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MEDIA PREPARATION AND OPTIMIZATION FOR THE GROWTH OF BAMBUSA VULGARIS

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ABSTRACT
The fastest-growing plant, bamboo, has a number of distinctive qualities that make it suitable for a wide range of uses. It is inexpensive, lightweight, flexible, strong, long-lasting, and able to spread even in unfavorable environments[3] This review discuss the media preparation and optimization for growth of Bambusa Vulgaris. For this species, vegetative propagation is the only practical option because B. vulgaris does not set seed following scanty flowering, making seedling progenies unavailable. To investigate clonal replication methods for the species, a low-cost propagation study was carried out using two different kinds of short branch cuttings: nodal leafy cuttings and tip cuttings. Following treatment with 0, 0.1%, 0.4%, and 0.8% IBA solutions, the cuttings were allowed to root in a non-mist propagator in order to evaluate their rooting capacity. After four weeks of rooting, the cuttings were grown in polybags under nursery conditions for ten months in order to evaluate their stunting[1].
KEY WORDS - *Bambusa vulgaris, Media, Optimization*

REVIEW OF LITERATURE

1. M.S.Islam -Bambusa vulgaris Schrad ex wendl is a popular bamboo species in rural Bangladesh due to its various applications. Vegetative propagation is the only viable option for this species because B. vulgaris does not set seed following scanty flowering, making seedling progenies unavailable. A low-cost propagation trial was carried out to investigate clonal multiplication approaches for the species, using two types of small branch cuttings: nodal leafy cuttings and tip cuttings. After being treated with 0, 0.1%, 0.4%, and 0.8% IBA solutions, the cuttings were placed in a non-mist propagator to allow them to root and assess their rooting potential.

2. Gil Sander Prospero Gama -To address the public health issue of microbial resistance to pharmaceuticals, researchers are exploring natural alternatives to conventional products. Wood vinegar, produced by carbonizing lignocellulosic raw materials, has potential as an antibacterial agent. The study aimed to assess the antibacterial and antifungal properties of two types of wood vinegar (WV) derived from Eucalyptus urograndis wood and Bambusa vulgaris biomass, as well as their chemical profiles. Antimicrobial activity was tested against Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella enteritidis, Escherichia coli, Streptococcus agalactiae, and Candida albicans. We determined the minimal inhibitory, bactericidal, and fungicidal concentrations.

3 .Kamna Chaturvedi -Bamboo, the fastest-growing plant, has various distinguishing properties that make it suitable for a variety of purposes. It is cost-effective, high-tensile, lightweight, flexible, resilient, and can spread even in infected areas (e.g., slope). This paper highlights bamboo's unique capabilities for producing charcoal and biochar for various applications. This study examines the pyrolysis process for producing bamboo charcoal and biochar, which involves thermal breakdown of organic materials in an oxygen-depleted atmosphere at a specific temperature. This is an alternate process for converting waste biomass into more valuable products, such as charcoal. Bamboo charcoal outperforms ordinary charcoal with four times the absorption rate and ten times the surface area, among other benefits.

4.Poonam tiwari - Bambusa vulgaris (Schrad. ex Wendl) has been pushed to address deforestation and economic issues. This investigation focused on quick in vitro multiplication of Buddha bamboo (Bambusa vulgaris) using internodes as explants. Three cytokinins (IAA, NAA, and 2,4 D) and 0.3 mg/l BAP were shown to be the most effective in triggering bud break and multiple shoot formation, resulting in considerable plant growth. Growth hormones NAA, IAA, 2,4-D, and BAP effectively promote root and shoot production.

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Fig.1 Bambusa Vulgaris [9]

INTRODUCTION

The woody plants that grow the fastest are bamboos, belonging to the Poraceae family and the Bambosidae sub-family. According to Shanmughavel et al. (1997), these multipurpose plants are essential to the daily lives of millions of people in South-East Asia because they provide food, fuel, fodder, clothing, medicine, shelter, and raw materials for a variety of industries, such as paper and pulp, furniture, and construction. Their exceptional splitting ability (Banik 2002), tensile and compressive strength, amenability to being harvested within five years of planting (Negi 1996), and other qualities contribute to their versatile application (Banik et al. 1997). With the expanding human population, the demands for bamboos in homes, agricultural activities and paper industries are increasing. Nevertheless, Bangladesh's bamboo stocks are shrinking concerningly in terms of both area and quantity[1].Due to its exceptional carbon sequestration capabilities, bamboo is currently attracting a lot of interest in the fight against global warming (Lou et al., 2010). Research to date has confirmed that bamboo has better CO2 sequestration than other fast-growing trees, and because of its rapid growth and high rates of carbon accumulation, bamboo is being seriously considered as a plant to mitigate effects of global warming (Lou et al., 2010). However, among the various genera of bamboo, it becomes difficult to identify best species which can serve all potential goals through consistent quality supply of plantlets[8].Bamboo is a rapidly growing renewable resource that offers ample opportunities for reforestation [3]. The use of liquid media in micropropagation processes has been found to be an effective way to lower the cost of plantlet production. The plant known as Buddha bamboo, or Bambusa vulgaris var. wamin, is native to China [4–8 m tall] and is an ornamental species with no records of flowering .Its culms are typically dark green in color, and its internodes are elongated and swollen, resembling pitchers. Some of the internodes of bamboos remain in a vegetative state for an extended period of time. The rate at which various economic trees, like bamboo, are being exploited globally is leading to a bleak future for various tree plants of significant importance[4].Worldwide, bamboos have a significant impact on society, the economy, and culture, particularly in East and South Asia. They are mostly utilized as building materials, food roots, and raw materials. The bamboos are flexible and have good bending strength. The bamboo plant can endure wind force up to 40 meters in the air. Yuming Y. and others [1]. Compared to steel, bamboo is more affordable, lighter, flexible, stronger, and versatile. Bamboo needs to be utilized extensively in building since it has so many advantages over other materials. Bamboo is frequently utilized in place of wood because of its superior mechanical and physical qualities. It matures

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in three to four years as opposed to wood, which takes over twenty years[3].Optimization difficulties generally occur in the sectors of social production activities such as intelligent computing, mathematical research, engineering optimization, distribution scheduling, and so on. Previous studies have searched for more precise and efficient ways to address optimization problems. The heuristic algorithm is one type of solution technique that is suggested to as closely resemble the ideal answer in relation to the optimization algorithm as feasible. There are three branches of heuristic algorithms. There are three types of heuristics: hyper-, meta-, and simple. Generally speaking, simple heuristic algorithms are deterministic algorithms with a single global optimal solution for defined structures and parameters. such as the hill-climbing algorithm, stereotype algorithm, greedy algorithm, and local search algorithm[7].

MEDIA PREPARATION

1.Collection of plant material

The experiment was conducted in the Department of Microbiology and Bioinformatics at Bilaspur University, Bilaspur (CG), using healthy yellow bamboo spp. (Bambusa vulgaris) that were collected at the green to brownish stage from the Raja nursery Jarhabhata chowk, Bilaspur (CG), India[4].

2. Preparation of Explant

Using a sterile blade, the internodal section of the stem (Bambusa vulgaris Schrad. ex Wendl) was chopped up to three inches. In order to get rid of the wax and dust, the top layers of the explant were scraped off. After that, the internode explant was cleaned for ten minutes under running tap water. The explant was submerged in fungicide (Bavistin 1%) for 10 minutes before being rinsed with sterile distilled water twice or three times. The explant was then cleaned with distilled water containing 1% detergent (Tween 20) for five minutes. Following a one-minute surface disinfection with 70% ethanol, the explants were treated with 0.1% aqueous mercuric chloride (HgCl2) for five minutes, and then carefully cleaned four to five times with sterile distilled water [4].

3. Preparation of MS Media

Growth conditions and the medium of culture For this investigation, MS (Murashige and Skoog 1962) medium containing 2% (w/v) sucrose was utilized. BAP (0.3 mg/L) was added to the medium along with 3 mg/l of NAA, 2,4-D, and IAA, respectively. The medium's pH was adjusted to 5.6 before the 1% agar gelled. Each of the 50 ml of Murashige and Skoog was poured into a 150 ml sterilized conical flask (Borosil) and sealed with a cotton plug that wasn't absorbent[4].

4 . Storage of prepared Media -

Following preparation, the media were autoclaved, allowed to come to room temperature, and then kept in a 6°C refrigerator[4].

5 .Volume of Culture Media used in Culture jar

For the usual plantlet regeneration experiment, each conical flask held 20 ml of semi-solid culture media[4].

6 . Establishment of Shoot

Immature and semi-hard wood shoots that had been surface sterilized were cultivated on MS media with and without 0.1% activated charcoal. The explants that made it through were then moved to regeneration media. Over the course of four weeks, the percentages of browning and survivals, as well as the quantity of shoot buds begun, new leaves developed, and callus formation, were noted. After that, the cultured explants were kept in the plant tissue culture room at 25 to 26 degrees Celsius, with cool white fluorescent bulbs providing a 16-hour photoperiod. There was a 50–55% relative humidity[4]

MATERIAL AND METHOD

1. Explant Collection

Nodal segments (1.3-2.0 cm length) from ex-plants of B. balcooa growing at the Abellon plantation site in the dry region of Modasa Taluka, Aravalli District, Gujarat, India. Ex-plants were gathered from October through January. Ex-plants were removedwithin two to three hours of each other. With a scalpel, an incision was made at the base of the leaf sheath to remove the leaf sheath tissues and some of the higher internodes[8]

2. Aseptic Sterilization

Nodal segments were surface sterilized for five minutes using Tween 20, then treated for ten minutes with 1% Bavistin (Saraswati agro Chemicals (India) Pvt. Ltd., Bari Brahmana, Jammu and Kashmir, India). After that, the segments were disinfected for five minutes with a solution of 0.1% mercuric chloride (Finar Chemicals Ltd., Ahmedabad, Gujarat, India) and 70% isopropyl alcohol. For the next steps in the initiation process, the treated ex-plants were washed with sterile RO water[8]

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3 . Initiation

The Murashige and Skoog (MS) basal medium was used for the initial phase of the experiment. To enhance the medium, additional ingredients were added, including 0.01% myo-inositol (Finar Chemicals Ltd., Ahmedabad, Gujarat, India), 3% sugar (Commercial Grade, Venkateswara Sugar Products, Kolhapur, India), 25 mg/L citric acid (Finar Chemicals Ltd., Ahmedabad, Gujarat, India), 50 mg/L ascorbic acid (Finar Chemicals Ltd., Ahmedabad, Gujarat, India), and 3.5 mg/L 6-benzylaminopurine (BAP) (Himedia Laboratory, Mumbai, Maharashtra, India) as a growth regulator. Gentamycin was diluted to a concentration of 3.0-8.0 mg/L in liquid and solid MS media for the purpose of initiation (Abbott Helthcare Ltd. Pvt., Pithampur, Madhya Pradesh, India)[8]

4. Shoot Multiplication

The shoots from the nodal segment were removed, and they were then cultivated in MS media that contained 3% sugar, 6% agar for solidification (Merck Specialties Private Limited, Mumbai, Maharashtra, India), and growth promoters (0.5 mg/L naphthalene acetic acid (NAA) and 3 mg/L BAP) at a concentration of 0.01% myo-inositol (Himedia Laboratory, Mumbai, Maharashtra). Propagules, or newly sprouting axillary shoots, were subcultured in fresh multiplication media at regular intervals of three to four weeks. The multiplication rates were determined using a number of propagules that were obtained from a cluster of shoots following each cycle. Decayed branches or leaves were removed before moving the cluster to fresh medium[8]

5 . Rooting

In two experiments designed in triplicate, each with 100 experimental plants in each group, different combinations and concentrations of root-inducing growth regulators were added to MS basal media with 3% sugar, 0.01% myo-inositol gelled with 2% BioM Gel (Merck Specialties Private Limited, Mumbai, Maharashtra, India).

6 . One step process

One set of experiments used solid media containing 3 mg/L of BAP, while the other set did not. To observe the effects of auxins with and without BAP, different concentrations of NAA, indolebutyric acid (IBA), indoleacetic acid (IAA), and auxins (Himedia Laboratory, Mumbai, Maharashtra, India) in a range of 1-4 mg/L were kept as variables in both sets at the respective locations.

7 .Two step process

In this two-step procedure, plants were initially allowed to root in liquid media before being moved to solid media. For three weeks, the three growth regulators were combined in varying amounts (0.5-2 mg/L) with 3 mg/L BAP in liquid medium (Table 2). After that, the mixture was moved to solid multiplication media with 3 mg/L BAP and 0.5 mg/L NAA. The total number of rooted cultures divided by the total number of bamboo cultures at the experimental rooting stage was used to compute the percentage of rooting. By calculating the mean root length of rooted cultures, the average root length was determined.

8 . Pre-hardning

The procedure of hardening tissue culture-grown bamboo cultures in a lab for 20–30 days prior to moving them into a greenhouse is called pre-hardening. Rooted bamboo cultures that were 3–4 weeks old were moved to full strength MS media with and without BAP (3.5–4.5 mg/L). Another group of samples was treated with half-strength MS media that contained and did not contain BAP (3.5–4.5 mg/L). Every experiment was carried out in triplicate, with 100 plants each set.

9. Primary hardening

Following pre-hardening, the in vitro plantlets were taken out of the culture jars and thoroughly cleaned with RO water to get rid of any remaining medium from the roots.

10. Secondary hardening

The well-developed root balls of the bamboo plants were then moved to the shade net house in two sets of polythene bags (6 cm × 6 cm) with a 1:1:1 potting mixer of vermicompost, soil, and sand. The second set was made up of vermicompost, soil, sand, and vesicular arbuscular mycorrhiza (VAM) in the following ratios: 1:1:1:0.5. The VAM culture was established at the Abellon R&D center in Ahmedabad, Gujarat, India, and mass production took place at the Abellon hardening center in Modasa, Gujarat, India. It was purchased from the ICAR, New Delhi. The shade net house was maintained at 35°C to 38°C with a 50%–60% humidity level. The mortality rate was computed by dividing the total number of dry cultures by the total number of transferred bamboo cultures. Every experiment was run in triplicate, using 150 plants in each set[8].

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The Bamboo Forest Growth Optimization Algorithm

1.Inspiration

Bamboo is a grass plant of the Poaceae and Bamboo genus, yet it can have the height of a tree. Young bamboo shoots can grow up to a meter each day. This quick development, according to Guihua Jin [36], is a crucial characteristic of woody bamboo that gives it an advantage over other trees in the forest setting by allowing it to compete with them.When bamboo is at the shooting stage, it grows in the rain; nevertheless, it takes three to five years for it to mature into bamboo. After then, the bamboo will grow at an incredible rate and suddenly exert force. When the bamboo does not develop for three or five years, its roots spread far and deeply beneath the surface. The term "deep" describes the depth of the earth. Bamboo roots have the ability to pierce extremely hard stone structures like steel. "Wide" refers to the bamboo's ability to extend its root system over several kilometers. Bamboo can readily acquire the nutrients and rainfall it requires on a plot of land that is several square kilometers in size.Bamboo is distinctive in its physiological characteristics, as seen by its reclining underground stem, sometimes known as a bamboo whip. It has numerous nodes and grows densely, with numerous fibrous roots and buds sprouting from the nodes. As Figure 2 illustrates. Bamboo whips are the main factor responsible for bamboo forests' rapid territorial expansion in addition to storing and supplying an abundance of nutrients for these woods. They are able to spread out and expand in any direction at random. These bamboos exchange nutrients through a network of interconnected rhizomes. They will share the pressure from the surroundings and impart nutrients to one another[7].

2 . Mathematical Model

Bamboo grows in stages, which can be summed up as budding, shoot growth, rapid growth, adulthood, flowering, and death. In this section, the stages of bamboo growth are mapped onto the algorithm optimization process, a mathematical model based on the stages of bamboo growth—bamboo root extension, bamboo forest expansion, and bamboo flowering—is constructed, and the BFGO method is suggested[7].

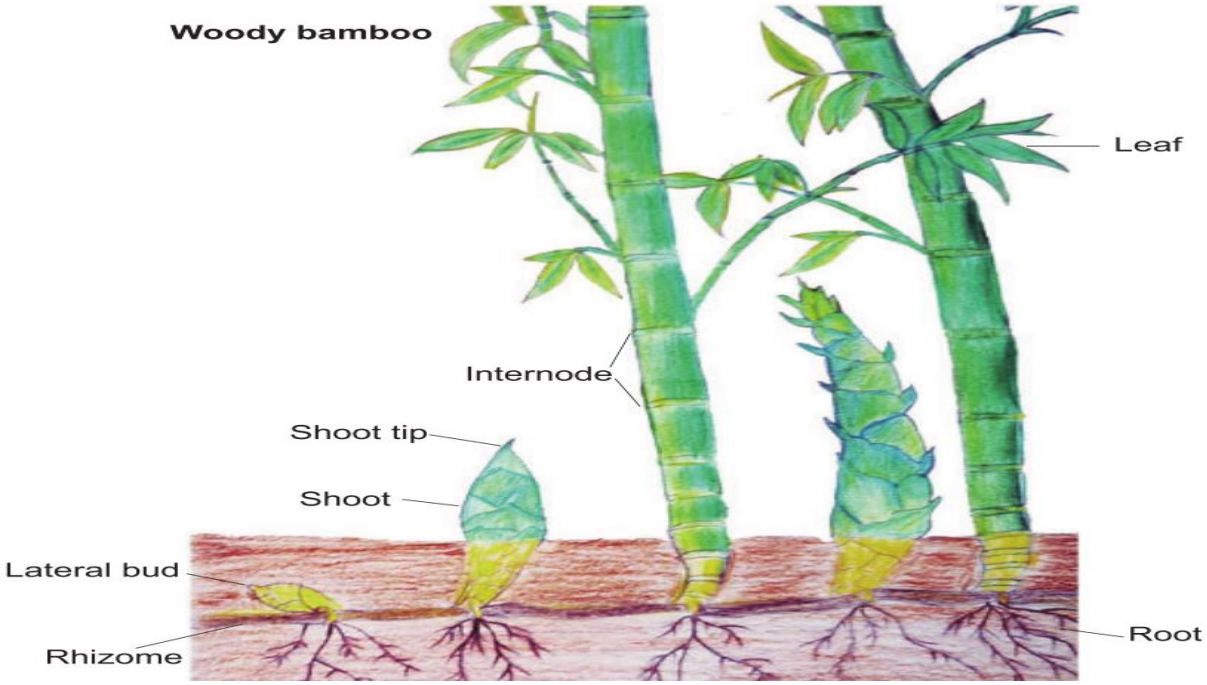

Fig.2 Structure of Bamboo [10]

RESULT

1.Aseptic Initiation

Ex-plants of bamboo that were harvested between October and January were first subjected to aseptic treatment. The liquid and solid media were supplemented with gentamicin (0–8 mg/L) in order to determine the optimal procedure for managing contamination. In both liquid and solid media, three to five sprouted axillary shoots were seen after ten to fifteen days after initiation. With 3 mg/L, 5 mg/L, and 7 mg/L of gentamicin, axillary shoots sprouted 3-5 days quicker in liquid media than in solid media (Table 3). When compared to the same concentration in solid media, sprouting was seen two days later in liquid media treated with 8 mg/L gentamicin . When

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compared to solid media with yellow leaves and shoots (Figure 1b) at a gentamicin dosage of 7 mg/L, we saw the highest results in liquid media with darker green shoots and leaves .

2.Shoot Multiplication

For shoot multiplication, various BAP and NAA combinations were investigated. After three weeks of good culture circumstances and clusters of 12-15 shoots (Figure 2 shooting), with an average multiplication rate of 3.5 times, NAA 0.5 mg/L and BAP 3 mg/L were the most successful.

3 . Rooting

Our goal was to determine the qualitative and quantitative effects of each auxin alone, in conjunction with BAP, and both with and without the addition of BAP.

4. One Step Processing

In comparison to NAA (1-4 mg/L) with addition of BAP (3 mg/L) (Figure 3b) (Table 1), the best rooting were found within 15 days in NAA 4 mg/L without addition of BAP (Figure 3a), displaying an average of 9.6 root numbers, root length 8 cm, and 83% rooted. 21% rooting was seen in the cases of BAP (3 mg/L) and IAA (2 mg/L). In contrast, Table 1 indicates that 3 mg/L IAA without BAP added resulted in 14% rootingIBA (1-4 mg/L) showed no rooting with or without BAP (3 mg/L) . For three weeks, the plants were kept at the roots stage.

5 . Two Step Processing

In the second set of rooting experiments, three weeks of liquid medium containing a combination of different doses of each of the three auxins was added to a BAP concentration of 3 mg/L. Afterwards, the plants were placed in solid growth media for three weeks, including 0.5 mg/L NAA and 3 mg/L BAP. The IAA + IBA + NAA combination at 1:2:2 mg/L concentrations showed 62% rooting, 10.2 average number of roots, and 9.1 cm average root length, respectively (Table 2, Figure 3b liquid medium, and Figure 3c solid media).

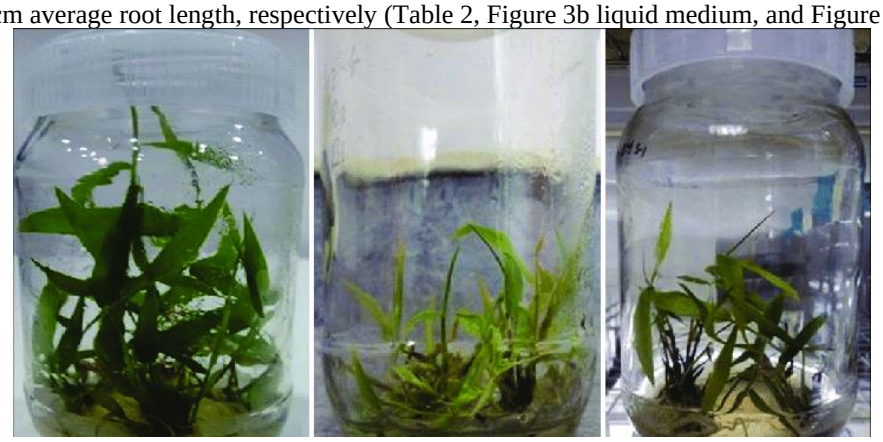

Fig . 3 [11]

6. Pre-Hardning

With 3 mg/L BAP, the bamboo shoot elongation reached its maximum at half strength of MS medium, measuring 6.8 ± 2.2 cm for the shoot and 12.4 ± 2.1 cm for the root (Figure 4). The quality of the leaves and green shoots was superior than the MS medium at its maximum strength. Plant survival rates in half strength MS media were 68%, whereas those in full strength MS medium were 37%.

7. Primary Hardening

The bamboo plants underwent primary hardening in two distinct potting formulations. One set had only coco peat, while the other contained a 3:1 ratio of coco peat to vermicompost. The combination of coco peat and vermicompost produced the best results, with shoot lengths of 6.85 ± 0.04 cm and root lengths of 14.70 ± 0.1 cm. Bamboo plants grown in coco peat alone exhibited 5.45 ± 0.09 cm shoot length and 11.55 ± 0.08 cm root length (Figure 5). The growth of coco peat alone (Figure 6a) and coco peat + vermicompost mixture (Figure 6b) is compared in Figure 6. Compared to plants grown only with coco peat (61%), plants treated with vermicompost had a survival percentage of 72%.

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8 . Secondary Hardening

To optimize the hardening process, 150 plantlets were transferred in triplicate to two potting mixes containing varying ratios of vermicompost:soil:sand:VAM and another mixture of vermicompost:soil:sand, as specified in the materials and methods section. VAM cultivation with vermicompost, soil, and sand produced the longest shoot and root lengths (8.25 ± 0.4 cm and 18.60 ± 0.1 cm, respectively).

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