EFFECT OF HORMONAL PRE-TREATMENT ON VEGETATIVE PROPAGATION OF BUTEA MONOSPERMA (Lam.) Taub.

BY

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DISSERTATION

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Certificate I

This is to certify that the dissertation entitled EFFECT OF HORMONAL PRE-TREATMENT ON VEGETATIVE PROPAGATION OF BUTEA MONOSPERMA (Lam.) Taub. submitted for the award of B.Sc. Forestry of Kannur University, Kannur is a bona fide research work carried out by NIMYA TOMY, PRATHEESHA P., V.V. MALAVIKA MOHANAN, JAGATHKRISHNA K., ABHINA P., FARHANA K. and SAHLA THASNEEM M.M under my supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

Taliparamba **SNEHA C**

31-03-2023 **Supervising Guide**

Certificate II

This is to certify that the dissertation entitled 'EFFECT OF HORMONAL PRE-TREATMENT ON VEGETATIVE PROPAGATION OF BUTEA MONOSPERMA (Lam.) Taub.' submitted to Kannur University, Kannur in partial fulfillment of the requirements for the degree of B.Sc. Forestry has been approved.

External Examiner **Supervising Guide**

Head of the Department

DECLARATION

I do hereby declare that the dissertation entitled "**EFFECT OF HORMONAL PRE-TREATMENT ON VEGETATIVE PROPAGATION OF BUTEA MONOSPERMA (Lam.) Taub."** submitted to the Department of Forestry, Sir Syed College, Taliparamba in partial fulfillment of the requirements for the award of degree of Bachelor of Science in Forestry is the original work done by me during February- March months of 2023 under the supervision and guidance of Sneha C, Assistant Professor and Head, Department of Forestry, Sir Syed College.

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ABSTRACT

Butea monosperma, commonly known as the Flame of the Forest, is a deciduous tree species widely distributed in the Indian subcontinent. It is valued for its ornamental, medicinal, and ecological importance. The propagation of *Butea monosperma* through seeds is challenging due to their hard seed coat and low germination rates. Thus, vegetative propagation methods, such as cutting and grafting are commonly used to produce large numbers of genetically identical plants. Hormonal pre-treatment is a widely used method to enhance the rooting and survival of plant cuttings.

The objective of this study was to investigate the effect of hormonal pre-treatment on the propagation of *Butea monosperma*. The experiment was conducted at Sir Syed College from February 24th to March 31st of 2023, and involved treating stem cuttings with different concentration of plant growth hormones such as indole-3-butyric acid (IBA) and indole-3-acetic acid (IAA) both of which are commonly used for rooting and vegetative propagation of plant. The cutting were taken from different mature tree, and were subjected to different hormone treatments before being planted in a growth medium. The growth medium consist of a mixture of soil, cow dung, and peat moss in equal proportions. The environmental conditions will be maintained at a temperature of 25-30°C, a relative humidity of 70-80%, and a light intensity where poor as we done our project in a closed condition. After a period of 4 weeks, the cutting were evaluated for the percentage of rooting and shooting. The result were analysed statistically to determine the effect of hormone treatments on propagation of *Butea monosperma*. The study found that the application hormones significantly increased rooting and shooting of cuttings. Among the hormone treatments, high rooting and shooting percentage were observed with IAA at a concentration of 200 ppm.

Overall the study concluded the hormonal pre-treatment with IBA and IAA can be useful method for vegetative propagation of *Butea monosperma.* The result suggest that the optimal concentration of hormones for rooting and vegetative propagation of *Butea monosperma* may vary, and further studies are needed to determine the most effective hormone treatment for this species.

1. INTRODUCTION

Butea monosperma, also known as Flame of Forest, is a deciduous tree belonging to the family Fabaceae (Plate 1). It is native to South Asia and Southeast Asia, including countries such as India, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia, and Vietnam. Locally, it is known by names such as Palas, Palash, Mutthuga, Bijasneha, Dhak, Khakra, Chichra, Bastard Teak, and Bengal Kino. The tree is typically found in open grasslands and scattered in mixed forests. Plantations of *Butea monosperma* can be raised on both irrigated and dry lands. The pods of the tree should be collected and sown before the start of the rainy season. Root suckers are freely produced and can help in vegetative propagation of the tree.

In addition to its ecological and cultural significance, *Butea monosperma* is known for its various uses in traditional medicine, construction, and handicrafts. Its bright red- or orange-coloured flowers (Plate 2), which bloom in the spring, are used in religious and cultural ceremonies in India and are considered sacred by some communities. The bark and seeds of the tree have been used in traditional ayurvedic medicine to treat ailments such as fever, inflammation, and digestive issues. The tree is also a source of timber and is used in construction and for making furniture. Its leaves are used in various religious purposes in India, and in rural areas, they are used to make leaf plates, cups, and biddies. Additionally, the bark of *Butea monosperma* yields a kind of coarse brown-coloured fibre, which is used for rough cordage.

In *Butea monosperma*, the use of hormonal pre-treatment has been shown to increase the rooting ability of stem cuttings. Auxins, such as indole-3-butyric acid (IBA) and indole acetic acid (IAA), are commonly used plant growth regulators for rooting of cuttings. Studies have shown that the application of IBA or IAA at appropriate concentrations can significantly increase the rooting percentage and root length of *Butea monosperma* stem cuttings. Apart from hormonal treatments, environmental factors such as temperature, humidity, and light intensity can also affect the success rate of vegetative propagation. For instance, maintaining high humidity and moderate temperature can promote root development in cuttings.

Furthermore, selecting healthy and disease-free donor plants, proper cutting preparation, and suitable growing medium can also contribute to the success of vegetative propagation.

Vegetative propagation is an important technique for propagating desirable traits of Butea. The success rate of this technique can be enhanced by the use of hormonal pre-treatment, along with other factors such as environmental conditions, proper cutting preparation, and suitable growing medium. The use of vegetative propagation can aid in the conservation and management of Butea, ensuring the availability of its various benefits for future generations. In the present study, the vegetative reproductive capacity of *Butea monosperma* in response to different hormonal treatments are evaluated. This project will involve comparing the success rates of stem cuttings treated with various hormonal treatments to those that are untreated.

2. REVIEW OF LITERATURE

The relevant literature on the study entitled "Effect of hormonal pre-treatment on vegetative propagation of *Butea monosperma"* is briefly reviewed here.

2.1 Botanical description of *Butea monosperma*

Butea monosperma belongs to kingdom Plantae in Magnoliophyta and class magnoliopsida. It's order and family is Fabales and Fabaceae respectively (Mishra *et.a*l, 2012). It reaches a height of 12-15m, irregularly branched, medium sized, deciduous upright tree. The species timber is porous by nature, has a soft texture, and a greenish white hue. Grey or dark silky pubescence covers the shoots, while bark is fibrous in structure and ranges in colour from light brown to bluish.

The leaves are three - foliate, compound in nature ,big ,stipulate ,and have a moderately tough texture .The coriaceous leaflets have a covering that is glabrascent above and hairy silken below the leaves are generally elliptic in form and range in size from 15 to 20cm by 10 to 15cm.The petiole measures 10 to15 centimeters. From January to March, the foliage turn deciduous, and the tree becomes bald during this time. Despite due to its lack of leaves, the entire area where the plantation is located has a picturesque attractiveness, exquisitely coloured orange and crimson. Its floral begins to bloom in February and continues through the end of April .The flower is 2-4 centimeters in diameter and has orange to red colour and is cultivated in 15 cm tall, rigid racemes (Rai*.et.al*, 2016).

The blossom appears to be like flame from a distance due to its rapid growth and dense clustering on the branch lacking leaves, earning the name ''flame of the forest''. It's sepals, the flower's upper portion, is brick red, while the bottom portion is a slate-grey colour like the branch itself. Corolla has silky silvery hairs on the outside and is an orange crimson colour (Tandon.*et.al,* 2003). The pod of the fruit, a fatty legume, ranges in size from 15 centimeter to 5cm .The flesh smells sweet indistinct and has a faintly bitter flavour. Pods that have just begun to sprout are velvety and densely haired. When grown, the pods droop like strange legumes. The seeds are thick, measuring between 1.5 and 2 millimeters. The seeds are reniform, curve, and thick. When hurt, the tree secrets a crimson juice. Its seed ranges in dimension from 15 to

25mm wide and 25 to 40 mm long. Two substantial leafy yellowish cotyledons are enclosed by a reddish-brown seed covering (Das.*et.al,* 2011)

2.2 Medicinal uses

According to the historic ayurvedic document Charaka Samhita, *Butea monosperma* seeds are insecticidal, and ayurvedic doctors are used to create medications for diarrhoea and dysentery. For controlling menstrual flow, colic and intestinal worm, juice prepared from the leaves can be used to treat sores, zits, swellings, and *haemorrhoids*. *Butea monosperma* flowers have astringent, purgative and stimulating properties (Patnaik., 1993). The seeds nourishes human erythrocytes (Bhalla and Walter, 1999).

Brahmin, Chhetri , Rai , Limbu, Tamang and Magar communities of Eastern Nepal use *Butea monosperma* as a tonic and to treat worm infestation, cuts, wounds, and urinary problems (Oli *et al.,* 2005). Different forms of *Butea monosperma* have been used in Pakistan to treat constipation, piles, diabetes, and a blocked throat (Iqbal *et al.,* 2006). Since many years ago, almost all of the components of *Butea monosperma* have been used in medical and other fields. It is regarded as an excellent supply of food, fibre, dye, gum and resin being used traditionally to cure a variety of illnesses, including cancer, diabetes, diarrhea and dysentery (Burlia *et al.,* 2007). Burlia and khadeb (2007) reviewed that *Butea monosperma* has a broad variety of applications in economic, ecological, aesthetic and religious aspect and has to be explored.

The extractive gum from *Butea monosperma have wide variety of application, the* gum is extracted by making wounds in tree's stem. The bark's liquid congeals into brittle ruby-colored gum pearls (Jhade *et al*., 2009). Extracts from the bark was used to create spherical Ag nanoparticles which were successful in killing both Gram positive and Gram negative bacteria. Moreover, these nanoparticles were displayed anti-cancer qualities. Inexpensive breakthroughs in anticancer drugs and other medicinal uses could result from further study of this application (Pattanayak *et. al.,* 2015).Administration of *Butea monosperma* showed the ability to reduced tumour volume significantly, and it was discovered that this treatment significantly increased the number of non-viable tumour cells in comparison to the EAC control group. It was discovered that increased WBC count and reduced HB content with RBC count were observed

in tumor -bearing mice. In the differential WBC count, neutrophil and monocyte percentage rose while the lymphocyte count fell. At dose of 200 mg/kg and 400mg/kg body weight, the extract-treated group returned all abnormal haemotological markers to almost normal levels (Rekha and Jayakar, 2011). The demand for this product is high both domestically and abroad.

The plant is much demand in folk medicine. Stem bark extract with jeera powder used for leucorrhoea, jaundice and skin diseases. The decoction of stem bark is said to be given as a tonic to women after child-birth. One teaspoonful of root bark juice can be given orally a day for three days as contraceptive (Reddy et al., 2007). Chemical screening of the parts of the species has shown the presence of flavonoids, chalcones, linoleic acid and unsaturated fatty acids (Thirupathaiah, 2007).

Chepang community of Nepal uses *Butea monosperma* flowers as an anthelmintic to treat diarrhoea and dysentery (Tamang *et. al.*, 2017). Researches showed the anti-inflammatory, anti-hepatoprotective, anti-helminthic, anti-tumor, anti-ulcer, and wound healing properties of *Butea monosperma*. Several some of these characteristics have been confirmed through research on animals like rats and sheep, while others remain to be demonstrated. For further investigation of the medicinal properties of *B. monosperma* adequate management, as well as additional scientific research on indigenous medicinal value are needed (Nepuane and Aryal, 2022).

2.3 Economic importance

Butea forests have ecological and environmental functions in term of soil erosion control, land rehabilitation, water conservation and soil carbon sequestration (Kumari *et al.,* 2005).The presence of vegetation is critical in the places where *B. monosperma grow,* because it boosts the soil's ability to retain water and its fertility, both of which increase the physical protection and soil organic matter (Garcia *et. al.,* 1994; Sinha. *et. al.,* 2009). The tree can adapt to limited water availability and grow in saline situations and on poor soil type including swampy, drained, waterlogged, black cotton soil (Jhade. *et. al.,* 2009). It can also enhance the soil fertility by an increase in soil organic carbon (SOC) due to the quick turnover and breakdown of Butea's nutrient rich leaf litter (Kumar. *et.al.,* 2010).

B. Monosperma can serve in terms of ecosystem services, plantations on degraded lands can serve a variety of purposes, including carbon sequestration, soil improvement, rehabilitation, and pollution remediation (Singh. *et. al.,* 2012). The ecological restoration through natural forest is a potential strategy for regeneratinglands that have been harmed and degraded as a result of active human interference (Mukhopadhyay. *et. al.,* 2013). There are numerous methods for restoring degraded lands to their original state, including mechanical and biological methods, soil additives to increase productivity, effective land use planning, natural plantations, and agroforestry. Butea's biological traits and growth patterns make it more crucial in addressing the issue of degraded lands, such as for erosion control and carbon sequestration (Rai. *et. al.,* 2016; Mishra. *et. al.,* 2014)

2.4 Vegetative propagation

Regeneration of many species including woody ones, using larger tissue explants was successfully carried out in culture medium containing the the hormone indole-3-acetic acid(IAA)(Gautheret, 1940). The ability of trees to reproduce vegetatively varies widely between species and genotypes and is influenced by both their physiological state and environment (Komissarov, 1969). The studies conducted in a variety of genera, including Ulmus, Robinia, Prunas, Malus, Populus and Liquidambar, sucker shoots develop from healthy root systems. Suckers typically grow from newly begun meristems on young roots with an established bark layer and some secondary thickening (Eliasson, 1971).

Zimmermann (1976) evaluated the ability of trees to reproduce vegetatively should, in theory, be comparable to that of herbaceous plants; however, due to their larger size and more complex structural makeup as they age, they lose some of their rooting capacity, which must be avoided or compensated for by using young plants, coppiced shoots or rejuvenated shoots. Also the ability to regenerate vegetatively from whole or detached plant parts, some of which are specialised, has developed in many plants, most notably weed species organs. Although this method of vegetative proliferation in trees is not widespread (Leaky, 1981).

Hall and Swaine reported that when in touch with wet earth, some unbroken prostrate branches or buried stems can form roots. Certain tropical species exhibit this natural "layering"

ability particularly effectively (Hall and Swaine., 1981). Rhizomes and lignotubers are a means of survival for a variety of Eucalyptus species in the annually burned zone of tropical Australia. These plants keep an underground “bank” of healthy, dormant buds for root and shoot formation (Lacey *et al.,* 1982). *Doryphora sassafras* and *Eucryphia moorei* trees have evolved to renew by sprouting new shoots from their enlarged stem bases (Johnson and Lacey, 1983).

PLATE 1 – *BUTEA MONOSPERMA* TREE SPECIES

FIG 1: *BUTEA MONOSPERMA TREE*

FIG 2: BRANCH OF *BUTEA MONOSPERMA*

FIG 3: BARK OF *BUTEA MONOSPERMA*

PLATE 2 – FLOWERS OF *BUTEA MONOSPERMA*

FIG 4&5: FLOWERS OF *BUTEA MONOSPERMA*

PLATE 3 –SEEDS OF *BUTEA MONOSPERMA*

FIG 6&7: SEEDS OF *BUTEA MONOSPERMA*

PLATE 4 - PREPARATION OF HORMONE SOLUTION

FIG 8: PREPARATION OF HORMONE SOLUTION FOR PRE-TREATMENT OF *BUTEA MONOSPERMA*

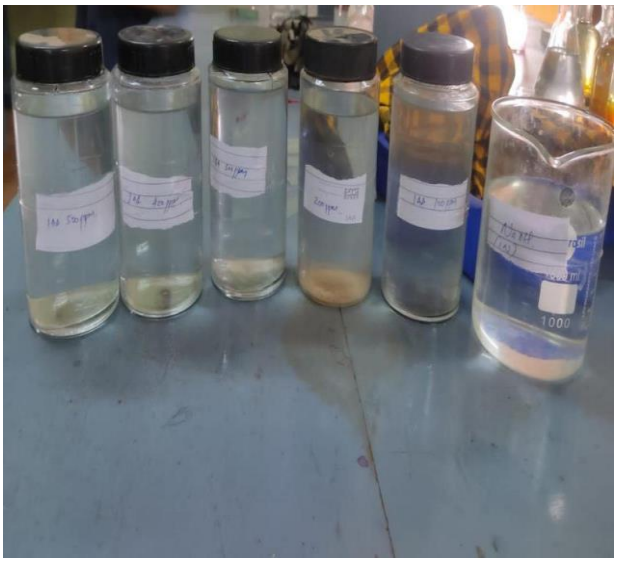

FIG 9&10: PREPARED HORMONE SOLUTION FOR PRE-TREATMENT OF *BUTEA MONOSPERMA*

PLATE 5 - CUTTINGS OF *BUTEA MONOSPERMA*

FIG 11, 12 & 13: PLANTED CUTTINGS OF HORMONE TREATED *BUTEA MONOSPERMA*

3. MATERIALS AND METHODS

3.1 Study Area

The present study was conducted at the Sir Syed College, Taliparamba, Kannur, Kerala. The study site experiences a warm and humid tropical climate with a distinct summer and rainy season.

3.2 Materials

The details of the materials used in the present investigation are discussed in the following sections.

3.2.1 Species under study

Butea monosperma, commonly known as the Flame of the Forest or Palash, is a deciduous tree native to the Indian subcontinent. It belongs to the Fabaceae family and is well-known for its spectacular display of fiery red, orange, and yellow flowers that bloom during the spring season. The tree is highly valued for its medicinal properties and is used in traditional medicine to treat a variety of ailments. Additionally, *Butea monosperma* is also an important component of the ecosystem as it provides food and habitat for a range of animals and insects. Due to its cultural and ecological significance, the tree holds a special place in Indian mythology and is considered a symbol of fertility, love, and devotion.

Vegetative propagation is commonly used in *Butea monosperma* because it is a slow-growing tree that takes several years to reach maturity and produce seeds. Vegetative propagation allows for the rapid multiplication of the species, which is particularly useful for reforestation efforts, landscaping, and horticultural purposes. Additionally, vegetative propagation can preserve the genetic traits of superior varieties, ensuring that desirable traits such as disease resistance and fast growth are maintained in subsequent generations. *Butea monosperma* can be propagated vegetatively through various methods, including stem cuttings, root cuttings, layering, and grafting. These methods are relatively simple, require less time and resources than growing from seed, and can result in the production of genetically identical trees with desirable traits. Here we are experimenting the Effect of hormonal pretreatment on vegetative propagation of *Butea monosperma.*

3.3 Methods

The details of the methodology adopted for the present study is described in the following sections.

3.3.1 Collection and preparation branch cuttings

For the present study, primary branch cuttings of *Butea monosperma* is collected from different areas of Kannur district. The semi hard wood cuttings of mature trees where collected using secature and tree pruner. The collected branches were immediately transported to the nursery by keeping in moistened gunny bags to avoid the moisture loss. The two-noded branch cuttings were treated with 0, 100, 200, 300, 400 500 ppm IBA (make- Merk) and IAA (make SRL) solutions prepared as per the method suggested by KFR (1990) (Plate 4). After dipping the cuttings in upright position, they were planted in the two rooting media (Plate 5).

The cuttings were irrigated twice a day for the first two weeks and once a day thereafter. The experiment was laid out in factorial completely randomized design (CRD) with 10 replications. The sprouted cuttings were uprooted after forty days and observations were made. Some of the sprouted cuttings were retained even after forty day but they eventually dead.

3.4 Main items of observations to be made

The cuttings were observed for sprout and root formation and the following observation were made.

3.4.1 Sprouting percentage

The sprouting percentage was calculated using the formula,

$$\text{Percentage of sprouting} = \frac{\text{Number of cuttings sprouted}}{\text{total number of cuttings}} \times 100$$

3.4.2 Number of sprouts/ cutting

Number of sprouts produced by the cuttings was recorded.

3.4.3 Sprout height

The height of sprout produced by the cuttings was recorded in centimeters using a meter scale.

3.4.4 Rooting percentage

The rooting percentage was calculated using the formula,

$$\text{Percentage of rooting} = \frac{\text{Number of cuttings rooted}}{\text{total number of cuttigns}}$$

3.4.5 Root length

The length of root produced by the cuttings was recorded in centimetres using a ruler

3.5.6 Statistical analysis

The first experiment was laid out in factorial completely randomized design (CRD) with 10 replications. Univariate analysis of variance was conducted taking growth regulators and their concentration as the factor and the sprouting percentage, number of shoots and shoot length as the dependent variables.

4. RESULTS

The results of the propagation trials through stem cuttings in *Butea monosperma* are presented in the following sections.

4.1. Observations

The two-noded stem cuttings were treated with 0, 100, 200, 300, 400 500 ppm IBA (make- Merk) and IAA (make SRL) solutions prepared as per the method suggested by KFR (1990) The experiment was laid out in factorial completely randomized design (CRD) with 10 replications. The sprouted cuttings were uprooted after forty days and observations were made. The overall observations made for the experiment is tabulated and given below (Table 4.1)

Table . 4.1. Results of continuous observation:

	1st Week		2nd Week		3rd Week		4th Week		After 40 Days
Replication	Whether shoot appeared	No. of Shoot	Whether shoot appeared	No. of Shoot	Whether shoot appeared	No. of Shoot	Whether shoot appeared	No. of Shoot	No: of roots
$H_1T_1R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_1R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_1R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_1R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_1R_5$	NO	0	NO	0	NO	0	NO	0	2
$H_1T_1R_6$	NO	0	NO	0	NO	0	NO	0	1
$H_1T_1R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_1R_8$	NO	0	NO	0	NO	0	NO	0	1
$H_1T_1R_9$	NO	0	NO	0	NO	0	NO	0	1
$H_1T_1R_{10}$	NO	0	NO	0	NO	0	NO	0	1
$H_1T_2R_1$	NO	0	NO	0	NO	0	NO	0	2
$H_1T_2R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_2R_3$	NO	0	NO	0	NO	0	NO	0	1

$H_1T_2R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_2R_5$	NO	0	NO	0	NO	0	NO	0	2
$H_1T_2R_6$	NO	0	NO	0	NO	0	NO	0	1
$H_1T_2R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_2R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_2R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_2R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_3R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_4R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_3$	NO	0	NO	0	NO	0	NO	0	0

$H_1T_5R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_1T_5R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_2$	NO	0	NO	0	NO	0	NO	0	1
$H_2T_1R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_4$	NO	0	NO	0	NO	0	NO	0	2
$H_2T_1R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_1R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_2R_1$	NO	0	NO	0	NO	0	YES	1	1
$H_2T_2R_2$	NO	0	NO	0	NO	0	YES	1	1
$H_2T_2R_3$	NO	0	NO	0	NO	0	YES	1	2
$H_2T_2R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_2R_5$	NO	0	NO	0	NO	0	NO	0	2
$H_2T_2R_6$	NO	0	NO	0	NO	0	YES	2	3
$H_2T_2R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_2R_8$	NO	0	NO	0	NO	0	NO	0	2
$H_2T_2R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_2R_{10}$	NO	0	NO	0	NO	0	NO	0	1
$H_2T_3R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_3$	NO	0	NO	0	NO	0	NO	0	0

$H_2T_3R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_3R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_1$	NO	0	NO	0	NO	0	NO	0	1
$H_2T_4R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_6$	NO	0	NO	0	NO	0	NO	0	1
$H_2T_4R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_4R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_1$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_2$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_3$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_2T_5R_{10}$	NO	0	NO	0	NO	0	NO	0	0
$H_oT_oR_1$	NO	0	NO	0	NO	0	NO	0	0
$H_oT_oR_2$	NO	0	NO	0	NO	0	NO	0	0
$H_oT_oR_3$	NO	0	NO	0	NO	0	NO	0	0

$H_0T_0R_4$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_5$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_6$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_7$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_8$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_9$	NO	0	NO	0	NO	0	NO	0	0
$H_0T_0R_{10}$	NO	0	NO	0	NO	0	NO	0	0

From the observations it is clear that after the third week the cuttings treated with 200 ppm of IAA showed sprouting (Plate 6), while IBA failed to give sprouting. The replications showed sprouting are ***$H_2T_2R_1$, $H_2T_2R_2$, $H_2T_2R_3$*** and ***$H_2T_2R_6$*** respectively.

But rooting was clearly shown by the cuttings treated with 100ppm, 200ppm, 300ppm and 400ppm of IAA and 100ppm and 200ppm of IBA. ***$H_2T_4R_6$, $H_2T_4R_1$, $H_2T_2R_{10}$, $H_2T_2R_8$, $H_2T_2R_5$, $H_2T_2R_6$, $H_2T_2R_1$, $H_2T_2R_2$, $H_2T_2R_3$, $H_2T_1R_4$, $H_2T_1R_2$, $H_1T_2R_5$, $H_1T_2R_6$, $H_1T_1R_8$, $H_1T_1R_9$, $H_1T_1R_{10}$, $H_1T_2R_1$, $H_1T_1R_5$*** and ***$H_1T_1R_6$.***

The observations were further analysed and calculate the rooting and sprouting percentages of each treatment.

4.2. Sprouting Percentage

The sprouting percentage for each treatment was calculated using the formula,

$$\text{Percentage of sprouting} = \frac{\text{Number of cuttings sprouted}}{\text{total number of cuttings}} \times 100$$

The sprouting was only shown by the second treatment of IAA hormone ie., 200ppm (***H2T2)***.Therefore the sprouting percentage of H_2T_2 is alone calculated.

From the ten replications only four were sprouted thus the

$$\text{Percentage of sprouting} = \frac{4}{10} \times 100$$

Percentage of sprouting = 40 %

4.3. Rooting percentage

The rooting percentage for each treatment was calculated using the formula,

$$\text{Percentage of rooting} = \frac{\text{Number of cuttings rooted}}{\text{total number of cuttigns}} \text{x } 100$$

The rooting was shown by the more than one treatment, thus it was calculated for each treatment.

4.3.1. Rooting percentage of H_1T_1

Percentage of sprouting$= \frac{5}{10}$ x 100

Percentage of sprouting$=$ 50 %

4.3.2. Rooting percentage of H_1T_2

Percentage of sprouting$= \frac{4}{10}$ x 100

Percentage of sprouting$=$ 40 %

4.3.3. Rooting percentage of H_2T_1

Percentage of sprouting$= \frac{2}{10}$ x 100

Percentage of sprouting$=$ 20 %

4.3.4. Rooting percentage of H_2T_2

Percentage of sprouting$= \frac{6}{10}$ x 100

Percentage of sprouting$=$ 60 %

4.3.5. Rooting percentage of H_2T_4

Percentage of sprouting$= \frac{2}{10}$ x 100

Percentage of sprouting$=$ 20 %

From the calculations it is clear that the highest rooting percentage was also shown by the second treatment of IAA hormone ie ., 200ppm (***H2T2)***.

PLATE 6 -SPROUTED STEM CUTTINGS OF *BUTEA MONOSPERMA*

FIG 14, 15, 16&17: SPROUTED PLANT CUTTINGS OF *BUTEA MONOSPERMA*

5. Conclusion

In conclusion, the result of this study indicate that hormonal pre-treatment can significantly improve the propagation of *Butea monosperma*. Specifically treatment with IAA of 200 ppm concentration was found to be the most effective in promoting root and shoot growth. However, it is important to note that this study has some limitations .For example the study was done in a closed area where the availability of sunlight is less and also had some time constraints that affects the result of this study. In addition further field trial is required to understand more about this study.

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