds for keeping the seedlings Y1, 35 beds @ 3500 x 2	245000
17	Cost of making of sand beds for keeping the seedlings Y2 10 mt wide beds x2	390000
17	Cost of making of sand beds for keeping the seedlings Y3v10 mt wide beds x2	865000
	Total Rs	**3985000.00**

for production of 2&1/2 year old 50000 seedlings every year

MODEL ESTIMATE FOR PREPARATORY WORK FOR RAISING NURSERY FOR 1000 NOS OF TALLER SAPLINGS				
	Year Y1+Y2+Y3			
	Period of Nursery (5"x10"- 6.5 months, 12"x14"- 1 year, 18"x18"- 10.5 to 11.5 months)			
Sl.No	Name of work	Schedule of rate	Qty	Amount
1	cost of seeds.		LS	300
2	Cost of 5"x10" Plastic gunny bags with 1 no. hole of 1" at centre. (Rs./no., no.)	1.50	1000	1500
3	Forming Germination beds/Hygropit as specified in WBFBCP nursery mannual.		LS	100
4	Watering the germination beds/Hygropit twice daily with rose cans for 15days.		LS	100
5	Watering the germinarion/Hygropit beds once daily with rose cans for 15 days.		LS	50
6	Collection & supply of Top soil (1/3rd of total volume) according to the requirement for preparation of soil mixure (Rs/m3, m3)	245	0.22	53.90
7	Collection & supply of burnt rice husk (1/3rd of total volume) according to the requirement for preparation of soil mixure (Rs/m3, m3)	210	0.22	46.20
8	Cost of making of compost (1/3rd of total volume) according to the requirement for preparation of soil mixure (Rs/m3, m3)	525	0.22	115.50
9	Preparation of soil mixture by braeaking clods, seiving, mixing Top soil, burnt rice husk & compost- heaping at the filling site and filling in poly bags, arranging bags in bed and pricking out the seedlings (excluding cost of soil mixure). (labour rate, md)	225	4	900
10	Watering the container plants with rose cans			
	a)Twice daily--Feb to May - 120 days (labour rate, md)	225	6	1350
	b)Once daily-- Jun to 14th Aug- 75 days (labour rate, md)	225	2	450
11	Shifting the container plants,weeding,grading and replacement of casulaities in the bags-shifting to done on 1st April, 1st Jun, 1st Jul- Total 3 (labour rate, md)	225	2.25	506.25
	Sub total Y1			5471.85

PART II - Shifting in Bigger size bags: 12"x14"				
	Name of work	Schedule of rate	Qty	Amount
	B/F			
12	Cost of 12"x14" Plastic gunny bags with 4 no. 1" holes at perimeter of bottom and 1 hole of 2" at centre of bottom (Rs./no, no.)	2.9	1000	2900
13	Collection & supply of Top soil(1/3rd of total volume) according to the requirement for preparation of soil mixure (excluding the volume of top soil in 5"x10" containers) (Rs/m3, m3)	245	1.15	281.75
14	Collection & supply of burnt rice husk(1/3rd of total volume) according to the requirement for preparation of soil mixure (excluding the volume of burnt rice husk in 5"x10" containers) (Rs/m3, m3)	210	1.15	241.50
15	Cost of making of compost (1/3rd of total volume) according to the requirement for preparation of soil mixure (excluding the volume of compost in 5"x10" containers) (Rs/m3, m3)	525	1.15	603.75
16	Preparation of soil mixture by breaking clods, seiving, mixing Top soil, burnt rice husk & compost- heaping at the filling site and filling in poly bags arranging bags in bed and pricking out the seedlings (excluding cost of soil mixture) (labour rate, md)	225	10	2250

17	Labour cost for transplanting seedings from 5"x10" containers bags in to 12"x14" containers (labour rate, md)	225	10	2250
18	Pruning side branches once in 3 months - 4 times (labour rate, md)	225	4	900
19	Watering the container plants with rose cans watering regime.			
	a)Once daily-- 15th Aug to 31st Jan- 137 days (labour rate, md)	225	9	2025
	b)Twice daily--Feb to May - 120 days (labour rate, md)	225	16	3600
	c)Once daily-- Jun to 14th Aug- 75 days (labour rate, md)	225	5	1125
20	Shifting the container plants,weeding,grading and replacement of casulaities in the bags-shifting to done on 1st Nov, 1st Jan, 1st Mar, 1st May, 1st July - Total 5 (labour rate, md)	225	12	2700
	Sub total Y2			18877.00
	PART III - Bigger size bags: 18"x18"			
	Name of work	Schedule of rate	Qty	Amount
	B/F			
21	Cost of 18"x18" Plastic gunny bags with 4 no. 1" holes at perimeter of bottom and 1 hole of 2" at centre of bottom (Rs./no., no.)	5.5	1000	5500
22	Collection & supply of Top soil (1/3rd of total volume) according to the requirement for preparation of soil mixure (excluding the volume of top soil in 12"x14" containers) (Rs/m3, m3)	245	2.50	612.50
23	Collection & supply of burnt rice husk(1/3rd of total volume) accordingf to the requirement for preparation of soil mixure (excluding the volume of burnt rice husk in 12"x14" containers) (Rs/m3, m3)	210	2.50	525.00
24	Cost of making of compost (1/3rd of total volume) according to the requirement for preparation of soil mixure (excluding the volume of compost in 12"x14" containers) (Rs/m3, m3)	525	2.50	1312.50
25	Preparation of soil mixture by breaking clods, seiving, mixing Top soil, burnt rice husk & compost- heaping at the filling site and filling in poly bags arranging bags in bed and pricking out the seedlings (excluding cost of soil mixture) (labour rate, md)	225	12	2700
26	Labour cost for transplanting seedings from 12"x14" containers bags in to 18"x18" containers (labour rate, md)	225	10	2250
27	Pruning side branches once in 3 months - 3 times	225	6	1350
28	Watering the container plants with rose cans watering regime.			
	a)Once daily-- 15th Aug to 31st Jan- 137 days (labour rate, md)	225	18	4050
	b)Twice daily--Feb to May - 120 days (labour rate, md)	225	32	7200
	c)Once daily-- 1st Jun to 31st July - 61 days (labour rate, md)	225	8	1800
29	Shifting the container plants,weeding,grading and replacement of casulaities in the bags-shifting to done on 1st Nov, 1st Jan, 1st Mar, 1st May - Total 4 (labour rate, md)	225	16	3600
30	Contingencies for application of pesticides and nutrients etc., and unforseen items if any		LS	1751.15
	TOTAL(Y1+Y2+Y3)			57000.00

Cost of one Seedlings in 18"x18" Poly gunny bag Rs. 57.00

MODEL ESTIMATE FOR PLANTING 1000 NOS OF TALLER SEEDLINGS DURING Y1				
SIZE OF BAGS : 18"x18"		Wages rate Rs. 225		
Sl. No	Details of Work	Schedule of rate	Qty	Amount
1	Digging of 60cmx60cmx60cm pits all types of soil during non rainy seasons. (labour rate, md)	225	22	4950
2	Transporting saplings (transported to the radius of 40km) excluding loading and unloading.		LS	4000
3	Loading and unloading the polythene container seedlings in private / department vehicles (excluding hire charges) (labour rate, md)	225	2	450
4	Distribution of saplings from where seedlings are stocked to the planting spot up to 200 mts. (labour rate, md)	225	4	900
5	Planting the container seedlings by refilling the pits of size 60cmx60cmx60cm. (labour rate, md)	225	25	5625
6	Replacement of causlities by re-opening the failed pits and planting the container plants and refilling the pits. (labour rate, md)	225	8	1800
7	Scrap weeding for 1m dia and soil working 15cm depth around each plant and removing the grass roots away from the site by or upturning the soil. (labour rate, md)	225	10	2250
8	Cost of water @ 20 liters pe seedlings (April to June 3months watering 10 days) at the rate once in 9 days 20x1000x10=200000liters.		LS	8000
9	Watering the plants onces in 9 days during April to June @ one mazdoor for 200 plants / watering day (10 watering days) (labour rate, md)	225	50	11250
10	Engaging Protection mazdoor @ 1 mazdoor/2000 plants (for Rd Avenue for 1 year) (labour rate, md)	225	183	41175
13	Contingenceis and unforseen items if any.		LS	1600
Total				82000
Planting Cost of one Poly gunny bag 18"x18" Seedling (Rs.)		82.00		

MODEL ESTIMATE FOR THE 1st YEAR MAINTENANCE OF 1000 NOS OF TALLER SEEDLINGS 10% casuality

SIZE OF BAGS : 18"x18"		Wages rate Rs. 225		
Sl. No	Details of Work	Schedule of rate	Qty	Amount
1	Cost of Taller seedlings	57	100	5700
2	Transporting seedlings (transported to the radious of 40km) excluding loading and unloading.		LS	400
3	Loading and unloading the polythene conainer seedlings in private / department vehicle (excllluding hire charges.)	225	0.25	56.25
4	Distribution of seedlings from where seedlings are stocked to the planting spot up to 200 mts.	225	0.50	112.50
5	Replacement of causlities by re-opening the failed pits and planting the contaianer plants and refilling the pits	225	8	1800
6	Scrap weeding for 1 m dia and soil working 15cm depth around each plant and removing the grass roots away from the site by upturning the soil .	225	1	225
7	Watering the plants once in 9 days during summer Non rainy period-April to June 10 watering days/one mazdoor for every 200 plants	225	5	1125
8	Cost of water @ 20 liters per seedlings (April to June) 10 watering days at the rate of once 9 days 100x10x20=20000 liters.		LS	800
9	Engaging Protection mazdoor @ 1 mazdoor/2000 plants for 1 year	225	183	41175
10	Contingenceis and unforseen items if any.			606.25
	Total			52000
	1st year Maintance Cost of one Poly gunny bag 18"x18" Seedlings Rs		52.00	