Influence of Age of the Planting Material on the Survivability Percentage of Mulberry Mini Clones Propagated Using Mini Clonal Technology

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ABSTRACT

Mulberry (*Morus spp*.) is the cornerstone of sericulture, as its leaves are the primary feed for silkworms (*Bombyx mori* L.). Efficient and rapid propagation of mulberry plants is essential to meet the ever-growing demand for high-quality mulberry leaves in sericulture. Mini clonal technology, which allows for mass propagation of genetically identical and disease-free plants has gained prominence in the mulberry industry. The age of the planting material, specifically the age of the source plant from which cuttings are taken is a critical factor influencing the success rate of rooting and the survival of propagated mini clones. This article explores how the age of the planting material affects the physiological, biochemical and morphological properties of mulberry mini clones and consequently, their survivability. A detailed understanding of this influence is essential for optimizing propagation protocols thereby ensuring higher survival rates and improving the overall efficiency of mulberry production.

INTRODUCTION

Mulberry (*Morus* spp.) plays a pivotal role in the global silk industry, as it is the sole food source for the silkworm (*Bombyx mori* L.). The success of sericulture is heavily reliant on the consistent supply of high-quality mulberry leaves. This growing demand has prompted the need for efficient propagation techniques particularly for large-scale production of mulberry plants that are genetically uniform and disease-resistant (Bharathi *et al.,* 2024).

Mini clonal technology has emerged as a viable solution for meeting this demand. It is a specialized form of vegetative propagation where small cuttings are taken from a mother plant and rooted under controlled environmental conditions. One of the key variables that determine the success of this technology is the age of the planting material. The age of the mother plant or the cuttings taken for propagation significantly impacts rooting success, vegetative growth and the eventual survivability of the mini clones once transplanted to field conditions (Parthiban *et al.*, 2017).

This article will examine how the age of the planting material influences the survivability percentage of mulberry mini clones. Specifically, it will explore the physiological and biochemical characteristics of cuttings derived from different-aged source plants, their rooting capacity and their ability to establish themselves in the field. By understanding the impact of planting material age, growers can fine-tune their propagation techniques to optimize clone survival and overall crop performance (Bharathi *et al.*, 2024).

Mini Clonal Technology: Overview and Importance

Mini clonal technology involves the use of small, vegetative cuttings from selected mother plants to propagate new plants. This method is widely used in the production of several high-value crops including mulberry, due to its ability to produce uniform plants with desirable traits (Sharma *et al.,* 2012). The process consists of several key steps including:

1. **Selection of Mother Plants**: Healthy, disease-free mother plants with superior genetic traits are selected for propagation.
2. **Collection of Cuttings**: Small cuttings usually 2-5 cm in length were taken from the mother plants. The cuttings contain at least one apical bud, which will develop into a shoot.
3. **Rooting Process**: The cuttings are treated with rooting hormones (such as auxins) to promote root formation and then placed in a suitable rooting medium under controlled conditions.
4. **Acclimatization and Hardening**: After root development, the clones are gradually acclimatized to outdoor conditions through a process called hardening, which enhances their ability to survive in field conditions.

The success of mini clonal technology depends on several factors including the quality of the mother plant, environmental conditions, the application of growth regulators and the age of the planting material. Of these, the age of the source plant plays a particularly crucial role as it directly affects the physiological and biochemical status of the cuttings.

Importance of Planting Material Age in Clonal Propagation

The age of the planting material refers to the physiological age of the mother plant from which cuttings are taken, as well as the age of the shoots themselves. In mulberry, both factors can significantly influence the rooting

success and survivability of mini clones. Younger plants and shoots typically exhibit higher vigour and faster growth while older plants may show signs of senescence thereby leading to reduced rooting capacity and survival rates (Bharathi *et al.*, 2024).

1. Physiological Age of the Mother Plant

The physiological age of the mother plant determines the vigour and vitality of the cuttings. Younger mother plants typically less than 2 years old produce cuttings with high rooting potential. These plants are in the active phase of growth with high levels of endogenous auxins (growth hormones) and other root-promoting substances. In contrast, older mother plants may have reduced levels of these hormones thereby leading to poor rooting and reduced survival (Kiruthika *et al.*, 2020).

2. Age of the Shoots

The age of the shoots (or the specific portion of the plant from which cuttings are taken) also plays a role in determining the success of clonal propagation. Young and tender shoots from the apical regions of the plant tend to root more readily than older & lignified shoots from the basal regions. The younger shoots have more active meristematic tissues which promote faster root initiation and development (Bindhumadhava *et al.*, 2011).

3. Influence on Rooting Capacity

The age of the planting material affects the physiological processes that govern root formation. Younger cuttings are typically more responsive to auxin treatment and exhibit higher rates of cell division and differentiation in the root zone. This leads to faster root initiation and greater root mass which directly correlates with the clone's ability to absorb water and nutrients once transplanted to the field (Bharathi *et al.*, 2024).

4. Survivability and Field Establishment

Once the clones are transplanted to the field, their ability to establish themselves and survival is heavily influenced by the quality of the root system. Clones derived from younger planting material tend to have more robust root systems which enhance their capacity to withstand transplant shock, drought and other environmental stresses. In contrast, clones from older planting material may struggle to establish due to weaker root systems and reduced vigour (Bharathi *et al.*, 2024).

Physiological and Biochemical Differences Based on Planting Material Age

The physiological and biochemical properties of mulberry cuttings vary depending on the age of the planting material. These differences have a direct impact on rooting success and survivability.

1. Auxin Levels

Auxins are plant hormones that play a critical role in root initiation and development. Younger plants and shoots typically have higher endogenous levels of auxins which promote faster and more uniform rooting. In contrast, older planting material may have lower auxin levels thereby leading to delayed or incomplete root formation. The application of synthetic auxins (such as indole-3-butyric acid or IBA) can mitigate this issue but younger material still tends to respond better to hormone treatments (Kiruthika *et al.*, 2020).

2. Carbohydrate Reserves

Carbohydrates serve as an energy source for root development. Younger shoots tend to have higher carbohydrate reserves which provide the necessary energy for cell division and growth during the rooting process. Older shoots particularly those from senescing plants may have depleted carbohydrate levels thereby leading to poor rooting and reduced survival.

3. Water Retention Capacity

Younger plant material generally has higher water retention capacity which is crucial during the rooting phase. High water retention ensures that the cuttings do not desiccate during the early stages of root formation. In contrast, older material may have reduced water-holding capacity thereby making the cuttings more prone to dehydration and failure (Sulichantini *et al.*, 2014).

4. Antioxidant Activity

During the rooting process, cuttings experience oxidative stress due to the generation of reactive oxygen species (ROS). Younger cuttings have higher levels of antioxidant enzymes such as superoxide dismutase and catalase which help mitigate oxidative damage. This enhances the rooting success and overall health of the clones. Older cuttings may have reduced antioxidant activity thus leading to higher levels of oxidative damage and lower survival rates (Bharathi *et al.*, 2024).

Morphological Factors Influencing Clone Survival

The age of the planting material also influences the morphological characteristics of the cuttings which in turn affect their ability to root and survive.

1. Shoot Lignification

Lignification refers to the process by which plant tissues become woody and rigid due to the deposition of lignin. Younger shoots are typically less lignified thus making them more pliable and conducive to rooting. In contrast, older shoots are more lignified which can inhibit root formation and reduce the overall survival rate of the clones. Lignified cuttings are also more prone to desiccation as their reduced flexibility impairs water absorption.

2. Leaf Area and Photosynthetic Activity

The leaf area of the cutting plays a critical role in rooting success. Leaves are the primary source of photosynthates which provide energy for root development. Younger shoots tend to have larger, more active leaves that contribute to faster rooting and improved survival. Older shoots may have smaller or senescing leaves which produce fewer photosynthates and reduce the energy available for root growth (Kuppusamy *et al.*, 2019).

3. Root Architecture

The root system that develops during the rooting phase is critical for the clone's ability to absorb water and nutrients once transplanted to the field. Younger cuttings typically produce a more extensive and fibrous root system which enhances their ability to establish in the field. Older cuttings may produce fewer roots with a more compact and less efficient root system thereby leading to reduced survival (Bharathi *et al.*, 2024).

Environmental Factors Affecting the Influence of Planting Material Age

The effect of planting material age on the survivability of mulberry mini clones is also influenced by environmental factors. These factors interact with the physiological and morphological characteristics of the cuttings to determine their overall success in the field.

1. Temperature

Temperature plays a crucial role in the rooting process. Younger cuttings are typically more responsive to optimal rooting temperatures (20-25°C) while older cuttings may have a narrower temperature range for successful rooting. High temperatures can exacerbate the negative effects of older planting material thus leading to increased desiccation and failure (Parthiban *et al.*, 2020).

2. Humidity

High humidity levels are essential during the rooting phase to prevent desiccation and promote water uptake. Younger cuttings, with their higher water retention capacity are better suited to withstand fluctuations in humidity. Older cuttings with their reduced water-holding capacity were more prone to desiccation in low-humidity environments (Kiruthika *et al.*, 2020).

3. Light Intensity

Light intensity affects the photosynthetic activity of the cuttings and their ability to produce the energy needed for root development. Younger cuttings with their more active leaves can tolerate higher light intensities and produce more photosynthates. Older cuttings may be more sensitive to light stress thus leading to reduced photosynthetic activity and poor rooting (Bharathi *et al.*, 2024).

Best Practices for Optimizing Clone Survivability Based on Planting Material Age

To maximize the survivability of mulberry mini clones propagated using mini clonal technology, it is essential to consider the age of the planting material and adopt best practices for propagation.

1. Use of Younger Mother Plants

Where possible, cuttings should be taken from younger mother plants (less than 2 years old) to ensure high rooting success and survivability. Younger plants have higher levels of endogenous growth hormones and are more vigorous thus leading to faster and more uniform rooting (Kuppusamy *et al.*, 2019).

2. Selection of Apical Shoots

Cuttings should be taken from the apical regions of the plant where the shoots are younger and more actively growing. These cuttings are more responsive to rooting hormones and have a higher capacity for root development (Bindhumadhava *et al.*, 2011).

3. Hormone Treatment

The application of synthetic auxins (such as IBA) can enhance rooting success particularly for cuttings taken from older planting material. However, younger cuttings typically require lower concentrations of hormones as they already have higher levels of endogenous auxins (Sulichantini *et al.*, 2024).

4. Environmental Control

Environmental conditions during the rooting phase should be optimized to support the rooting process. High humidity, moderate temperatures and controlled light intensity are essential for promoting root development and preventing desiccation (Sharma *et al.*, 2012).

5. Hardening and Acclimatization

After rooting, clones should be gradually acclimatized to outdoor conditions through a process of hardening. This involves gradually reducing humidity and increasing exposure to sunlight and wind. Younger clones tend to harden more successfully but careful management is essential for all cuttings to ensure high survival rates in the field (Bharathi *et al.*, 2024).

CONCLUSION

The age of the planting material is a critical factor influencing the survivability of mulberry mini clones propagated using mini clonal technology. Younger mother plants and apical shoots provide cuttings with higher rooting potential, greater vigour and improved survivability in field conditions. The physiological, biochemical and morphological characteristics of the cuttings along with environmental factors will determine the

overall success of the propagation process. By optimizing the age of the planting material and adopting best practices for propagation and hardening, growers can significantly enhance the efficiency of mulberry production and ensure a reliable supply of high-quality plants for sericulture and other industries dependent on mulberry cultivation.

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