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**Research Article**

# Macropropagation of *Lannea coromandelica* (Houtt.) Merr. clones

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**Abstract**
The present study was undertaken to contribute to the continuous search for efficient protocol for the macropropagation of *Lannea coromandelica.* It investigates the main factors involved in the macropropagation process, namely cutting type, rooting medium composition and rooting hormones at nursery conditions. Among this study identified that soft wood cutting as the ideal propagating material for mass multiplication of *Lannea coromandelica* genetic resources and also IBA at 3000 ppm as the optimal rooting hormone and sand and soil as the ideal potting media for clonal propagation.

**Key words**
Lannea, Clonal forestry, Macropropagation, Potting media, Indole Butyric Acid (IBA) and Indole Acetic Acid

## Introduction

*Lannea coromandelica* is one of the fast growing indigenous medium size trees. It is belongs to the family Anacardiaceae. It is deciduous in nature and grows up to 22 m tall. It can be wildly distributed at southern parts of India and diverse population is available in coastal zones since it grows well in high saline condition. This species is propagated by seeds as well as vegetative parts. Seeds are having less viability only up to two months and also there is a problem in embryo development and maturation. Vegetative or clonal propagation in tree breeding programmes has been emerging as a strong attraction to the traditional seed orchard breeding system. The use of clonal propagation is rapidly increasing and is of vital importance to any tree improvement programme (Surendran *et al.*, 2000). There has been growing interest in using the techniques of clonal forestry and thereby exploiting the considerable amount of genetic variability existing in the natural populations (Kiondo *et al*., 2014). However studies pertaining to clonal forestry are not available either for research reference or for commercial utility in *Lannea coromandelica* and hence demand research in this front.

## Materials and Methods

The experiment were conducted at Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam (11°19'N, 76°56'E, 300 meters MSL, Rainfall 800 mm, pH 7.1) during 2014-2015. The various cutting types *viz.,* leafy shoot, soft wood and semi hard wood cuttings were excised from the selected CPTs of *Lannea coromandelica*. The cuttings were further trimmed to a length of approximately 10 cm with minimum two to five nodes. All the leaves were removed before subjecting to the rooting hormone treatments. A slanting cut was given at the basal part of all the cuttings. Then the cuttings were treated with 0.2 per cent bavistin and treated with various rooting *viz.,* Indole Butyric Acid (IBA) and Indole Acetic Acid (IAA) at various concentrations ranging from 1000 to 5000 ppm on quick dip basis. Such treated cuttings were planted in different rooting media *viz.,* standard nursery mixture (1:1 ratio of soil and sand $M_1$), coir pith ($M_2$) and sand alone ($M_3$) and kept under controlled condition (Temperature 33 ± 1°c and RH 80 and 90 percent). This experiment was conducted in Factorial Completely Randomized Block Design (FCRD) with three replications and each replication consisting of 50 cuttings. Most of the cuttings were started for rooting at after 25 days. Observations on percentage of cuttings sprouted, percentage of cuttings rooted, average number of roots per cutting and average root length (cm) were recorded after 90 days of planting. Destructive samplings were done on the five randomly selected cuttings of each treatment and replication and then mean values were analysed with statistical design at Factorial Completely Randomized Block Design.

## Results and Discussion

The influence of growth regulators and rooting media on production of clonal plants of different cutting type, rooting medium and rooting hormone concentration of *Lannea coromandelica* was evaluated under nursery condition.

The per cent sprouting differed significantly due to growth regulator and media. The different cuttings with quick dipping in growth hormone IBA 3000 ppm recorded the maximum per cent sprouting in softwood cutting (63.49 %) followed by IBA 2000 leafy shoot cutting (55.63%). Considering the rooting media, the per cent sprouting was higher in $M_1$ (75.18) followed by $M_2$ (67.34). Among the growth regulator treatments, IBA 3000 ppm recorded the significant higher rooting per cent in softwood cutting 58.99 per cent followed IBA 2000 ppm leafy shoot cutting (44.87 %). The highest number of roots was noted with IBA 3000

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ppm softwood cutting (7.32) and leafy shoot cutting (6.48) planted in $M_1$ rooting media composition. IBA 3000 ppm at soft wood cuttings exhibit the maximum root length (33.23cm) and minimum root length was noted IAA 1000 concentration of semi hard wood cuttings (3.35 cm). Considering the shoot length maximum observed at IBA 3000 ppm concentration of soft wood cuttings (40.06) and minimum in IAA 1000 ppm of semi hard wood cutting (4.55 cm)**.** In a holistic perception, considering all three types of cuttings *viz*., leafy shoot, soft wood and semi hard wood cuttings, the superiority of soft wood cuttings was evident due to higher rooting per cent coupled with other growth parameters in the growth regulator concentration of IBA 3000 ppm and 1:1 mixture of sand and soil composition (Table 1-3). Macro propagation through different types of cuttings is generally considered as an important tool for rapid multiplication of true-to-type genotypes with the highest genetic quality materials (Chauhan *et al.,* 2015). Exogenous application of harmones has been found to be promote rooting in many species and growth regulators like IAA (Gurumurthi *et al*., 1994), IBA (Das et al., 2015).

In the present study, the growth of various types of stem cuttings *viz*., leafy shoot, soft wood were deployed and it was found that semi hard wood cuttings were better in soil: sand (1:1) medium that might be attributed due to good nutrient status, aeration and moisture supply to the cuttings (Fig. 1-5). Similar study was earlier reported by Dhixya (2014) for propagation of *Dalbergia sissoo* through hard wood cutting, which also confirms the results of current findings. Propagation of tree species through stem cuttings is a function of several factors one of which is medium of propagation (Hyun, 1967). The role of rooting media in inducing rooting and developing healthy seedlings in stem cutting is well known. An ideal rooting media should be able to provide enough moisture and nutrients for root initiation and further development besides preventing the desiccation of the cut ends. Three potting media were evaluated with sand medium as the control. Among these, the mixture of soil + sand in the ratio of 1:1 recorded markedly higher values for per cent sprouting, per cent rooting, average number of roots, average root length and average shoot length. The same medium was also reported to be superior in *Eucalyptus* (Sivarajan *et al.,* 2014).

## Conclusion

Optimum protocol derived for macro clonal propagation of *Lannea coromandelica* revealed that among the various types of potting media, the sand and soil mixed at the ratio of 1:1 was found to be optimal. For successful clonal mass multiplication of *Lannea coromandelica*, soft wood cuttings was found to be a better type of cuttings and IBA 3000 ppm concentration of rooting hormone was found to be the best one for macro clonal propagation of *Lannea coromandelica* with highest rooting per cent and other growth attributes.

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**Table 1. Effect of growth regulators and rooting media on rooting of leafy shoot cuttings of *Lannea coromandelica***

| Growth Regulator | Per cent sprouting | | | | Per cent rooting | | | | Number of roots | | | | Root length (cm) | | | | Shoot length (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rooting media (M) | | | | | | | | | | | | | | | | | | | |
| | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean |
| Control | 22.78 | 16.83 | 11.58 | 17.06 | 7.92 | 6.58 | 4.42 | 6.31 | 2.65 | 2.07 | 1.70 | 2.14 | 3.97 | 2.92 | 2.05 | 2.98 | 6.48 | 4.70 | 4.43 | 5.20 |
| IAA 1000 | 35.07 | 23.23 | 16.92 | 25.07 | 19.20 | 13.32 | 9.60 | 14.04 | 3.02 | 2.23 | 1.82 | 2.38 | 5.62 | 4.23 | 3.38 | 4.41 | 9.15 | 7.55 | 6.02 | 7.57 |
| IAA 2000 | 38.17 | 28.08 | 21.90 | 29.38 | 28.32 | 18.95 | 15.58 | 20.95 | 3.23 | 2.32 | 1.95 | 2.50 | 9.73 | 6.83 | 5.37 | 7.31 | 17.35 | 12.62 | 8.07 | 12.68 |
| IAA 3000 | 42.50 | 33.80 | 26.73 | 34.34 | 32.92 | 23.75 | 18.08 | 24.92 | 3.87 | 2.73 | 1.90 | 2.83 | 10.54 | 7.60 | 6.39 | 8.18 | 18.70 | 15.50 | 10.45 | 14.88 |
| IAA 4000 | 59.17 | 41.08 | 33.47 | 44.57 | 45.50 | 37.00 | 27.17 | 36.56 | 4.47 | 3.17 | 2.18 | 3.27 | 13.85 | 10.22 | 8.67 | 10.91 | 25.07 | 19.30 | 15.03 | 19.80 |
| IAA 5000 | 42.97 | 34.38 | 25.50 | 34.28 | 33.17 | 24.92 | 19.82 | 25.97 | 3.79 | 2.95 | 2.47 | 3.07 | 9.77 | 8.30 | 6.55 | 8.21 | 21.42 | 15.23 | 12.43 | 16.36 |
| IBA 1000 | 35.80 | 24.12 | 19.42 | 26.45 | 20.67 | 17.67 | 12.42 | 16.92 | 2.72 | 2.57 | 2.29 | 2.53 | 7.25 | 5.35 | 4.17 | 5.59 | 13.85 | 11.19 | 8.18 | 11.07 |
| IBA 2000 | 68.40 | 55.32 | 43.17 | 55.63 | 54.98 | 44.67 | 34.97 | 44.87 | 6.48 | 3.92 | 3.58 | 4.66 | 24.07 | 16.27 | 11.43 | 17.26 | 33.08 | 26.52 | 19.50 | 26.37 |
| IBA 3000 | 43.82 | 33.00 | 26.00 | 34.27 | 27.82 | 24.53 | 22.98 | 25.11 | 3.35 | 2.73 | 2.42 | 2.83 | 12.03 | 7.80 | 6.75 | 8.86 | 18.65 | 14.43 | 10.28 | 14.45 |
| IBA 4000 | 45.67 | 34.67 | 30.50 | 36.95 | 37.57 | 31.32 | 24.90 | 31.26 | 4.67 | 3.57 | 2.58 | 3.61 | 16.67 | 11.60 | 8.80 | 12.36 | 24.72 | 17.83 | 14.52 | 19.02 |
| IBA 5000 | 53.33 | 45.33 | 34.90 | 44.52 | 43.67 | 36.13 | 26.17 | 35.32 | 4.53 | 3.40 | 3.11 | 3.68 | 19.47 | 12.62 | 9.62 | 13.90 | 28.20 | 23.08 | 15.62 | 22.30 |
| **Mean** | **44.33** | **33.62** | **26.37** | **34.78** | **31.97** | **25.34** | **19.64** | **25.65** | **3.89** | **2.87** | **2.36** | **3.04** | **12.08** | **8.52** | **6.65** | **9.08** | **19.65** | **15.26** | **11.32** | **15.43** |
| | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | |
| **M** | 0.542 | | 1.083 | | 0.463 | | 0.924 | | 0.085 | | 0.169 | | 0.205 | | 0.409 | | 0.321 | | 0.639 | |
| **G** | 1.038 | | 2.073 | | 0.886 | | 1.771 | | 0.163 | | 0.325 | | 0.393 | | 0.784 | | 0.614 | | 1.225 | |
| **GXM** | 1.799 | | 3.591 | | 1.535 | | 3.066 | | 0.283 | | 0.564 | | 0.681 | | 1.358 | | 1.063 | | 2.123 | |

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**Table 2. Effect of growth regulators and rooting media on rooting of soft wood cuttings of *Lannea coromandelica***

| Growth Regulator | Per cent sprouting | | | | Per cent rooting | | | | Number of roots | | | | Root length (cm) | | | | Shoot length (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rooting media (M) | | | | | | | | | | | | | | | | | | | |
| | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean |
| Control | 29.83 | 21.27 | 15.90 | 22.33 | 11.91 | 8.72 | 7.07 | 9.23 | 2.95 | 2.68 | 2.20 | 2.61 | 6.94 | 5.49 | 3.91 | 5.45 | 11.08 | 5.49 | 5.55 | 7.37 |
| IAA 1000 | 45.17 | 27.95 | 24.63 | 32.58 | 24.65 | 18.51 | 13.05 | 18.74 | 3.45 | 3.15 | 2.22 | 2.94 | 9.48 | 7.67 | 6.13 | 7.76 | 15.22 | 7.67 | 7.74 | 10.21 |
| IAA 2000 | 46.71 | 32.98 | 26.80 | 35.50 | 33.86 | 24.51 | 23.91 | 27.43 | 3.58 | 3.27 | 2.78 | 3.21 | 17.16 | 11.32 | 9.73 | 12.74 | 25.48 | 11.32 | 12.42 | 16.41 |
| IAA 3000 | 52.45 | 43.53 | 32.04 | 42.67 | 39.16 | 34.06 | 28.59 | 33.94 | 3.95 | 3.55 | 2.73 | 3.41 | 20.75 | 15.07 | 14.03 | 16.62 | 32.08 | 15.07 | 14.51 | 20.55 |
| IAA 4000 | 62.72 | 51.10 | 47.37 | 53.73 | 58.28 | 51.00 | 39.25 | 49.51 | 6.55 | 4.28 | 3.45 | 4.69 | 36.08 | 24.82 | 19.51 | 26.80 | 40.64 | 21.82 | 25.14 | 29.20 |
| IAA 5000 | 56.55 | 42.22 | 36.28 | 45.02 | 42.25 | 34.25 | 30.18 | 35.56 | 4.07 | 3.39 | 2.95 | 3.47 | 26.34 | 17.50 | 14.99 | 19.61 | 33.14 | 17.50 | 16.38 | 22.34 |
| IBA 1000 | 45.29 | 31.95 | 27.48 | 34.91 | 28.47 | 23.61 | 18.22 | 23.43 | 3.20 | 2.93 | 2.88 | 3.00 | 13.05 | 10.17 | 8.76 | 10.66 | 17.17 | 10.17 | 10.66 | 12.67 |
| IBA 2000 | 54.58 | 45.18 | 35.75 | 45.17 | 36.75 | 32.43 | 27.40 | 32.19 | 3.51 | 3.56 | 2.88 | 3.32 | 19.15 | 13.57 | 10.41 | 14.38 | 24.55 | 13.57 | 13.59 | 17.24 |
| IBA 3000 | 75.18 | 67.34 | 47.95 | 63.49 | 72.03 | 58.23 | 46.70 | 58.99 | 7.32 | 5.20 | 3.63 | 5.38 | 41.95 | 34.67 | 23.08 | 33.23 | 54.91 | 34.67 | 30.61 | 40.06 |
| IBA 4000 | 62.97 | 54.94 | 39.68 | 52.53 | 54.02 | 48.94 | 37.62 | 46.86 | 5.76 | 4.32 | 2.88 | 4.32 | 33.91 | 27.19 | 16.35 | 25.82 | 35.24 | 27.19 | 22.46 | 28.30 |
| IBA 5000 | 64.38 | 51.81 | 40.37 | 52.19 | 51.33 | 42.14 | 31.85 | 41.77 | 5.08 | 4.38 | 3.23 | 4.30 | 28.58 | 29.06 | 15.10 | 24.25 | 31.46 | 29.06 | 20.56 | 27.03 |
| **Mean** | **54.16** | **42.75** | **34.02** | **43.65** | **41.15** | **34.22** | **27.63** | **34.33** | **4.49** | **3.71** | **2.89** | **3.69** | **23.04** | **17.86** | **12.91** | **17.84** | **29.18** | **22.58** | **16.32** | **22.70** |
| | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | | **SEd** | | **CD (p=0.05)** | |
| **M** | **0.508** | | **1.016** | | **0.424** | | **0.847** | | **0.078** | | **0.156** | | **0.298** | | **0.596** | | **0.387** | | **0.773** | |
| **G** | **0.974** | | **1.945** | | **0.813** | | **1.623** | | **0.149** | | **0.298** | | **0.572** | | **1.143** | | **0.742** | | **1.481** | |
| **GXM** | **1.688** | | **3.371** | | **1.407** | | **2.812** | | **0.259** | | **0.517** | | **0.992** | | **1.979** | | **1.284** | | **2.565** | |

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**Table 3. Effect of growth regulators and rooting media on rooting of semi hard wood cuttings of *Lannea coromandelica***

| Growth Regulator | Per cent sprouting | | | | Per cent rooting | | | | Number of roots | | | | Root length (cm) | | | | Shoot length (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rooting media (M) | | | | | | | | | | | | | | | | | | | |
| | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean | M1 | M2 | M3 | Mean |
| Control | 25.02 | 15.89 | 8.37 | 16.43 | 6.17 | 0.00 | 0.00 | 2.06 | 1.20 | 0.00 | 0.00 | 0.40 | 2.52 | 0.00 | 0.00 | 0.84 | 2.97 | 0.00 | 0.00 | 0.99 |
| IAA 1000 | 32.38 | 25.28 | 14.74 | 24.13 | 9.08 | 7.27 | 6.59 | 7.65 | 1.80 | 1.46 | 2.37 | 1.88 | 4.49 | 3.18 | 2.37 | 3.35 | 6.31 | 4.20 | 3.14 | 4.55 |
| IAA 2000 | 36.40 | 28.02 | 20.41 | 28.28 | 14.35 | 9.01 | 8.07 | 10.48 | 2.33 | 2.25 | 3.49 | 2.69 | 8.83 | 4.38 | 3.49 | 5.57 | 12.39 | 7.79 | 6.19 | 8.79 |
| IAA 3000 | 39.14 | 30.37 | 23.18 | 30.90 | 18.45 | 13.28 | 11.12 | 14.28 | 2.61 | 2.48 | 5.82 | 3.64 | 8.30 | 6.81 | 5.82 | 6.98 | 14.84 | 9.70 | 7.77 | 10.77 |
| IAA 4000 | 49.60 | 36.02 | 30.17 | 38.60 | 24.17 | 19.99 | 14.97 | 19.71 | 3.53 | 3.04 | 7.11 | 4.56 | 9.68 | 8.58 | 7.11 | 8.46 | 18.50 | 13.49 | 11.28 | 14.42 |
| IAA 5000 | 41.22 | 26.31 | 25.28 | 30.94 | 18.95 | 14.32 | 12.51 | 15.26 | 3.02 | 2.60 | 5.45 | 3.69 | 8.01 | 6.34 | 5.45 | 6.60 | 13.90 | 10.01 | 8.94 | 10.95 |
| IBA 1000 | 34.98 | 20.38 | 15.79 | 23.72 | 9.31 | 7.68 | 6.71 | 7.90 | 2.55 | 1.73 | 2.67 | 2.32 | 6.36 | 3.99 | 2.67 | 4.34 | 7.31 | 5.44 | 5.57 | 6.11 |
| IBA 2000 | 43.96 | 26.05 | 23.79 | 31.27 | 13.46 | 9.82 | 8.60 | 10.63 | 2.54 | 2.54 | 3.72 | 2.93 | 9.07 | 6.25 | 3.72 | 6.35 | 13.25 | 9.08 | 7.89 | 10.07 |
| IBA 3000 | 59.72 | 44.37 | 31.87 | 45.32 | 28.85 | 23.11 | 19.07 | 23.68 | 3.65 | 3.07 | 8.05 | 4.92 | 14.35 | 11.32 | 8.05 | 11.24 | 23.26 | 19.41 | 15.28 | 19.32 |
| IBA 4000 | 54.77 | 35.74 | 22.93 | 37.81 | 20.61 | 15.27 | 13.37 | 16.42 | 2.51 | 2.61 | 6.06 | 3.73 | 10.19 | 7.54 | 6.06 | 7.93 | 18.18 | 14.06 | 11.11 | 14.45 |
| IBA 5000 | 50.98 | 30.33 | 24.53 | 35.28 | 20.07 | 14.88 | 14.68 | 16.54 | 2.60 | 2.55 | 5.90 | 3.68 | 10.82 | 7.25 | 5.90 | 7.99 | 17.67 | 13.76 | 11.37 | 14.27 |
| **Mean** | **42.56** | **28.97** | **21.91** | **31.15** | **16.67** | **12.24** | **10.52** | **13.14** | **2.46** | **2.21** | **1.97** | **2.21** | **8.19** | **5.96** | **4.61** | **6.25** | **13.51** | **9.72** | **8.04** | **10.42** |

| | SEd | CD (p=0.05) | SEd | CD (p=0.05) | SEd | CD (p=0.05) | SEd | CD (p=0.05) | SEd | CD (p=0.05) |
|---|---|---|---|---|---|---|---|---|---|---|
| **M** | 0.429 | 0.856 | 0.335 | 0.668 | 0.074 | 0.149 | 0.143 | 0.287 | 0.237 | 0.474 |
| **G** | 0.821 | 1.641 | 0.641 | 1.281 | 0.143 | 0.285 | 0.275 | 0.549 | 0.454 | 0.907 |
| **GXM** | 1.423 | 2.842 | 1.112 | 2.217 | 0.247 | 0.494 | 0.476 | 0.952 | 0.787 | 1.572 |

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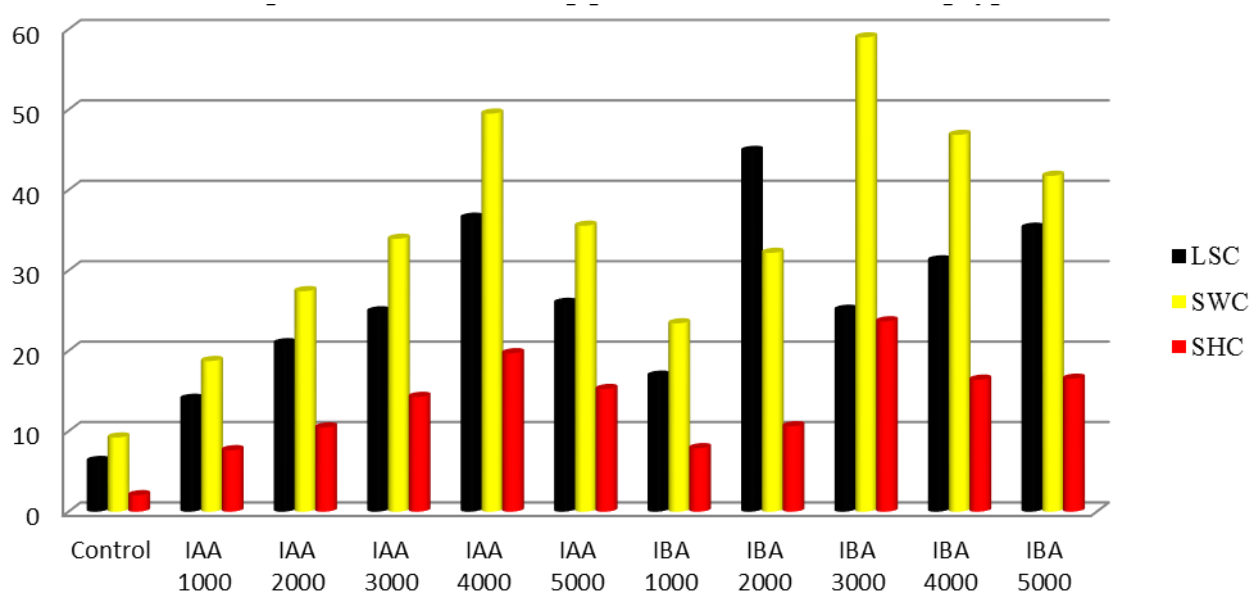


**Fig. 1. Variation in rooting per cent of different cutting type**

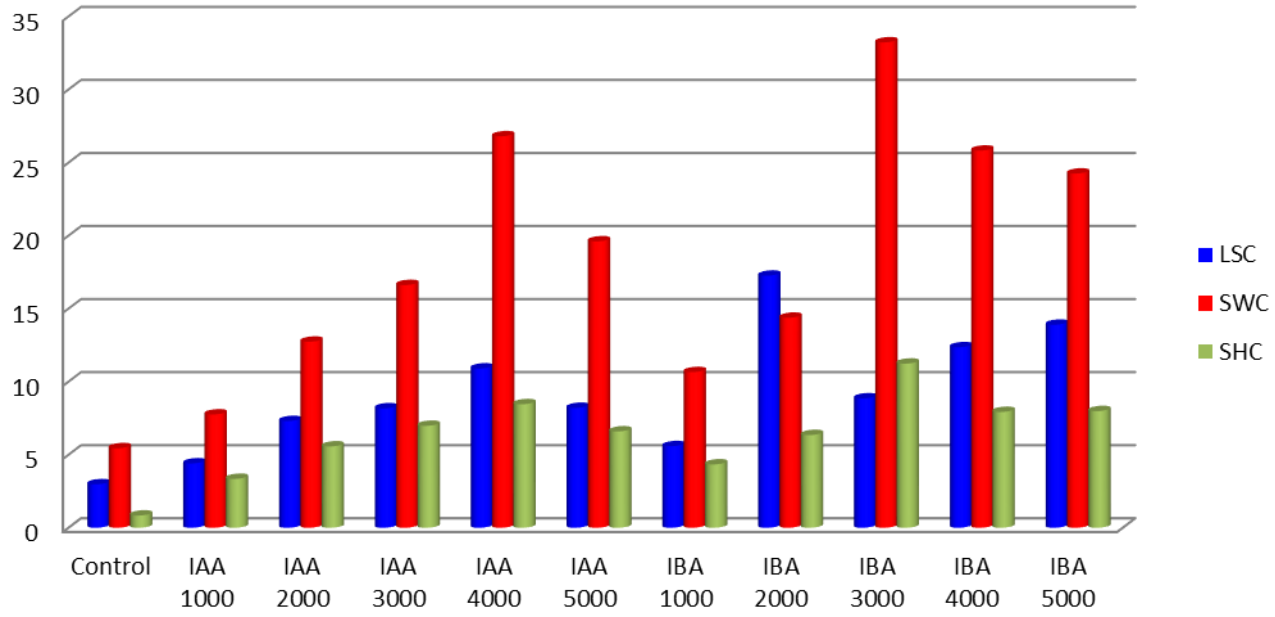


**Fig. 2. Average root length (cm) of different cuttings**

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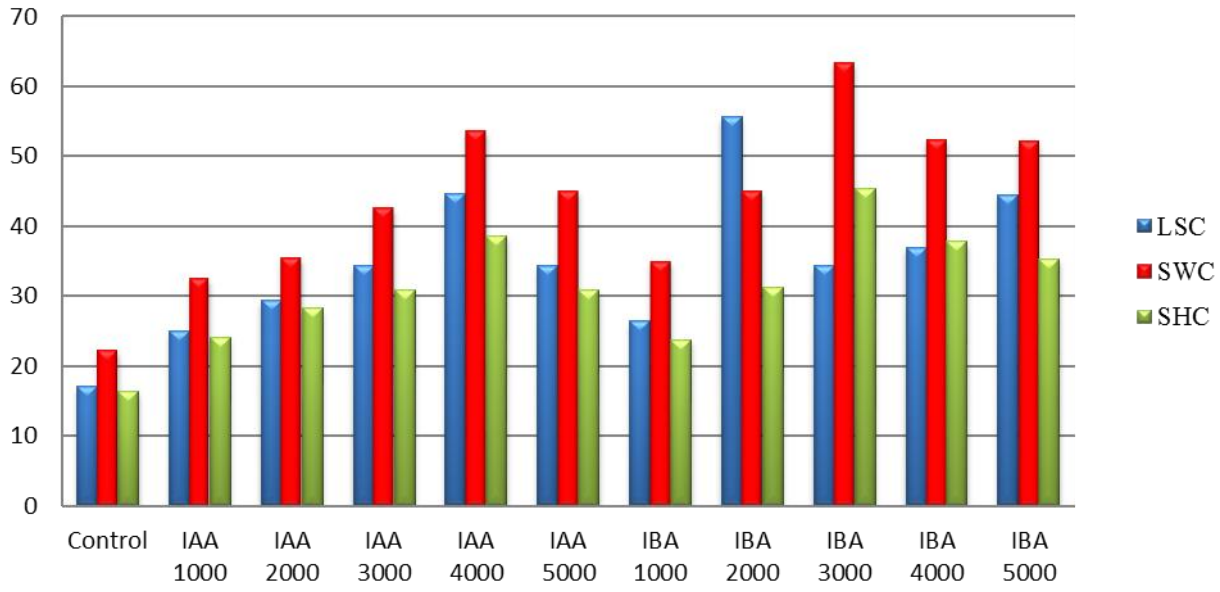


**Fig. 3. Variation in sprouting per cent of different cutting types**

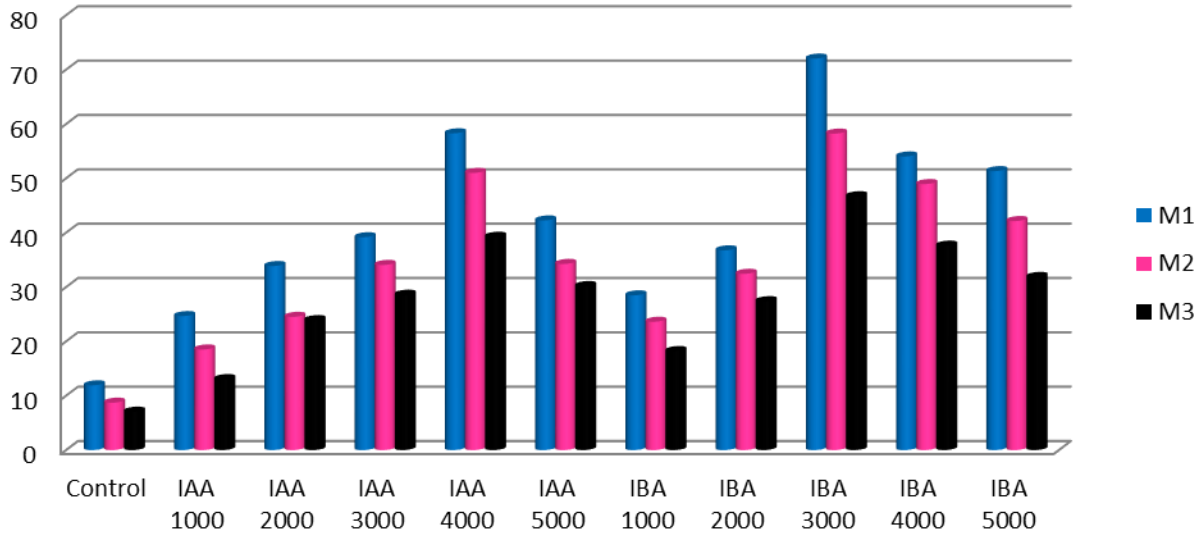


**Fig. 4. Variation in soft wood cutting rooting per cent at different rooting media**

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*IBA 3000 ppm* *IAA 4000 ppm*

***Shooting performance of IBA and IAA***

*IAA 4000 ppm* *IBA 3000 ppm*

***Rooting performance of IAA and IBA***

**Fig. 5. Growth performance of IBA 3000 ppm and IAA 4000 ppm**