

# Latest Technological Advancement In Plantation Including Clonal Technology

Velmurugan S, Shanmugam K

## ABSTRACT

Seshasayee Paper and Boards Ltd is one of the largest integrated pulp and paper mills in Tamil Nadu. The mill is using about 3 00 000 MT of wood as raw material (Eucalyptus and Casuarina) for its manufacturing process. The above quantity of raw material is being sourced from TAF CORN and from the "Farmer's Plantation".

To augment the wood based raw material on sustainable basis for the industry, the company has initiated large scale Tree Plantation programme through Farm Forestry Scheme since 2005 and has covered 24 000 acres so far. With unique scientific management and advanced technical know how, greater emphasis is being given for Genetic quality of the planting material combined with improved packaging practices.

Significant gains in productivity of Eucalyptus have been achieved through clonal planting material raised from apical shoot cutting, adopting optimum spacing for planting, application of organic and inorganic fertilizers and ploughing the field twice in a year. Nearly 20 lakhs site specific clones are produced and supplied to the farming community at subsidized rate.

Productivity of Farm Forestry eucalyptus plantation varies between 45 MT 50 MT per acre on 5 years rotation.

Further R&D will focus on increased productivity of land, improved pulping yield in pulp production.

In the area of Casuarina, seedlings are raised from seedling seed orchards and clonal material is being produced and supplied to farming community to a level of 2.5 crores per annum. The productivity of Casuarina is enhanced from 25-40 MT per acre in the seed route to about 60 MT per acre in clonal plantation on 3-4 years rotation.

## Introduction

SPB was incorporated in June 1960 with an initial capacity of 20,000 tpa and the production capacity was enhanced to 1,15,000 tpa after various expansions. The company was initially designed for using Bamboo as the primary raw material and it was replaced with hard wood like Eucalyptus and Casuarina etc. The present raw material requirement is at 3 lakhs tpa which are procured from TAF CORN and from man made plantations through Farm forestry in and around Tamilnadu.

To have a sustainable supply of wood based raw material and to improve the productivity of the plantation, SPB has started Tree Farming activities through farm forestry scheme in 2005 to plant Eucalyptus and Casuarina. SPB has covered 24000 acres so far under the scheme.

Initially while raising of eucalyptus seed route plantation, not much importance was given to the quality of planting material and hence the

productivity of the plantation was low. Therefore the productivity is improved by raising of eucalyptus clonal plantation using genetically superior planting stock. SPB has high tech clonal nursery (plate1), Clonal

propagation ( Plate 2, 3 and 4) in its campus for producing high yielding clones of eucalyptus and Casuarina in addition to that Casuarina seedlings are also being raised.

SPB is equipped with clonal production

Plate 1

Hightech Clonal Nursery



Plate 2

Eucalyptus Clones inside mist chamber



True to type Eucalyptus Clones

Plate 3



Rooted Clone taken from Root Trainer

Plate 4

Seshasayee Paper and Boards Ltd,  
Erode-638007, Tamil Nadu

capacity of 25 lakh clones per annum. The company has produced 20 lakhs site specific Eucalyptus clones and 5 lakhs Casuarina junghuhniana clones and supplied at a subsidized rate to the farming community.

In case of Casuarina, its cultivation was largely limited to coastal districts. The planting stock is being supplied by the local nurseries lead to low productivity in Casuarina plantation. Subsequently to enhance the productivity the company has decided to promote clonal technology based plantation and to have awareness among the farmers,

various training programmes were conducted to the farming community along with Forest College and Research Institute - Mettupalayam (TNAU-Coimbatore)

The Eucalyptus clonal planting material are being raised from apical shoot cuttings. The clonal technology with root trainer has given improvement for the production of quality planting material at a low cost. Because of this technology we can achieve the Clonal plants with better root system having more number of multiple roots and thereby root coiling

is totally avoided. Transporting of planting material is also made easy.

To augment the productivity of clonal plantations of Eucalyptus, the following studies were carried out.

- 1 To study the effect of indole 3 butyric acid on rooting percentage of Eucalyptus and Casuarina Junghuhniana clonal propagules
- 2 To study the rooting efficiency of different kinds of propagules in Eucalyptus
- 3 To study the productivity of the Eucalyptus Clonal plantations under different density of population.

### Clonal Mini Hedge Garden Plate 5

Clonal mini hedge garden



Eucalyptus Clones in Open Hardening area



Plate 6

### Experiments

The experiment site is located in the factory site of SPB Erode in the Western Zone of Tamil Nadu.

The clonal mini hedge garden has been formed at the size of 15 M x 1 M which can accommodate 1500 mother plants per bed @ 100 plants per M<sup>2</sup> (Plate3). In each bed the selected genetically superior clonal mother plants from Eucalyptus and Casuarina Junghuhniana were planted at the espacement of 10 cm x 10 cm. In Eucalyptus the outstanding clones are C3,C7,C226,C274 and C413. (Plate 5) In case of Casuarina Junghuhniana male sterile clonal mother plants were planted. Periodical irrigation and nutrients were provided through drip irrigation system.

By using this clonal mini hedge garden we were able to obtain about 30 lakhs propagules from Eucalyptus, enabling us to raise about 20 lakhs Clonal plants per annum. (Plate 6)

In the same manner we were able to raise about 5 lakhs successful clonal plants by using about 8 lakhs Casuarina Junghuhniana sprigs collected from the mini hedge garden.

**Study No.1** :To study the effect of indole 3 butyric acid on rooting percentage of Eucalyptus and Casuarina Junghuhniana clonal propagules.

An attempt has been made to study the rooting percentage of apical shoot cuttings of Eucalyptus and sprigs of Casuarina Junghuhniana by using IBA at different concentrations. The basal portion of the apical shoot cuttings of clone C3 in Eucalyptus and sprigs of Casuarina Junghuhniana were treated with IBA at different concentration viz 1000 ppm , 2000 ppm , 3000 ppm , 4000 ppm , 5000 ppm and 6000 ppm. Control ( without treatment of IBA ) were also maintained.

After treatment treated apical shoot cuttings of Eucalyptus and sprigs of Casuarina Junghuhniana were transferred to the mist chamber where the temperature was maintained 33<sup>o</sup> C to 36<sup>o</sup>C and the humidity @ 85 to 90%. Five replicates, thirty cuttings each were maintained for each treatment. After 30 days of planting, the rooting percentages were recorded.

### Study No.2 :

To study the rooting efficiency of different kinds of propagules in Eucalyptus

Study has been conducted to find out the rooting efficiency of apical shoot cuttings and nodal cuttings in Eucalyptus clones viz; C3, C7, C226, C274 and C413. These propagules were treated with IBA @ 5000 ppm. After treatment the treated propagules were kept under the mist chamber. Five replicates thirty cuttings each were maintained for each treatment. After 30 days of planting, root growth characteristics were recorded.

### Study No.3:

To study the productivity of the Eucalyptus Clonal plantations under different density of population.

The experiment was laid out in randomized block design in 2005 with 4 spacing viz; 3m x 3m ( 444 plants per acre) 3m x 2m ( 666 plants per acre), 3m x 1.5m ( 888 plants per acre) and 3m x 1.35 ( 1000 plants per acre) was maintained under rainfed condition. The size of each plot for each treatment was kept as 10m x 10m which were replicated seven times. The plots were harvested during 2010, when the plantation was of 5 years old. At the end of the harvest, the productivity of each plot was arrived.

## Result and discussion

### Study No.1 :

#### I Eucalyptus :

The data shown in Table 1 indicate that in Eucalyptus the rooting percentage did not show significant results with variations in the concentration of IBA. However the maximum rooting percentage (90%)was observed at the rate of 2000 ppm and minimum rooting percentage(83%)was recorded at concentration of IBA1000 ppm.

The results of the rooting percentage was not significant among treatments eventhough the propagules were

treated with different concentration of IBA in the case of apical shoot cuttings . However the propagules ( apical cuttings ) not treated with IBA also shows the same result. Hence it was observed from the study that apical shoot cuttings may have the potential of rooting materials ( inherent auxin ). Therefore in case of raising Eucalyptus Clonal plants using apical shoot cutting, the propagules may not be treated with any IBA concentration.

#### II Casuarina Junghuhniana :

The results indicated that the treatments differed significant over control ( 28 % - Table 2 ) . The rooting percentage varied between 56.6 % ( IBA 1000 ppm ) and 82 % ( IBA 2000 ppm) which exhibited significant differences. Among the treatments IBA 2000 ppm (82%) recorded superiority in terms of rooting percentage.

The similar rooting of sprigs in

Casuarina Junghuhniana was achieved using IBA powder @ 2000 ppm . The result of the current investigation is also in accordance with findings of ( Gurumurthi et al 2000 ). Hence the same treatment may be used for mass multiplication of Casuarina Junghuhniana through clonal technology.

#### Study No.2 :

To study the rooting efficiency of different kinds of propagules in Eucalyptus

The results showed ( Table 3) that there was a significant variance among the clones in respect of rooting percentage ranging from 52 % to 70 % in nodal cuttings where as the rooting percentage varied from 72 % to 90.1 % in respect of apical shoot cuttings. However in respect of nodal cuttings the rooting percentage was maximum (70 %) in Clone No C 3 but minimum ( 52%) in clone No C 226.

**Table 1:** Effect of IBA on rooting of Eucalyptus apical shoot cuttings.

S.No	Treatments	No of cuttings planted	No of cuttings rooted	Rooting %
1	Control	150	127	84
2	IBA 1000 ppm	150	125	83
3	IBA 2000 ppm	150	135	90
4	IBA 3000 ppm	150	132	88
5	IBA 4000 ppm	150	134	89
6	IBA 5000 ppm	150	133	88
7	IBA 6000 ppm	150	134	88

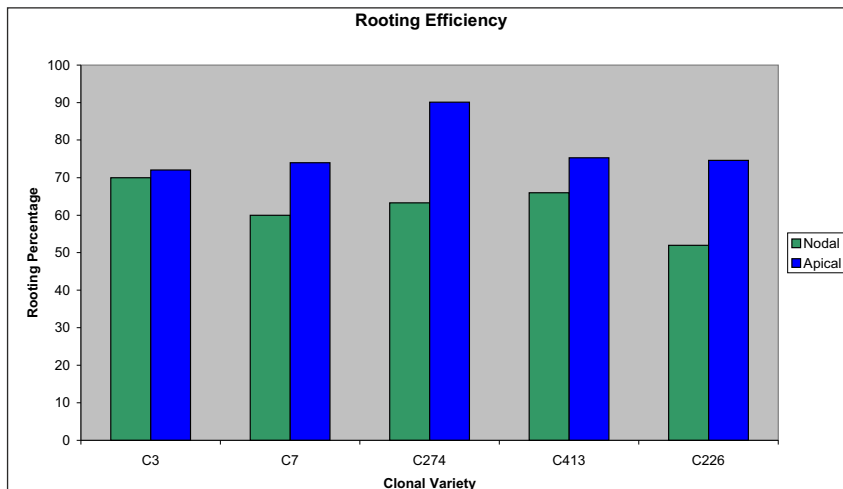
**Table 2:** Effect of IBA on rooting of Casuarina Junghuhniana sprigs.

S.No	Treatments	No of cuttings planted	No of cuttings rooted	Rooting %
1	Control	150	42	28
2	IBA 1000 ppm	150	76	50.6
3	IBA 2000 ppm	150	123	82
4	IBA 3000 ppm	150	100	70.6
5	IBA 4000 ppm	150	103	68.6
6	IBA 5000 ppm	150	90	60
7	IBA 6000 ppm	150	86	57.3

**Table 3:** Rooting efficiency of nodal and apical shoot cuttings in Eucalyptus clones.

S.No	Clone No	Nodal			Apical		
		No.of Cuttings planted	No.of cuttings rooted	Rooting %	No.of Cuttings planted	No.of cuttings rooted	Rooting %
1	C 3	150	105	70	150	108	72
2	C 7	150	90	60	150	111	74
3	C 274	150	95	63.3	150	135	90.12
4	C 413	150	99	66	150	113	75.3
5	C 226	150	78	52	150	112	74.6

CD: 2.85 10.24  
Average 62.26 % 77.20%



In respect of apical shoot cuttings the rooting percentage was maximum (90.12 %) in clone No C 274 and minimum (72 %) in Clone No C 3. When comparing the rooting percentage of nodal and apical shoot cuttings, apical shoot cuttings seems to be better in respect of clonal production. This investigation is in accordance with the findings of Mohamed Ammanullah et al 2004.

### Study : 3

To study the productivity of the Eucalyptus Clonal plantations under different density of population. ( Plate 7)  
In the Table 4, the survival percentage did not show significant results with variation in density. However maximum survival (94%) was observed at 3m x 3m spacing and minimum (82%) at 3m x 1.35m.

**Table No.4 :** Effect of density of population on the productivity of Eucalyptus.

S.No	Growth parameters	Spacing				CD
		3m x 1.35m	3m x 1.5m	3m x 2m	3m x 3m	
1	Survival %	82	84	88	94	NS
2	Productivity MT / acre	49.85	45.78	44.75	42.35	2.85

### Plantation Management

#### 1½ years old Eucalyptus clonal plantation at Cuddalore



The productivity was maximum 49.85 MT per acre at closer spacing ( 3m x 1.35m) and minimum 42.35 MT per acre at wider spacing (3m x 3m).

Survival percentage of Eucalyptus was found to increase with decrease in planting density but this increase was not significant. This trend can be attributed to the less plant competition for space, light, nutrient and moisture at lower density. Bhardwaj et al (2001) also reported the same trend of increase for poplars.

The productivity on per acre basis showed significant increase with increasing plant density. This increase can be attributed to the fact that there are more number of trees at higher density. The results are in line with the findings of Torvi et al (1998) for Pinus tree. Hence for raising Eucalyptus plantation, the spacing 3m x 1.35m may be adopted in future.

### Planting :

Planting operation is being taken up in the onset of S W monsoon. Because the early planting is giving an opportunity to the plants to utilize the entire monsoon rains ( both SW and NE monsoon) and thereby the plants can get better growth increment within a year.

### Site preparation :

The planting site is ploughed well with disc mounted tractor after clearing the bushes and weeds. Planting is done in 1 cu.ft pit. Each pit is treated neem cake @ 200grams per pit as basal dose.

### Espacement :

The Clonal plants are planted at the espacement of 3m x 1.35 m with 1000 plants per acre. Casualty replacement is being done within 1 month after planting.

### Weeding :

Eucalyptus is sensitive to weed competition. Hence ensure that there are no weeds in plantation field.

### Intercultural operation

### Soil working :

Soil working is being done 2 to 3 times for enhancing the growth of the plants.

### Inter Ploughing:

Ploughing the field twice in a year from 1<sup>st</sup> year to 5<sup>th</sup> year helps to improve soil aeration, moisture conservation and controlling the weeds.

**Fertilizer** : Application of fertilizer is essential for better growth of plantation. The fertilizer schedule for Eucalyptus plantation is given below (Table 5).

S.No	Year	Neem cake	DAP	NPK	Poultry manure	FYM
1	Basal dose	200 g / plant				
2	I		50 g / plant			1 Kg / plant
3	II			100 g / plant	½ Kg / plant	
4	III	500g / plant	150g / plant			
5	IV	500g / plant		150g / plant		
6	V	500g / plant	150g / plant			

### Inter Crop :

Intercrop is being taken up with watermelon, groundnut, vegetables etc during 1<sup>st</sup> year of planting which gives additional earnings to the farmer and also reduces the weeds.

### Rotation Age :

Eucalyptus is followed rotation period of 6-7 years for seed route plantation. After raising of clonal plantations the rotation period is fixed as 5 years.

### Pest attack in Eucalyptus :

1 : Termite cause wide spread damage to young plants. The damage occurs below the ground level by hollowing out or severely ring barking the tap root which results in death of the plants.

### Control Measures :

Drenching with a solution of chlorpyrifos @ 2ml/litre of water would control the termites effectively.

### 2: Gall Wasp :

Leptocybe invasa : The gall wasp infested the midrib, petioles of leaves and younger shoots. Finally the plants become stunted and looked like rosette appearance. Sometimes the plants may die due to severe infestation.

### Control Measures :

Spraying with a pesticide of Imidacloprid @ 0.5ml/litre of water or Rogor 2ml/litre of water once in a week alternatively.

### Harvesting :

Eucalyptus felling operation is being followed manually. From the Eucalyptus plantations raised in the farmer's field, the expected pulpwood yield is @ 45 to 50 MT per acre at the age of 5 years. Lops and tops are used as

fuel. After harvesting stumps are used for charcoal making. Mechanized harvesting techniques are explored to reduce the cost of harvesting. The demand for clones produced at SPB is

on the increase, year by year which catches the attention of the farming community due to productivity and economical benefits.

### Casuarina Cultivation

Casuarina is a nitrogen fixing tree grown extensively for multiple end uses like poles, pulpwood, fuelwood

#### True to type Casuarina Junghuhniana Clones



Rooted clone taken from Root trainer



and environmental purposes. Traditionally Casuarina is being cultivated in the coastal districts of Tamilnadu, AP, Orissa and Pondicherry.

### Traditional Method Adopted

The planting stock is being supplied by the local nurseries from unimproved seed sources which is spreaded in the Coastal region. The seeds are collected locally by them and used for raising nurseries.

The supply of poor quality seedlings by the nurseries leads to low productivity in Casuarina plantations. Subsequently SPB has initiated a high tech nursery in its campus for the production and supply of good quality seedlings and clones. (Plate 8& 9)

Casuarina seedling and Casuarina clonal material is being produced and supplied to farming community to a level of 2.5 crores per annum at a subsidised price with technical backup.

### Plantation Management

#### Site Preparation :

The planting site is ploughed well by tractor after clearing the bushes and weeds. The size of the Planting pit is 1cu.ft. Each pit is treated with about 5 10 grams of phorate and mixed 200 grams of neem cake per pit as basal dose.

#### Espacement :

The espacement is 4' x 4' for Casuarina Junghuhniana seedlings i.e 2750 plants per acre and 5' x 5' for Casuarina junghuhniana Clones i.e 1750 per acre. Casualty replacement is being done 2 months after planting.

#### Irrigation :

After planting irrigation is necessary for a month once in 3 days. After establishment irrigation is being done once in 15-20 days.

### Fertilizers

Fertilizer : Application of fertilizer is

S.No	Year	Neem cake	DAP	Urea	Super phosphate
1	Basal dose	200 g / plant			
2	6 months		40 g / plant		
3	I		50 g / plant	50 g / plant	
4	II		75g / plant	75g / plant	
5	III	200g / plant		20g / plant	75g / plant

essential for better growth of plantation. The fertilizer schedule for Casuarina junghuhniana plantation is given below (Table 6).

#### **Pruning :**

Pruning of side branches is necessary from 6 – 12 months after planting. Branches should be pruned by 1/3<sup>rd</sup> of the length of the total tree. The pruned material can be sold for fuel wood purpose.

#### **Intercrop :**

Intercrop should be taken up with any leguminous crops such as green gram, black gram etc., This will help in improving soil structure and fertility which helps in making available required nutrients which increases yield and also reduces weeds.

#### **Rotation Age :**

Casuarina is followed rotation period of 3 – 4 years. In Cuddalore area, the farmers are harvesting in 2 ½ years to 3 years old plantation.

#### **Pest and Diseases.**

##### **Pest :**

Termites cause wide spread damage to seedlings, cuttings of plantations. The damage occurs below the ground level by hollowing out or severely ring barking the tap root which results in death of the seedlings.

##### **Control Measures :**

Drenching with a solution of Chlorpyrifos @ 2ml/litre of water would control the termites effectively.

##### **Diseases :**

Wilt or Blister bark disease caused by Trichosporium Vesiculosum results in drying up of trees.

##### **Control Measures :**

Infected tree should be removed and burnt. Drenching with a solution of Copper Oxy Chloride @ 2.5 gram / litre of water around the infected trees area.

##### **Harvesting**

Casuarina felling operation is conventionally followed manually. From the Casuarina plantations raised in the farmer's field, the expected pulpwood yield for seedling route plantation is @ 25 to 40 MT per acre on 3-4 years rotation as against SPB clonal Casuarina Junghuhniana clonal productivity of 65 MT per acre in the same rotation period. (Plate 10) Lops and tops are used as fuel. After harvesting, stumps are used for charcoal making. Mechanized harvesting techniques are explored to reduce the cost of harvesting.

##### **Acknowledgement**

The authors are very much thankful to SPB Management for the permission to present the paper at IPPTA Seminar at Lucknow.

##### **References :**

- 1) Bhardwaj, S.D and Pankgi Panwar (2001).- Bio mass production potential and nutrient dynamics of Poplars under higher density plantations. Indian Forester 127 (2) 144 to 153

- 2) Gurumurthi and Warriar 2000. Four years of Casuarina net work in India. Proceedings of the Casuarina 4<sup>th</sup> annual work shop, IFGTB-Coimbatore Page 7 to 11

- 3) Mohamed Amanulla B.K (2004). Compendium on Clonal Forestry TNAU Page 165 to 167

- 4) Torvi R.K and Kariyappa G S (1998). Effect of initial spacing [production of pulp wood in Poplars. Indian Forester 123 (3) 192 to 197.

**Plate 10 ( 30 months old casuarina Junghuhniana Clonal plantation**

