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Sal (*Shorea robusta*) sapling growth under the impact of various potting mixture combination

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Abstract
The inquiry on the impact of potting mixture on the growth and quality of Sal (*Shorea robusta*) seedling was carried out at the Department Nursery of Forestry, Guru Ghasidas University Bilaspur, with the objective of enhancing the quality and survival of seedling in a short period of time. The influence of different growing medium on the growth performance of *Shorea robusta* (Sal) was investigated. *Shorea robusta* was grown in three different growth media: T_1: Soil (2): Sand (1): FYM (1): Coco pit (1), T_2: (T_2S) - FYM (2): Sand (1): Soil (1): Coco pit (1), and T_3: Coco pit (2): Sand (1): FYM (1): Soil (1). Sapling height (cm), number of leaves, petiole length (cm), leaf width (cm), and midrib length (cm). The goal of this study was to determine how different growing medium influenced the growth rate of *Shorea robusta*. The results of this study revealed that the plants' height (cm), number of leaves, petiole length (cm), leaf width (cm), and midrib length (cm) were considerably altered when cultivated in soil mix with coco coir in T_3. The results of this study demonstrated that increasing the nutritional content of the growth media can benefit the growth performance of *Shorea robusta*. The three treatments were T_1 and T_2 and T_3; soil, sand, coco coir, and FYM, and a combination of the four treatments increased seedling development in the order $T_3S > T_2S > T_1S$.

Keywords: *Shorea robusta*, sapling growth, various potting mixture combination

Introduction
The growth media composition has a significant influence on the productive growth of high-quality seedlings in a nursery (Wilson *et al*., 2083; Osaigbovo and Orhue, 2012) [8, 4]. Plant morphological and physiological features influence forest seedling field performance. Nursery practices, in turn, have a profound impact on the development of morpho-physiological features. The efficacy of the growth substrate is critical to seedling quality in container plant production. A good substrate should have a good combination of air porosity and water-holding capacity, enabling root growth and nutrient uptake. Growing media must also have a high cation exchange capacity and be economically viable.

Shorea robusta is a tough plant. Sal is a deciduous broad-leaved moist tropical forest with a wide range of ecosystem distribution that includes states such as Assam, Jharkhand, West Bengal, Odisha, Chhattisgarh, Madhya Pradesh, Haryana, Himachal Pradesh, and Uttarakhand (Singh and Singh, 1992) [6]. It is a valuable timber producing species as well as one of the dominating rainforest species of South and Southeast Asia, with a range that includes India, Nepal, Bangladesh, and Sri Lanka. Sal forest density has been reported to have decreased from 65.6% in 1976 to 11.1% in 1999, with an overall estimated drop of 42.1% in total forest area.

Plant vigor, as well as a greater number of shoots and leaves, are crucial characteristics for plant survival and growth. A proper environment must be supplied to the root system for the greatest plant growth [Wazir *et al* 2004] [4]. Thus, selecting a proper growing medium is critical for healthy plant growth. Growing media are materials that plant roots utilize to grow and obtain water and nutrients [Landis *et al* 2014] [4]. A good growth medium is made up of two or more elements. Each component contains unique chemical and physical qualities that can help plants develop. As a result, experiments on growing *Shorea robusta* with various types of growth mediums were conducted to determine the most effective growing media had been conducted in order to explore the optimum growing material that may be employed to commence the plant's most substantial growth performance. The study's aims were to (i) analyze how different growing medium impact the growth rate of *Shorea robusta* and (ii) conduct a chemical analysis of the growing media.

Material and method

This research was conducted at the Department of Forestry, Wildlife, and Environmental Sciences in Bilaspur, Chhattisgarh. Chhattisgarh is mostly a hilly state with latitudes ranging from 17°46' N to 24°6' S and longitudes ranging from 80°151' E to 84°511' W, with the majority of the forest cover being on the plateaus of Bastar, Jashpur, Surguja, and Pendra. Shivtarai is the closest forest region component of the Achankmar amarkantak biosphere reserve (AABR), which is 56 kilometers distant from the Bilaspur district headquarter. *Shorea robusta* seedlings were collected at the 2 to 3 leaf stage and placed in the departmental nursery on the GGU campus. The seedling was linked to soil and had roots.

Soil Treatment

Ten seedlings in four sets have been maintained for each soil treatments. In the soil treatment there are three types of soil compositions which are used for present experimentation.

a) Soil Treatment 1 (T_1S) – Soil (2): Sand(1): FYM (1): Coco pit (1)
b) Soil Treatment 2 (T_2S) - FYM (2): Sand(1): Soil (1): Coco pit (1)
c) Soil Treatments 3 (T_3S)- Coco pit (2): Sand(1): FYM(1): Soil (1)

Experimental design and lay out

Experimental design: Complete Randomized Design (Factorial)
Number of repetition: 4
Growing space: Open area near the glass house
Container size: Plastic Bags (6’ × 8’)

This part of study has been planned to investigate the establishment of saplings of *Shorea robusta* outside its natural habitat (AABR). The seedling was collected at 2 to 3 leaves stage (young seedlings), these seedlings have been transferred into different soil combination in Departmental nursery. Regular watering has been done during whole experimentation. Different potting mixture and seedlings growth variables measurement were taken at weekly interval for all the treatments. The measurement lasted for twelve months.

The seedling growth observations were recorded for the following parameter

1. Height of saplings
2. Number of leaf formed
3. Midrib length
4. Petiole length
5. Width of leaf

Result and Discussion

The influence of various potting mixes on survival %

T_3 had the highest proportion of sapling survival (90.00%), which was equivalent to T_2 (85.00%) and T_1 (50.67%). The best survival rate was seen in medium including cocopeat, soil, and FYM, which helped sapling development by maintaining water and nutrient supply balance. The poor survival rate recorded in the nursery control (36.00%) might be related to the quick drying of FYM that produced the saplings. Ragaji (2017) [5] both reported identical outcomes in soil + FYM (3:1) followed by soil + cocopeat (1:1) media for mango stone grafts.

The influence of different potting mixtures on morphological characteristics

Shorea robusta seedling growth was considerably impacted by the potting mixture in terms of height growth, diameter growth, leaf number, branch number, shoot biomass, root, and quality. The T_3S treatment (28.7 cm) had the biggest percentage gain in plant height at the conclusion of the trial, followed by the T_2S treatment (27.3 cm), which was superior to the other treatments. The T_1S treatment resulted in the smallest percentage increase in plant height (18.1 cm). Similarly, the T_3S treatment increased plant girth by the greatest percentage (7.9 cm), which was equivalent to the T_2S therapy (7.0). The T_1S therapy resulted in the smallest percentage increase in plant girth (5.3). A medium combination that has enough aeration, moisture, and nutrients promotes root absorption for photosynthetic production. It assisted in cell division. It assisted in cell proliferation, cell elongation, and proper water transport, resulting in an increase in sapling plant girth %. T_2S therapy produced the greatest number of leaves (9.2). The control group had the fewest leaves (5.2). This was linked to enhanced morphological traits such as height, girth, and leaf number due to the availability of moisture and nutrients through medium. Soilless media is light and porous (Wilson, 1983) [10], with a low salt content, strong water holding capacity, and ion exchange capacity, and it generates the most nodes at the ideal pH. T_2S also had the highest petiole length (1.0 cm), whereas T_1 had the smallest (0.8 cm). In successful seedlings, an optimum balance of nutrients, moisture, and aeration in a cocopeat, leaf manure, and compost combination with or without soil resulted in quicker physiological activity. Soil moisture, humidity, and temperature all promoted cell elongation and multiplication, which influenced the number of leaves on the scion and leaf area. At 180 DAG, T_{10} had the highest AGR (0.1483 cm/day), whereas T9 had the lowest AGR (0.0048 cm/day). On a height basis, T_{10} had the highest RGR (0.0237 cm/cm/day), whereas T_1 had the lowest (0.0208 cm/cm/day). The largest root length was T9 (21.97), which was equivalent to T_2 (20.20 cm). The smallest root length (14.57) was reported by T5. T9 (7.23) had the greatest dry weight. Aeration promotes adequate gas exchange by supplying enough oxygen to the root, resulting in easy nutrient availability. The simultaneous removal of respiratory CO2 facilitated root growth. Bachubhai (2005) [1] discovered comparable results for mango seedlings in soil, sand, and FYM (2:2:1), Waseem *et al*. (2013) [9] in soil + leaf mold + coconut husk (33:33:33), Kelkar (2016) [10] in topsoil + FYM + Vermicompost media for mango, and Ragaji (2017) [5] in soil + leaf manure for mango stone grafting. Thakur *et al*. (2000) [11] discovered tall Albizia lebbeck Benth seedlings in a sand+soil+farm yard waste combination. According to Nandeshwar and Patra (2004) [12], a 1:1:2 mixture of soil+sand+compost was the optimal media for growing and boosting the survival of Acacia catechu seedlings.

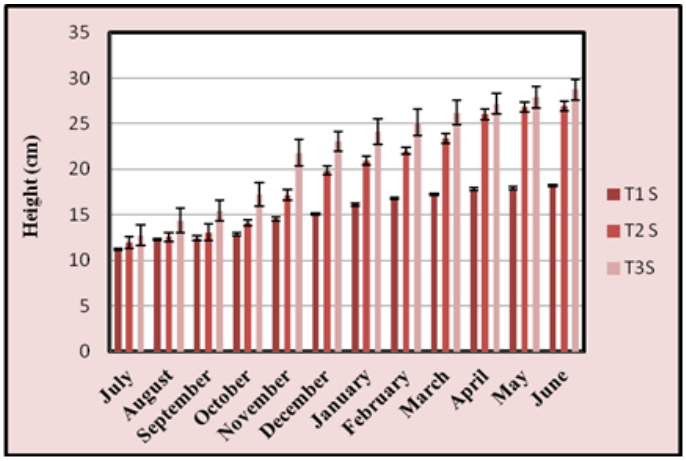
The effect of various potting mixtures on the Benefit: Cost ratio

Finally, the potting mixture had a substantial influence on Sal sapling sprouting, survival, growth characteristics, and B:C ratio. In the near future, locally available FYM, cocopeat, and compost can be utilized as media as an alternative to soil. The weight of a bag filled with soilless media was one-fourth that of a bag filled with soil and compost. The media including

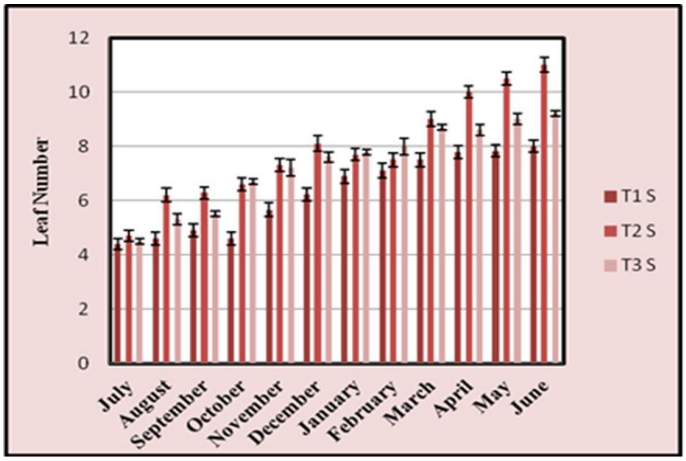
cocopeat and compost (1:1:2:1) was the best soilless medium for Sal sapling nursery. It will also assist to cut farmer mortality and transportation costs.

Table 1: Shows the growth pattern of a Sal seedling outside of its native environment as impacted by various Potting mixture.

Soil Treatment	Height (cm)	Average no of leaves per sapling	Petiole length	Midrib length (cm)	Width (cm)
Control	19.2	5.2	0.8	6.3	5.1
T_1S [Soil (2): Sand (1): FYM (1): Coco pit (1)]	18.2	8	0.8	10.3	0.14
T_2S [Soil (1): Sand (1): FYM (2): Coco pit (1)]	26.9	11	1.0	14.3	0.23
T_3S [Soil (1): Sand (1): FYM (1): Coco pit (3)]	28.7	10	0.85	14.5	0.27



(A)



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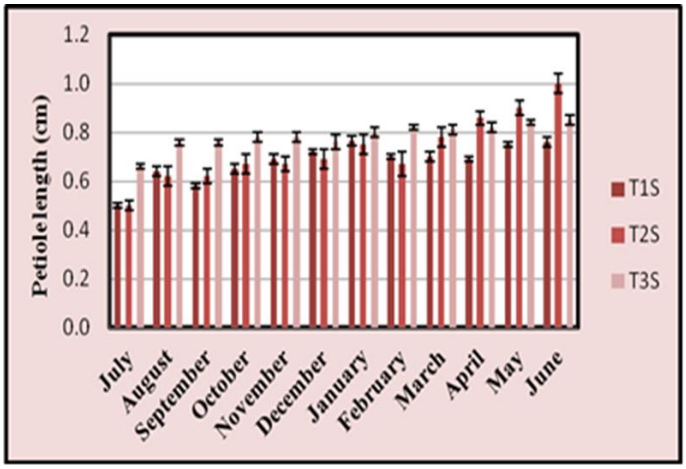

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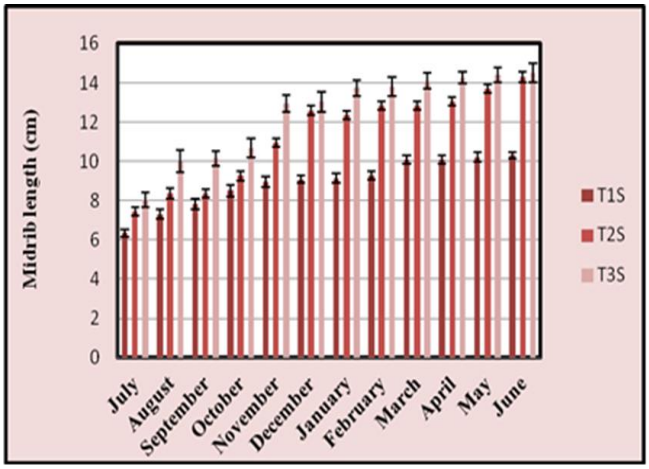

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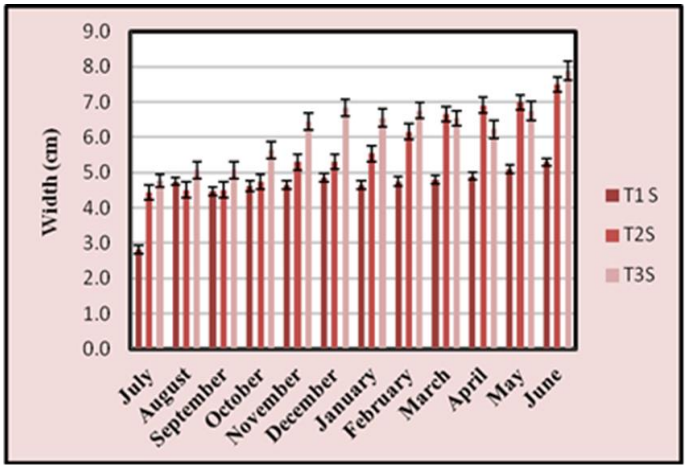

(E)

Fig 1: (A, B, C, D, E) shows the Shows the growth pattern of a Sal seedling outside of its native environment as impacted by various Potting mixture

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