MODIFICATION OF CLOSED PERMANENT IMMERSE SYSTEM TO MASS PRODUCE OF *ARUNDINA GRAMINIFOLIA* BY STEM CUTTING

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ABSTRACT

The increasing popularity and high demand of Arundina graminifolia orchids for landscaping purpose have added a new dimension to its propagation through conventional technique. Previous studies show that the use of closed permanent immerse systems (CPIS) has been successful in accelerating the shoot induction of A. graminifolia. However, some aspects of research are still needed to optimize the CPIS to mass produce of A. graminifolia. Therefore, a study on improvement of the CPIS system under different light intensity (0%, 20%, 50%, 70%, 90% and 100% light shaded) on A. graminifolia shoot performed. Furthermore, the study on addition of air bubbles to accelerating the shoot proliferation on A. graminifolia cutting in this system should be carried out. The results on light influence, the most significant mean shoot length is under 90% shade level (22.03±1.32 mm) followed by 70% (18.71±1.39 mm), 50% (13.06±0.84 mm), 100% (8.42±1.14 mm) and 20% (3.75±0.09 mm) of shade. The highest mean shoot gap was under 90% of shade (7.44±0.26 mm) followed by 70% (6.22±0.03 mm), 50% (3.5±0.65 mm), 100% (2.0±0.01 mm) and 20% (2.0±0.01 mm) of shade. The results on the effect of CPIS system with the presence of air bubbles gives resulted in a significant increase in the shoot width, shoot height and shoots gap (3.15 ± 0.06 mm, 16.15 ± 1.27 mm and 10.56 ± 2.08 mm) compared to CPIS system without the presence of air bubbles (2.91 ± 0.07 mm, 13.90 ± 0.83 mm and 6.66 ± 0.54 mm). In fact, within a month, the resulting shoots in the CPIS system with the presence of air bubbles are also capable of producing root (10% of rooting shoot) compared to CPIS system without the presence of air bubbles that do not generate root directly. In conclusion, CPIS with presence of air bubbles under 90% shade level is an efficient propagation technique derived that can be used for large-scale multiplication of A. graminifolia in a short time for commercial purposes at the lowest cost.

Key words: *Arundina graminifolia*, cutting, light, shoot-bud proliferation, CPIS

INTRODUCTION

Arundina graminifolia or bamboo orchid is a terrestrial orchid, heat-resistant, resistant to disease, easy to maintain, flowering throughout the year and it is suitable for use in outdoor landscapes. Commonly *A. graminifolia* is propagated through division of the root mass, seed culture and tissue culture. The rate of propagation via this technique is very slow and take a long growth period to produce more planting materials.

The increasing popularity and high demand of *Arundina graminifolia* orchids for landscaping purpose have added a new dimension to its propagation through conventional technique. The present focus is oriented towards the use of low cost and economically as an alternative propagation system. It is particularly useful among the many types of propagation system for stem cuttings (Hartmann et al., 1983), but the most common are fogging system, intermittent mist, air-tight, water-tight, high humidity, non-mist propagators. These are all very effective, but vary in their cost and sophistication (Leakey, 2004).

Recently, Sakinah et al. (2019a and 2019b) propagated *A. graminifolia* through the conventional propagation using close permanent immerse system (CPIS). The CPIS system was shown to produce some promising results, but some aspects of research are still needed to improve the growth of shoot and optimize the system under different light intensity and addition of air bubbles to develop the best propagation system, thus meeting the needs of the species.

The present study was undertaken to modifide the CPIS system to produce the optimum growth of shoot of *A. graminifolia* under varying light influence (0%, 20%, 50%, 70%, 90% and 100% light shaded) and addition of air bubbles on growth of shoots.

MATERIALS AND METHODS

Planting materials

Stem cuttings of *A. graminifolia* orchid were obtained from Malaysian Agricultural Research and Development Institute (MARDI), Serdang. Three nodes cuttings about 12-14 cm long were used as explants (Figure 1). All leaves on the cuttings were removed and the cuttings were soaked with twenty-20 solution to disinfect pathogens in the explants and washed in running tap water for 20 min before planting. These cuttings were then inserted in a propagator system, namely close permanent immerse system (CPIS).

Figure 1: Stem cuttings with three nodes of *A. graminifolia* used in CPIS system.

Experiment 1: Optimization of CPIS system under different light intensity

A CPIS system was placed in the field under a netted structure with different shade level, which is 0% (open area), 20%, 50%, 70%, 90% and 100% to expose to different levels of light intensity. The structure used polyvinyl chloride (PVC) pipes size 2 x 2.5 m and covered with netting as a treatment.

Experiment 2: Modification of CPIS by addition of air bubbles

This experiment was conducted with the best shade level form Experiment 1 of 90% level of shade with the light intensity ranging of 50-100 µmol m²/s¹. The temperature and humidity of the system were 36±2 °C and 94±3% respectively. The CPIS system was prepared with and without air bubbles using polystyrene box and sponges (Figure 2).

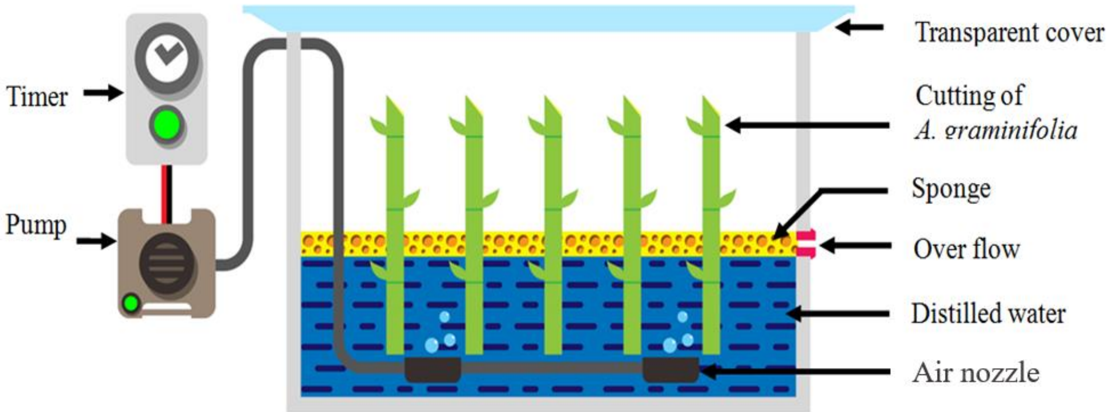

Figure 2: Close permanent immerse system (CPIS) with presence of air bubbles.

Statistical analysis

The design of the experiment was Randomized Complete Block Design (RCBD) with four replications and each replicate consisted of thirty cuttings. The experiments were repeated twice. Data on shoot width, shoot length, shoot gap and number of leaves were taken every week after planting. Data on shoot width, shoot length, shoot gap were measured using a digital calliperMitutoyo 0.01 mm (Figure 4). Data were analyzed by analysis of variance (ANOVA) using SAS software version 9.3 and tested for significance using the Least Significant Difference (LSD) at P≤0.05.

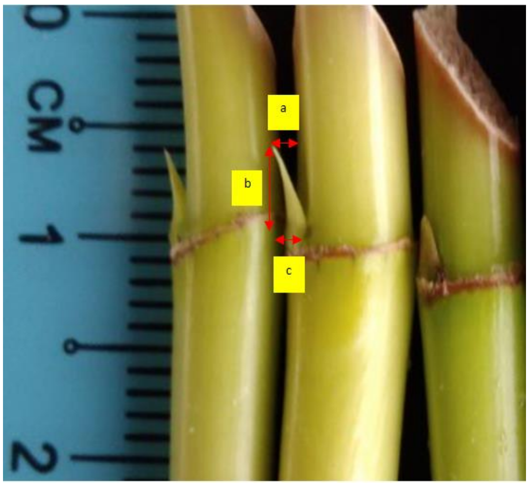

Figure 4: Data on shoots gap (a), shoots length (b) and shoots width (c) were measured using a digital calliper.

RESULTS AND DISCUSSION

The optimization of CPIS system under different light intensity levels

As shown in Figure 5, different shade levels of 20%, 50%. 70%, 90% and 100% of shade had different impacts on the shoot growth of *A. graminifolia*. Shoot width, shoot length, shoot gap and number of leaves under different shade levels of light showed significant differences in mean growth. The highest shoot width was in 90% shade level (3.54±0.14 mm) followed by 70% (3.31±0.12 mm), 100% (3.25±0.19 mm), 50% (3.20±0.03 mm), and 20% (2.03±0.07 mm) of shade.

The most significant mean shoot length is under 90% shade level (22.03±1.32 mm) followed by 70% (18.71±1.39 mm), 50% (13.06±0.84 mm), 100% (8.42±1.14 mm) and 20% (3.75±0.09 mm) of shade. The highest mean shoot gap was under 90% of shade (7.44±0.26 mm) followed by 70% (6.22±0.03 mm), 50% (3.5±0.65 mm), 100% (2.0±0.01 mm) and 20% (2.0±0.01 mm) of shade.

While for the number of leaves, Shading under 70% gave the highest mean leaf number of 4.75±0.48 mm followed by 90% (4.5±0.5 mm), 50% (6.18±0.04 mm), 100% (3.79±0.63 mm) and 20% (1.63±0.03 mm) of shade.

However, CPIS system without shading (0% shading) caused necrosis and death to all explants. The explants were able to survive only a week in the CPIS system. This was due to the high intensity of sunlight resulting in decreased humidity which caused the stems to wilt and turn yellow followed by death (Erviana, 2016), while the CPIS system under 100% shading (0 light intensity) could induce shoots of *A. graminifolia* but the resulting shoots were not green in colour because they could not carry out the photosynthesis process.

Influence of addition of air bubbles to improve CPIS system on shoot growth of Arundina graminifolia

The CPIS system with and without addition of air bubbles showed a significant difference in mean shoot growth of *A. graminifolia.* As shown in Figure 6, the addition of air bubbles in the CPIS system gave better results on shoot width (3.15±0.06 mm), shoot length (16.15±1.27 mm) and shoot gap (10.56±2.08 mm) as compared to the CPIS system without air bubbles, with lower shoot width (2.91±0.07 mm), shoot length (13.90±0.83 mm) and shoot gap (6.66±0.54 mm).

By adding air bubbles it enabled the optimization of growth of the shoot buds. This was because all the physiological processes and metabolism occurred more efficiently. This statement was also supported by Izzati (2006) and Febriani (2009), who stated that sufficient amounts of dissolved oxygen in the water could help to absorb nutrients by the plant and thus improving the growth of the plant.

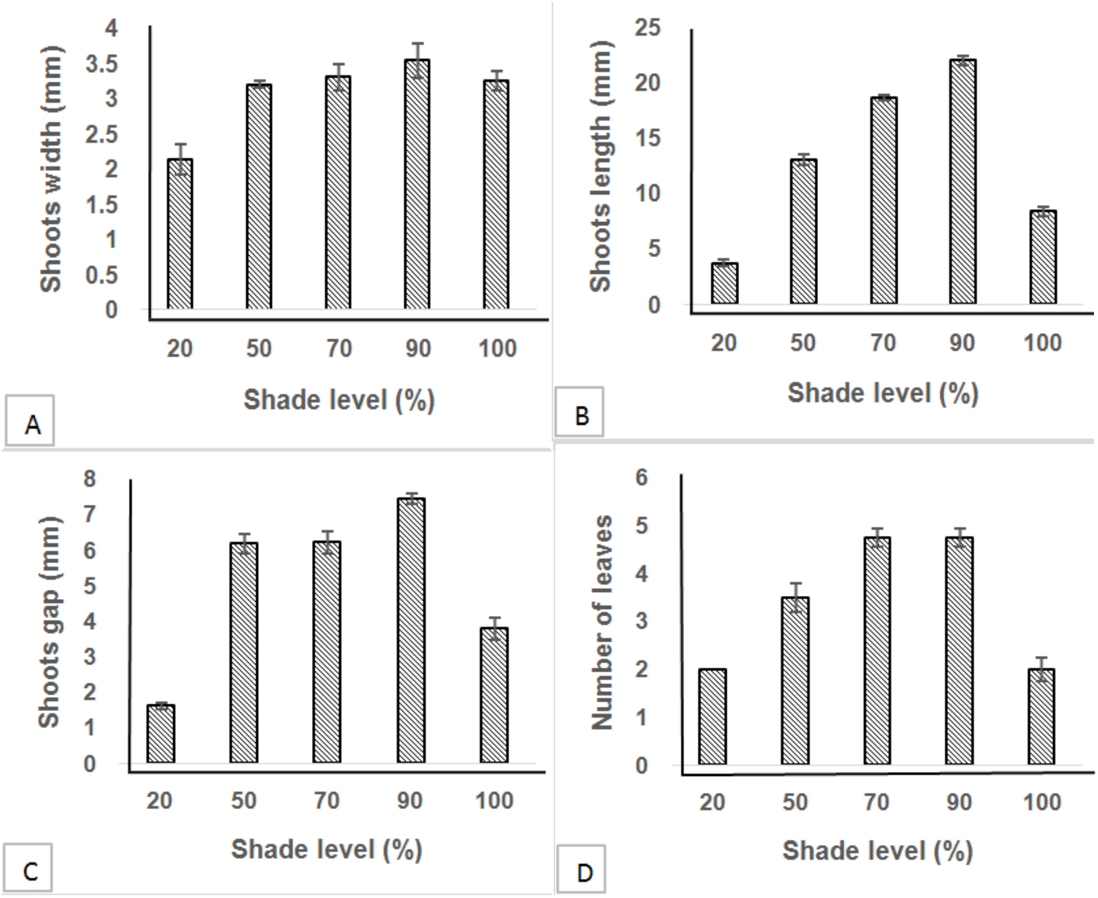

Figure 5: Shoots width (A), shoots length (B), shoots gap (C) and number of leaves (D) under difference shade level after eight weeks.

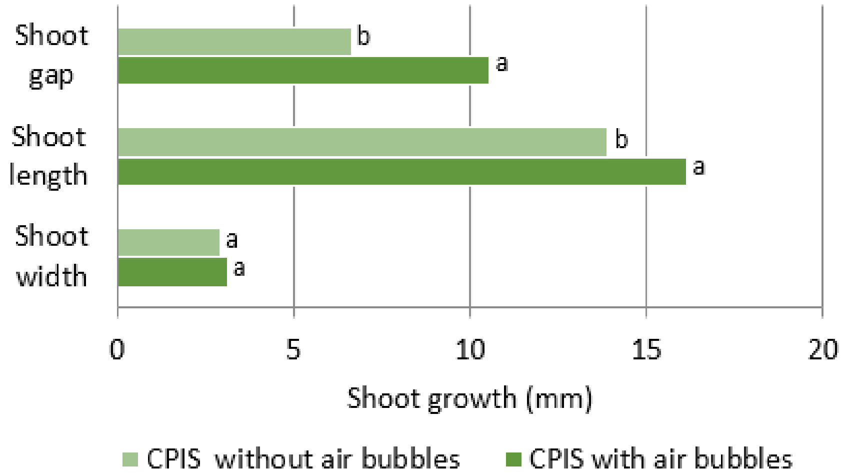

Figure 6: Shoot growth after four weeks in CPIS system with and without air bubbles.

CONCLUSION

The present results showed that the selection of suitable shade level and adding air bubbles in the CPIS system was vital in propagating *A. graminifolia*. Close Permanent Immerse System (CPIS) with presence of air bubbles under 90% shade level is an efficient propagation technique or protocol derived that can be used for large-scale multiplication of *A. graminifolia* in a short time for commercial purposes at the lowest cost.

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