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RESEARCH PAPER

Effect of stump diameter and nutrient application on shoot growth attributes of *Tectona grandis* Linn.f.

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Abstract: Teak is one of the most important tropical hardwood species and high-quality timber extracted from both natural forest and Plantations. The growth and development of seedlings play a crucial role in the successful establishment of tree species. Understanding the factors that influence seedling growth is important for optimizing plantation practices and ensuring the long-term sustainability of teak forests. One such factor that can significantly impact seedling growth is the diameter thickness of the stump. An experiment was conducted with the objective of studying the effect of stump diameter thickness and integrated nutrient management on the growth attributes of *Tectona grandis*. Experiment was conducted at Shivaram karanth forest nursery Yadaguppa village, Banavasi, Sirsi. Experiment was laid out in Factorial randomized block design with three main treatments and ten sub treatments with three replications.Results revealed that larger stump of greater than 0.9cm and the nutrient treatmentof 1gN:2gP:1gK significantly improved growth metrics such as plant height, collar diameter. The study emphasizes the importance of stump size and balanced nutrient supplementation for optimal teak growth, with larger stumps and specific nutrient treatments promoting the most robust development.This study indicates that selecting larger stumps having size more than 0.9cm and1gN:2gP:1gK/seedlings can significantly enhance the growth of *Tectona grandis* seedlings. These findings highlight the necessity of different nutrient management and appropriate stump selection to maximize the productivity and health of teak plantations.

Key words: Nutrient management, Stump diameter thickness, *Tectona grandis*

Introduction

The name *Tectona* has been derived from Portuguese word "Teca" meaning carpenter and *"grandis*" from Latin stands for large meaning carpenter used to prefer this species in large quantity because of its durability and resistance to pest and insect attack. Teak also known as royal timber and king of timber and belongs to family lamiaceae it constitutes about 13 per cent of total broad leaf forest (Bebarta, 1999). *Tectona grandis* is a unique species whose timber is most aristocrat among the timbers of India because of its longer durability and other properties such as termite, fungus and weather resistance, lightness with strength, attractiveness, workability and seasoning capacity without splitting, cracking or materially altering shape (Tewari, 1992). The growth and development of seedlings play a crucial role in the successful establishment of tree species. Understanding the factors that influence seedling growth is important for optimizing plantation practices and ensuring the long-term sustainability of teak forests. One such factor that can significantly impact seedling growth is the diameter thickness of the stump. Understanding the effect of stump diameter thickness on *Tectona grandis* seedlings is essential for improving plantation practices and maximizing the productivity of teak forests. By identifying the optimal stump diameter thickness for seedling production, forest managers and practitioners can make informed decisions regarding stump management and suitable stump selection. This knowledge can contribute to the sustainable management of teak plantations, ensuring the continuous supply of high-quality Planting material while preserving the ecological integrity of teak forests. Present day Teak nursery seedling production is decreasing in nutrient content in the soil, availability of nutrient has become a major limiting factor. Hence there is an urgent need to improve the nutrient content of the nursery soil.

Material and methods

The present investigations entitled "Effect of stump diameter and nutrient application on shoot growth attributes of *Tectona grandis* Linn.f."was conducted at Shivaram Karantha forest nursery, Yadaguppa village, Banavasi Range, Sirsi, Uttar Kannada district during 2023- 24. Experimental material consisted of freshly prepared six month old teak stumps which were prepared from six month old teak seedlings.The stumps of respective treatments were planted in slanting position in poly bags size of 9 x15 inch. Stumps planting were done by inserting the root portion inside the planting medium gently so that the root may not get damaged. After planting the stumps, same planting medium is used to cover the stumps.Seedlings were raised by providing suitable tending operation which involves regular weeding at regular intervals and cleaning. Different quantity of nutrients were measured as per the treatment details by using electronic weighing balance and applied directly to the polybag as per the treatment details. The experiment included 13 treatments and replicated three times. The study utilized a Two Factorial Randomized Block Design. Each treatment group comprised of 10 stumps. A total of 900 stumps were selected for the experiment to study the effects of stump diameter thickness and different nutrient

application on seedling growth attributes of *Tectona grandis*.The data collected for different shoot parameters includes Plant height (cm),Collar diameter (cm) was subjected to statistical analysis by using OP-STAT programme by adopting Factorial Randomized Block Design. The level of significance used in 'F' was P = 0.05.

Treatments details	
First factor treatments : 3	
D_1	Less than 0.6 cm Stump diameter thickness
D_2	0.6cm-0.9cm Stump diameter thickness
D_3	More than 0.9cm Stump diameter thickness
Second factor treatments : 10	
T_1	Control (2:1:1) Soil:Sand:FYM
T_2	N: P: K (1g: 2g: 1g/seedlings)
T_3	Poultry manure (20 g/seedlings)
T_4	Vermicompost (30g/seedlings)
T_5	VAM (5g/seedlings)
T_6	PSB(5g /Seedlings)
T_7	0.5g N: 1g P: 0.5g K + 10g Poultry manure/ seedlings
T_8	0.5g N: 1g P: 0.5g K + 15g Vermicompost/ seedlings
T_9	0.25g N: 0.5g P: 0.25g K + 5g Poultry manure + 2.5g VAM + 2.5g PSB/ seedlings
T_{10}	0.25g N: 0.5g P: 0.25g K + 7.5g Vermicompost + 2.5g VAM + 2.5gPSB/ seedlings

Results and discussion

Plant height (cm)

The differences in plant height among different stump thickness were significant as indicated by Table 1and Fig 1 where D_3having size more than 0.9 cm stump diameter thickness maintained the highest growth with heights of 39.81 cm. The minimum heights were observed in D_1having size less than 0.6 cm diameter thickness 24.97cm . Application of different nutrients also showed significant effects on the growth attributes of *Tectona grandis*. T_2(N: P: K 1g: 2g: 1g/seedlings) showed maximum heights of 52.38 cm, significantly higher than other treatments, while T_1 (Control 2:1:1 Soil: Sand: FYM) remaining the lowest 16.87 cm and the differences were statistically significant. The study investigated the interaction effects of stump diameter and application of different nutrients on plant height.D_3T_2(More than 0.9 cm stump diameter thickness+ N: P: K 1g: 2g: 1g / seedlings) exhibited the maximum height (74.28 cm) followedby D_3T_{10} (More than 0.9 cm stump diameter thickness+ 0.25g N: 0.5g P: 0.25g K + 7.5g Vermicompost + 2.5g VAM + 2.5gPSB/ seedlings) while D_1T_1(Less than 0.6 cm diameter thickness + Control 2:1:1 Soil: Sand: FYM)had the minimum (14.5 cm), with significant differences.

Collar diameter (cm)

D_3having size more than 0.9cm stump diameter thickness showing the highest collar diameter (1.983 cm) followed by D_2having size 0.6cm-0.9 cm stump diameter thickness(1.416 cm) and D_1having size less than 0.6 cm stump diameter thickness was the lowest (1.258 cm). Study evaluates the effects of different nutrients application on collar diameter of the seedlings. T_2-1gN:2gP:1gK continued to have the highest collar diameter (2.06 cm) and T_1- Control (2:1:1) Soil : Sand : FYM was the lowest (0.646 cm). D_1T_1(Less than 0.6 cm Stump diameter thickness + Control (2:1:1) Soil : Sand : FYM) exhibited the minimum collar diameter of 0.469 cm, whereas D_3T_2(More than 0.9 cm stump diameter thickness+ N: P: K 1g: 2g: 1g/seedlings) showed the maximum diameter of 2.695 cm followed by followed by D_3T_{10} (More than 0.9 cm stump diameter thickness+ 0.25 g N: 0.5 g P: 0.25 g K + 7.5 g Vermicompost + 2.5 g VAM + 2.5 g PSB/ seedlings) had the collar diameter of 2.353 cm.

Table 1. Effect of stump diameter and nutrients application on Shoot growth attributes of *Tectona grandis* seedlings

Treatments	Plant height (cm)	Collar diameter (cm)
Stump size		
D_1	24.97	1.25
D_2	33.02	1.41
D_3	39.81	1.98
S.Em±	0.48	0.007
C.D@ 5%	1.36	0.019
INM		
T_1	16.87	0.64
T_2	52.38	2.06
T_3	25.48	1.44
T_4	31.12	1.57
T_5	28.36	1.53
T_6	30.33	1.47
T_7	33.93	1.6
T_8	31.3	1.66
T_9	32.93	1.73
T_{10}	43.29	1.78
S.Em.±	0.48	0.01
C.D.@ 5%	1.36	0.03
Interaction (TX I)		
S.Em.±	1.51	0.02
C.D @ 5%	4.3	0.06

The thicker stump diameter possessing more reserved carbohydrates might be the reason for the better growth of seedling as compared to thinner ones. The increase in plant height with bigger stumps may be attributed to presence of higher carbohydrate reserves in the bigger stumps, which gave initial boost to the seedling height growth. These findings are in conformity with Tiwari (1995) in *Dalbergia latifolia* and Mohan and Chaturvedi (1990) in *Acacia nilotica* and *Albizia*

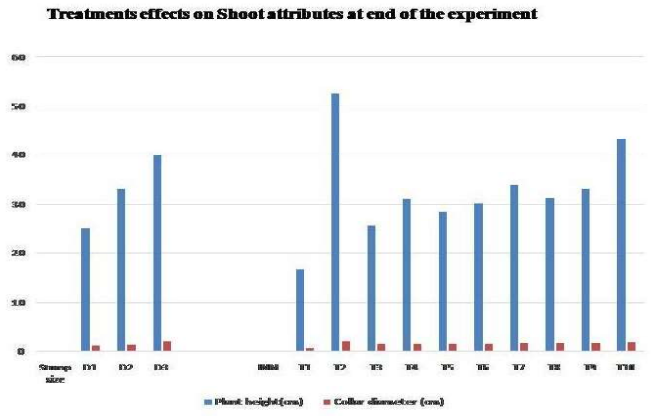

Fig 1. Effect of stump diameter and integrated nutrient management on shoot attributes of *Tectona grandis* seedlings

Legends	
D_1	- Less than 0.6 cm Stump diameter thickness
D_2	-0.6cm-0.9cm Stump diameter thickness
D_3	- More than 0.9cm Stump diameter thickness
T_1	- Control (2:1:1) Soil : Sand : FYM
T_2	-N: P: K (1g: 2g: 1g/seedlings)
T_3	- Poultry manure (20 g/seedlings)
T_4	- Vermicompost (30g/seedlings)
T_5	- VAM (5g/seedlings)
T_6	- PSB(5g /Seedlings)
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T_9	- 0.25g N: 0.5g P: 0.25g K + 5g Poultry manure + 2.5g VAM + 2.5g PSB/ seedlings
T_{10}	-0.25g N: 0.5g P: 0.25g K + 7.5g Vermicompost + 2.5g VAM + 2.5gPSB/ seedlings

Plate 1. Measurements of plant height and collar diameter

lebbeck who found that the stumps of bigger diameter thickness enhanced the height growth of seedlings. Because of greater allocation of photosynthesis into stem, there was significant increase in collar diameter due to bigger stumps diameter thickness. The findings of this study are similar to those obtained by Anon (1945) in *Tectona grandis*, Wilson (1987) in *Gmelina arborea* and Latif *et al*. (1986) in *Tectona grandis* seedlings, who observed that increase in collar diameter of seedlings due to bigger stumps of size 1.0-2.0 cm diameter. The significant higher plant height, collar diameter, in T_2 may be due to its balanced and optimized nutrient ratio of NPK, which supports various growth processes such as cell division, root development, and overall biomass accumulation and biosynthesis of molecules unlike the control treatment which lacks these additional nutrients (Buchanan *et al*., 2000). Similar findings have been reported by Kannur and Devar (2003) recorded that application of 1 g N seedling^{-1} had significant effect on shoot parameters by producing maximum height, collar diameterin *Tectona grandis* seedlings raised by stumps.

Conclusion

Larger stump diameter thickness having size more than 0.9 cm (D_3) consistently resulted in taller plants at later growth stages**.** Nutrient treatment T_2 consisting of N: P: K 1g: 2g: 1g/ seedlings showed the highest plant heights. The combination of D_3 with T_2 resulted in the tallest plants**.** D_3 having size more than 0.9 cm consistently had the largest collar diameter. T_2 consisting of N: P: K 1g: 2g: 1g/seedlings again had the maximum collar diameter, with D_3T_2 showing the best results.These results provide valuable insights for reforestation projects, especially in selecting the right stump size and nutrient management strategies to ensure successful plant establishment and growth.

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