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Effect of Moringa Leaf Lxtract (MLE) on Sprouting and Growth Responses of Stem Cuttings of China rose (*hibiscus rosa- sinensis l.)*

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Abstract

The China rose, also known as *Hibiscus rosa-sinensis*, is a tropical flowering plant renowned for its large, vibrant blossoms. It is native to East Asia and thrives in warm climates. The propagation of China rose (*Hibiscus rosa-sinensis*) face several challenges, such as Rooting difficulty, inconsistent growth so that the present study investigates the effects of Moringa Leaf Extract (MLE) on the sprouting and growth responses of stem cuttings of Hibiscus rosa-sinensis L. (China Rose). Healthy, mature, and disease-free moringa leaves were carefully collected from near the Faculty of Crop Production Sindh Agriculture University, Tandojam. The leaves were washed under running water and then kept in a freezer for a day. Subsequently, the frozen leaves were crushed to extract juice with a locally made mortar and pestle. Moringa leaf extract was made with different concentrations, after which it was passed through a sieve before applying it to the cutting. The cuttings were 9 inches long and soaked for 5 hours in four different concentrations of MLE (10%, 20%, 30%, and 40%) they were planted in plastic bags filled with canal silt. the research utilized a Completely Randomized Design and assessed various growth parameters including sprouting percentage (%), number of sprouts per cutting, rooting percentage (%) fresh root biomass (g), dry biomass of roots (mg), fresh shoot biomass (g), Dry biomass of shoot (mg), Root Collar Diameter (mm). Results revealed that while sprouting percentages reached 100% at all MLE concentrations, the number of sprouts per cutting peaked at 10% MLE, indicating enhanced growth responses at this concentration. Furthermore, MLE significantly improved rooting percentages and biomass metrics, with optimal results observed at 10% concentration, while higher concentrations led to diminished effectiveness. The study concludes that MLE serves as a potent growth promoter for the propagation of China Rose, highlighting its potential in horticultural practices.

Key Words: Moringa leaf Extract (MLE)1, Sprouting2, Growth3, China rose3, Development5

Introduction

(Hibiscus rosa-sinensis L.), commonly known as the China Rose, is a species of flowering plant in the Malvaceae family.It is native to East Asia, but due to its aesthetic beauty, the plant has spread widely across the globe, particularly in tropical and subtropical regions(Magdalita et al., 2022). Revered for its striking, large flowers, Hibiscus rosa-sinensis has become a popular ornamental plant, cultivated for both aesthetic and medicinal purposes. The plant's cultural significance, ease of cultivation, and versatile applications make it an important species in both horticultural and traditional medicinal fields(Kosenkoet al., 2020).The China Rose is a shrub that typically grows between 1.5 and 2 meters in height, although some varieties can grow taller under optimal conditions. Its leaves are dark green, glossy, and elliptical, often with serrated edges. The flowers are the most striking feature of the plant, usually large, trumpet-shaped, and ranging in color from vibrant reds, pinks, and yellows to whites and purples. The flower has five petals and typically measures 4-5 inches in diameter. It has a prominent central stamen structure, adding to its ornamental appeal (Armitage, 2008).The plant blooms profusely throughout the year, particularly in warm climates. Hibiscus rosa-sinensis is not only important in ornamental gardening, but it also has ecological benefits. The plant attracts pollinators like bees and butterflies, playing a key role in supporting biodiversity in the ecosystems where it is found. In many tropical and subtropical regions, Hibiscus rosa-sinensis is often used in landscaping, parks, gardens, and as hedging plants due to its vibrant colors and hardy nature.In addition, it holds cultural significance in various parts of the world. In Hindu culture (Roy, 2013).

Propagation of *Hibiscus rosa-sinensis* is primarily carried out through stem cuttings, which is a common method for reproducing desirable traits such as flower color, size, and growth habits. However, the success of stem cutting propagation can be influenced by various factors, including hormonal treatments, environmental conditions, and nutrient availability Izadi et al., 2014).

Moringa oleifera, often referred to as the "miracle tree," has gained considerable attention for its rich nutritional content and medicinal properties. Moringa leaf extract (MLE), which is derived from the leaves of this plant, has demonstrated various beneficial effects in agricultural practices, including enhancing plant growth, improving root development, and promoting faster sprouting.(Mashamaite et al., 2022). Moringa is rich in growth hormones, vitamins, minerals, and antioxidants, which can potentially influence the physiological processes of plant cuttings and improve their success rate during propagation.The application of Moringa leaf extract (MLE) to stem cuttings of ornamental plants like *Hibiscus rosa-sinensis* could represent a valuable method for improving the rooting and growth performance of cuttings.

Materials and Methods

Study location

The experiment was carried out at the Nursery of the Department of Horticulture, Sindh Agriculture University (SAU), Tando Jam, within the agro-ecological environment of Tandojam, Sindh, Pakistan, during November-December 2024. The major aim of this research was to evaluate the effect of moringa leaf extract (MLE) on sprouting and growth responses of stem cuttings of china rose (hibiscus rosa- sinensis l.).

Preparation of Moringa Leaf Extract

Healthy, mature, and disease-free moringa leaves were carefully collected from near the Faculty of Crop Protection Sindh Agriculture University, Tandojam. The leaves were washed under running water and then kept in a freezer for a day. Subsequently, the frozen leaves were crushed to extract juice with a locally made mortar and pestle. Moringa leaf extract was made with different concentrations, after which it was passed through a sieve before applying it to the cuttings. Twenty cuttings of china rose were dipped with varying concentrations of moringa leaf extract (MLE), as per the treatments: (M_1= Control-no MLE), M_2 = 10% of MLE , M_3 = 20% of MLE , M_4 = 30% of MLE , M_5 = 40% of MLE. For each treatment, the cuttngs were immersed in the specific MLE solution for a period of 12 hours.

Results and Discussion

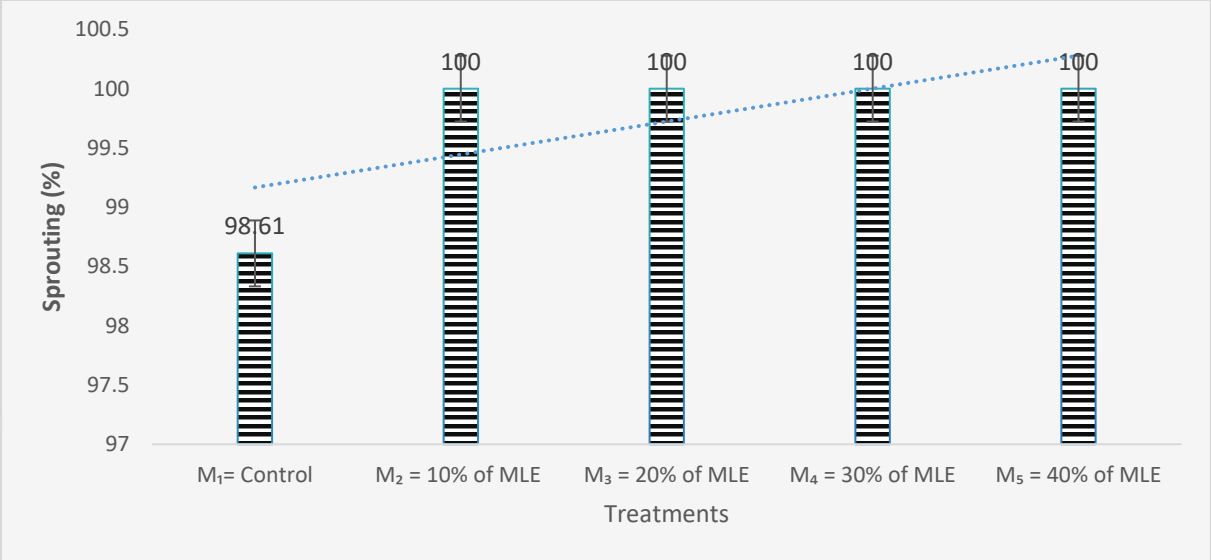

Figure no 1. Effect of Moringa Leaf Extract (MLE) on Sprouting % of china rose cuttings.

Sprouting %:

The sprouting percentages **of china rose** in response to different concentrations of Moringa Leaf Extract (MLE) and the findings are given in (Figure1)The sprouting percentage was **100%** at all concentrations of Moringa Leaf Extract (from 10% to 40%), demonstrating that Moringa Leaf Extract, even at higher concentrations, consistently promoted full sprouting. The control treatment showed slightly lower sprouting percentages, with **98.61% .**

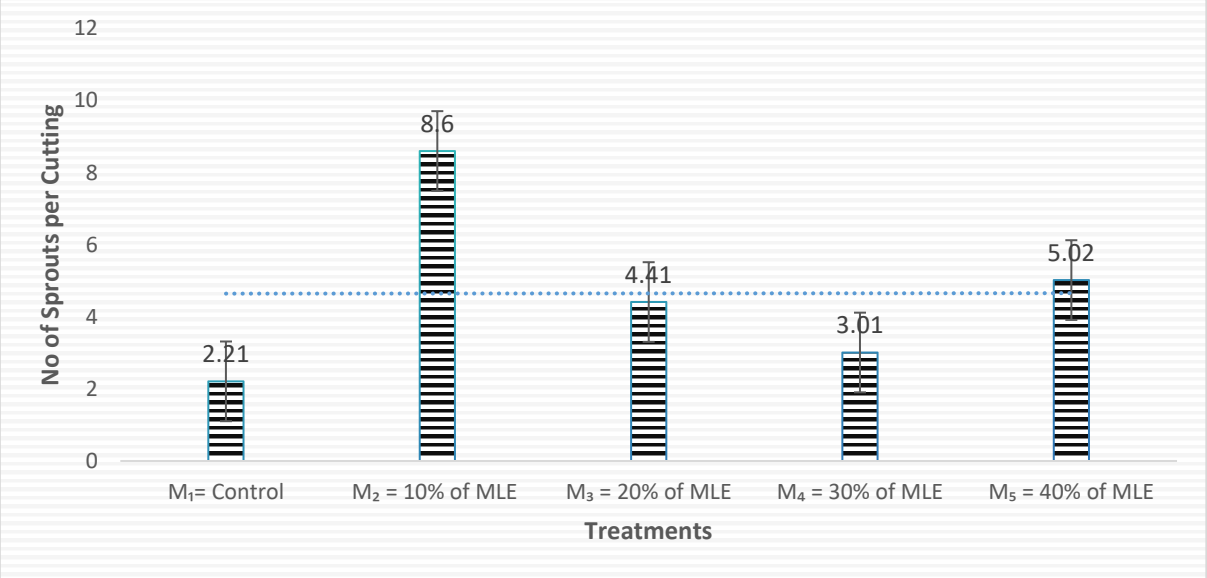

Figure no 2. Effect of Moringa Leaf Extract (MLE) on number of sprouts per cuttings of china rose cuttings.

Number of Sprouts Per Cutting:

The results regards the number of sprouts produced by stem cuttings of china rose varied in response to different concentrations of Moringa Leaf Extract (MLE) and the findings are given in (Figure2). In the control (M_1), the cuttings produced an average of 2.21 sprouts, This served as the baseline for the experiment. When the concentration of Moringa Leaf Extract was increased to 10% (M_2), the sprouting response was significantly higher. The cuttings produced the highest number of sprouts, with an average of 8.6. This indicated that 10% MLE was the most effective concentration for promoting sprouting. However, as the concentration increased further, the number of sprouts decreased. At 20% MLE (M_3), the cuttings produced 4.41 sprouts. showing a reduction in sprouting compared to the 10% concentration. Similarly, at 30% MLE (M_4), stem cuttings yielded 3.01 sprouts, This continued decline in sprouting suggests that higher concentrations of Moringa Leaf Extract were less effective at promoting growth. At the highest concentration of 40% MLE (M_5), Terminal cuttings produced 5.02 sprouts, still showing higher sprout numbers compared to the control group but lower than at the 10% concentration.

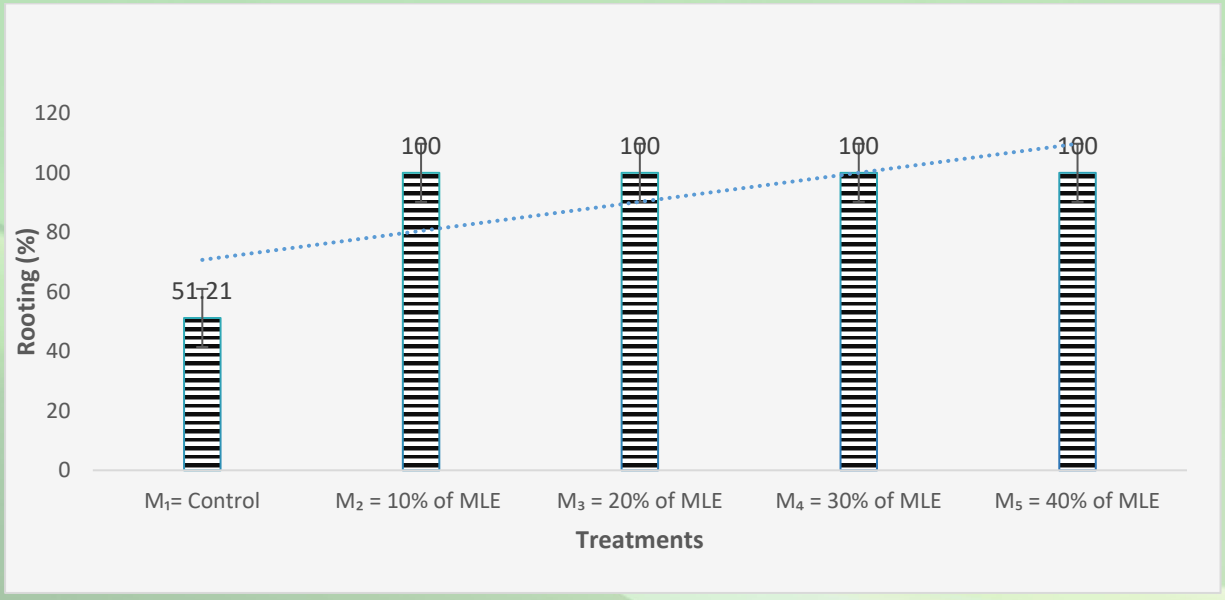

Figure no 3. Effect of Moringa Leaf Extract (MLE) on Rooting % of china rose cuttings.

Rooting percentages:

The rooting percentages stem **cuttings of china rose** in response to different concentrations of Moringa Leaf Extract (MLE) the findings are given in (Figure 4). In the **control group (M_1)**, **cuttings** had a rooting percentage of **51.21%**, indicating that rooting was limited without the use of Moringa Leaf Extract. When **10% Moringa Leaf Extract (M_2)** was applied, **cuttings** achieved **100% rooting**, showing a dramatic improvement. The same

100% rooting was observed at **20% (M3)**, **30% (M4)**, and **40% (M5)** concentrations, demonstrating that higher concentrations of Moringa Leaf Extract did not decrease rooting success.

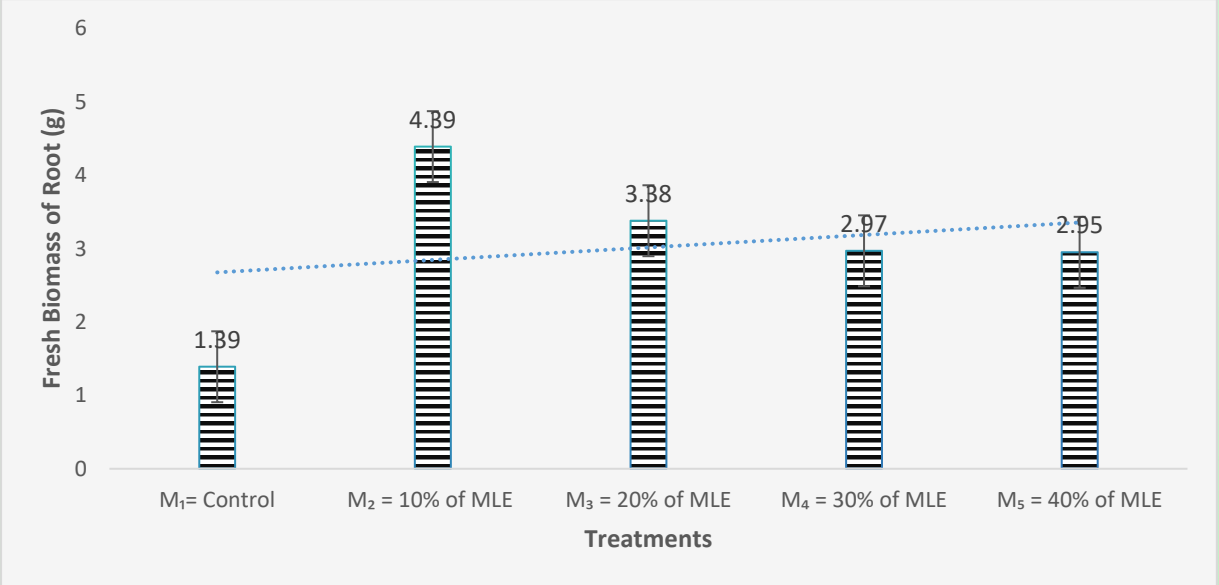

Figure no 4. Effect of Moringa Leaf Extract (MLE) on Fresh biomass of Root (g) of china rose cuttings.

Fresh Biomass of Roots (g):

The Results regards fresh biomass of roots in response to different concentrations of Moringa Leaf Extract (MLE), significant differences were observed in the stem cutting **of chna rose** the findings are given in (Figure 5). The control group (M_1) showed relatively low root biomass, with having **1.39,** establishing the baseline for the experiment.When **10% Moringa Leaf Extract (M_2)** was applied, cuttings experienced a considerable increase in root biomass. **cuttings** reached **4.39 grams**, This marked a substantial improvement compared to the control, indicating the effectiveness of the 10% MLE concentration in promoting root growth. At **20% Moringa Leaf Extract (M_3)**, the root biomass remained significantly higher than the control, with stem **cuttings** producing **3.38 grams.** While still an increase, the root biomass was somewhat lower than at the 10% concentration, suggesting a slight decline in effectiveness as the concentration of MLE increased.With **30% Moringa Leaf Extract (M_4)**, the fresh root biomass decreased further. **Terminal cuttings** produced **2.97 grams.** This decline in root biomass with increasing MLE concentration indicated that higher concentrations may not be as effective for root growth as the lower concentrations. At **40% Moringa Leaf Extract (M_5)**, **Terminal cuttings** produced **2.95 grams** of root biomass. While these values were still higher than the control group, they were lower than the biomass observed at the 10% and 20% concentrations, further suggesting that the optimal concentration for root biomass was at the lower levels of Moringa Leaf Extract.

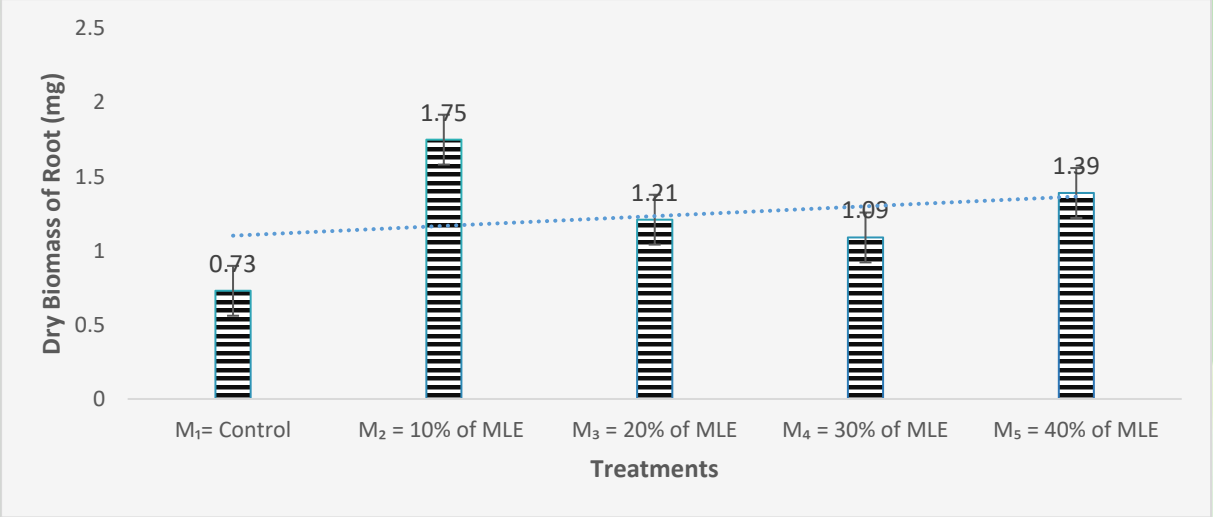

Figure no 5. Effect of Moringa Leaf Extract (MLE) on Dry biomass of Root (mg) of china rose cuttings.

Dry Biomass of Roots (mg):

The results regards the dry biomass of roots stem cutting **of china rose** in response to various concentrations of Moringa Leaf Extract (MLE) showed notable differences are given in (Figure 5). In the **control group (M_1)**, the dry root biomass was **0.73 mg**, These values served as the baseline for comparison. When **10% Moringa Leaf Extract (M_2)** was applied, stem **cuttings** experienced a significant increase in dry root biomass. **Terminal cuttings** produced **1.75 mg**, demonstrating the positive impact of Moringa Leaf Extract at this concentration.At **20% Moringa Leaf Extract (M_3)**, the dry biomass was **1.21 mg**, While both values were higher than the control, there was a slight reduction in biomass compared to the 10% concentration, suggesting a diminishing effect with higher concentrations.With **30% Moringa Leaf Extract (M_4)**, **Terminal cuttings** produced **1.09 mg**, Although these values were still higher than those in the control group, they were lower than those observed at the 10% and 20% concentrations, indicating that the effectiveness of the Moringa Leaf Extract began to decrease as the concentration increased.At **40% Moringa Leaf Extract (M_5)**, **Terminal cuttings** showed **1.39 mg**.

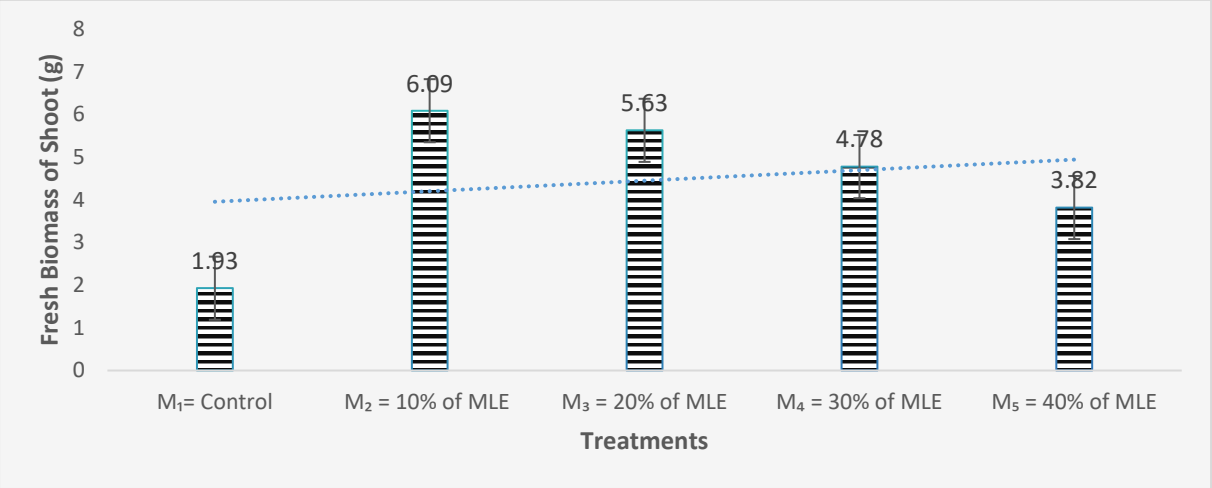

Figure no 6. Effect of Moringa Leaf Extract (MLE) on Fresh biomass of Shoot (g) of china rose cuttings.

Fresh Biomass of Shoot (g):

The results regards the fresh shoot biomass **of china rose** in response to different concentrations of Moringa Leaf Extract (MLE) the findings are given in (Figure 6). The outcomes clearly indicated an influence of MLE on shoot biomass, with the maximum biomass noted at the 10% MLE concentration (M_2). At this concentration, cuttings had a fresh biomass of 6. 09 g, This implies that Moringa leaf extract may greatly improve shoot growth. Though the 10% MLE level was most successful, more concentrations (20%, 30%, 40% MLE) resulted in a reduction in biomass for stem cutting. M_3 is 20% MLE; the biomass for terminal cuttings falls to 5. 63 g, Terminal cuttings' biomass dropped even more to 4. 78 g at 30% MLE (M_4), At the highest level of 40% MLE (M_5), though, biomass decreased once more; terminal cuttings had 3. 82 g.

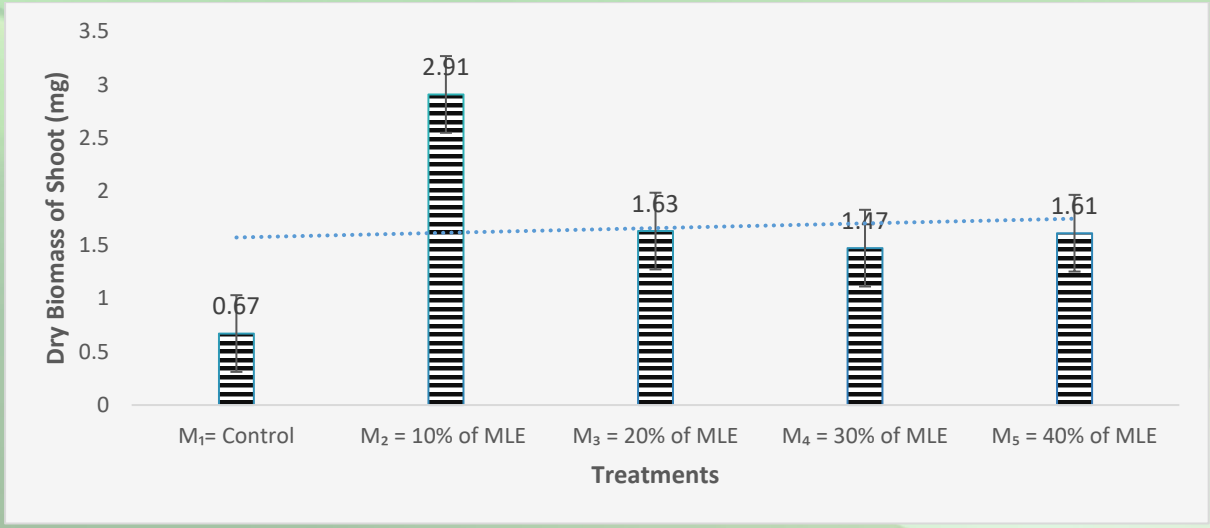

Figure no 7. Effect of Moringa Leaf Extract (MLE) on Dry biomass of Shoot (mg) of china rose cuttings.

Dry Biomass of Shoot (mg)

The results regards the Dry biomass of shoot of china rose in response to different concentrations of Moringa Leaf Extract (MLE) the findings are given in (Figure 7). Control treatment (M_1) yields 0. 67 mg terminal cut's Terminal cuttings' dry biomass rose significantly to 2. 91 mg after a 10% MLE (M_2) treatments, This suggests that terminal cuttings reacted more favorably to the 10% MLE concentration. By comparison, terminal cuttings saw a small decrease in dry biomass that dropped to 1. 47 mg at this level.With the highest 40 percent MLE (M_5), terminal cuts showed a small dry biomass rise to 1. 61 mg. This indicates that although higher MLE levels first raised biomass in sub terminal cuts, there was a reduced impact at the 40 percent level.

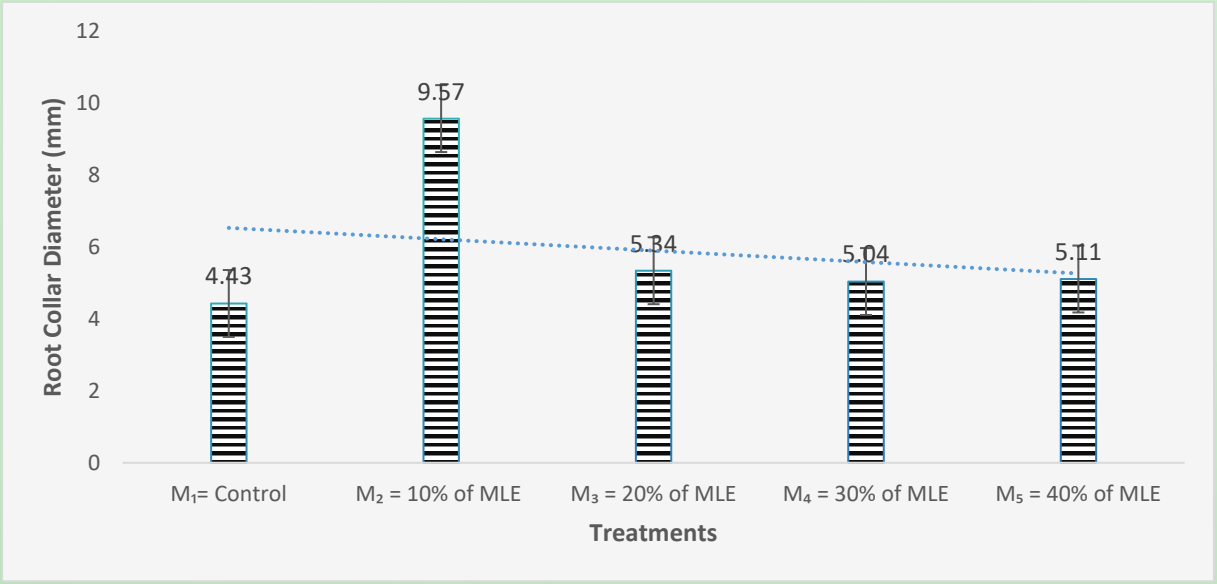

Figure no 8. Effect of Moringa Leaf Extract (MLE) on Root Collar Diameter (mm) of china rose cuttings.

The results regards Root Collar Diameter (RCD) of stem cutting of china rose treated with various concentrations of Moringa leaf extract (MLE)are shown in (figure 8). At the control level (M_1), the root collar diameter for terminal cuttings was 4.43 mm, On the application of 10% MLE (M_2), cuttings showed a significant increase in root collar diameter. Terminal cuttings showed a marked increase to 9.57 mm. This improvement is quite huge, and there is a huge positive effect in the development of the root collar by Moringa leaf extract at 10%. At the increasing concentration of 20% MLE (M_3), root collar diameter declined to 5.34 mm for terminal cuttings, Further reduction in root collar diameter for terminal cuttings was recorded by application of 30% MLE (M_4), and this came to be 5.04 mm while that of sub-terminal cuttings slightly decreased to 10.71 mm. This means higher concentrations of Moringa leaf extract did not show further improvement for terminal cuttings and only marginally affected the sub-terminal cuttings. At the highest concentration, 40% MLE (M_5), a slight increase to 5.11 mm in the terminal cuttings were observed. It indicates that though higher MLE concentrations failed to increase root collar diameter of the terminal cuttings positively.

Discussion

The current work sought to assess the effects of Moringa Leaf Extract (MLE) on sprouting and growth reactions of Hibiscus rosa-sinensis (China Rose) stem cuttings. Outcomes of this experiment indicate that MLE has a significant effect on promoting sprouting, rooting, and growth characteristics in China Rose cuttings with a different level of efficacy based on the concentration of MLE. The results of this research indicated that the percentage of sprouting of China Rose cuttings was 100% at all Moringa Leaf Extract concentrations, ranging from 10% to 40%, which indicates the high potential of MLE in promoting sprouting. These findings are in agreement with research that has indicated the positive impact of Moringa on seed germination and plant sprouting. Maishanu et al. (2017) showed that Moringa leaf extract was able to boost sprouting in several plant species owing to its high growth hormone content. The control treatment with the slightly lower percentage of sprouting (98.61%) also complements the positive effect of MLE on sprouting. This uniform sprouting response at all MLE concentrations indicates its function in inducing early growth processes irrespective of oncentration and implies that MLE may be a useful tool for enhancing China Rose propagation rates. The highest number of sprouts per cutting was achieved with the use of 10% MLE (M_2), where the cuttings averaged 8.6 sprouts, the highest across all treatments. This result is in line with other studies that have established the beneficial role of Moringa extract

on shoot growth and plant development (khan et al., 2020). The decrease in the number of sprouts with increasing MLE concentrations (20%, 30%, and 40%) may reflect a decreasing return at increased concentrations. This trend is consistent with the findings of khan et al. (2017), who hypothesized that elevated concentrations of plant growth regulators can cause phytotoxicity or decreased efficacy because of excess growth-promoting substance accumulation. So, a concentration of 10% MLE seems to be most effective for induction of sprouting and further shoot growth in China Rose.

The experiment proved that Moringa Leaf Extract greatly enhanced China Rose cutting rooting percentage with 100% rooting obtained on all concentrations, including the control. This aligns with Rajani et al. (2024) who found enhanced root growth in several plants exposed to Moringa leaf extract. Nevertheless, although MLE enhanced rooting at all concentrations, the similar percentages of uniform rooting across treatments indicate other factors, rather than MLE concentration, like environmental conditions and the inherent genetic makeup of the plant, could be involved in successful rooting. These findings suggest that MLE's influence on rooting can be less concentration-sensitive than its effect on sprouting since the rooting process tends to saturate at all the tested concentrations. The research noted drastic variation in the root and shoot biomass in accordance with the use of Moringa Leaf Extract. At 10% MLE, cuttings recorded the greatest fresh and dry biomass for roots and shoots. These findings agree with earlier research that noted the growth-promoting role of Moringa based on its high vitamin, mineral, and plant growth regulator content (Sonbarse et al., 2020). The enhancement of root and shoot biomass at reduced concentrations of MLE indicates improved overall growth and development, with the most effective being the 10% concentration.This is consistent with the fact that reduced levels of growth-stimulating substances are more effective in stimulating plant growth than elevated levels, which might bring about toxicity or compromise nutrient uptake efficiency (Bano et al., 2022).

The reduction of biomass at the higher concentrations (30% and 40%) may be an indication of the plant's reaction to excess growth promoter compounds. High levels of Moringa Leaf Extract might cause nutrient imbalance, cellular stress, or suppression of normal metabolic processes, which may result in reduced growth. These results indicate that, although Moringa Leaf Extract is a very effective plant growth promoter, the most suitable concentration for stimulating biomass accumulation in China Rose is approximately 10%.

The root collar diameter (RCD) improved considerably at the 10% MLE concentration, with the cuttings exhibiting a notable increase in RCD than the control group. This suggests that Moringa Leaf Extract can promote the structural growth of the roots, especially root collar development, which is an important consideration for root stability and nutrient absorption. But as the level of MLE intensified, the influence on root collar diameter decreased, especially at 20%, 30%, and 40% levels. This trend is consistent with what was recorded for biomass, where elevated levels of MLE yielded worse growth results.The growth-promoting properties of Moringa Leaf Extract noted in this study are due to its high concentration of growth hormones like cytokinins, auxins, and gibberellins that are responsible for cell division, root initiation, and shoot elongation (Basra et al., 2016).

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