Adaptability of tissue-cultured Dendrobium orchid planlets on planting media and its position during acclimatization process

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Abstract. The acclimatization process of cultured plants needs special attention because it is a critical period for adaptation to In-Vivo conditions. The environmental changes and the imperfection of planlet anatomy are important things that need to be considered to support the growth of Dendrobium orchid planlet. The aim of this study was to determine the effect of planting media type and its positioning on the Dendrobium orchid adaptability during acclimatization process. This study was conducted from March to Mei 2017 in AIAT North Sumatra tissue culture laboratory and screen house. The experimental design used in this study was a randomized group design with five replications. The treatment consisted of planting media and pot position model. The planting media combination were fern+wood charcoal (M0); fern+coconut fibre (M1); ferns+broken bricks (M2); fern+wood charcoal+coconut fibre (M3); and ferns+wood charcoal+coconut fibre+broken bricks (M4) while the pot position model were laying (P0) and hanging (P1) model. Morphological parameters observed were growing plant percentage, plant height, leaves number, roots number, and roots length. The results showed that the best planting media and pot position combination supported the Dendrobium orchid growth were found in ferns and wood charcoal (M0) and ferns and bricks (M2) with lying model (P0).

1. Introduction

Orchid is an ornamental plant that is very popular with a diversity of species based on shape, colour, and characteristics so that it has high aesthetic and selling value. Indonesia, as one of the Asian countries, has a diversity of orchids of approximately 5000 species from about 30,000 species spread throughout the world. Dendrobium genus are the largest species in Indonesia that are widespread in sub-tropic regions of Indonesia and highly favoured because their colours and shapes diversity, high selling value, adaptability to various environmental condition, high productivity, and as a cut flower has flexible stem, flowers don’t fall easily, long freshness, and easy to pack.

Orchids propagation can be done conventionally and modernly, both have its advantages and disadvantages. Orchid propagation conventional can be done through cuttings, clumps separation, and plant saplings cutting and generally spent cheaper cost. The disadvantages of this conventional propagation are limitation of crop seed, long obtaining time of new tillers, the nature of the produced plants are varies [1], and requires much plant material so it is not practical on a large scale. Orchid modern propagation through tissue culture done by isolating plant parts in the form of meristem tissue and culturing it on artificial media with sterile and controlled environmental conditions. Tissue culture can be carried out all the time without depending on the season with produced homogen and disease-
free seedlings in large quantities simultaneously with a relatively short time but requires a very expensive cost.

Acclimatization is a transition period for plantlets to adapt from controlled environmental conditions (In-Vitro) to natural environments (In-Vivo) and define as critical point that determines the success of tissue culture. Plantlet vulnerability to the unconditioned external environment makes the acclimation process very important. Plantlets are still susceptible to moisture, evapotranspiration, high light intensity, microorganism infections and difficulty in absorbing nutrients because the plantlet stomata are more open, the waxy layer and the network of root vessels have not developed properly. To reduce plant stress and increase the percentage of growing plant, there are 2 important factors to be considered, which are the growing media and the micro climate of the growing environment.

Growing media is one of the determinant factors of productivity and quality of Dendrobium orchids [2][3]. The appropriate growing media for orchid growth are expected to store water and nutrients well, hard to weathered, supply sufficient air for roots, easily obtained, relatively cheap [4] and not a source of disease [5]. Ferns, wood charcoal, coconut fibre, husk charcoal, compost, bark and bricks are organic growing media that are often used by orchid cultivators on industrial and household scales either singly or combination. Pot position related to plantlets adaptation on microclimate conditions. In vitro plantlets are very sensitive to evapotranspiration and high light intensity [6] [7], the orchid planlets requirement of light intensity ranging from 25 to 65% with high humidity. In order to observed the adaptation of orchid planlets on micro climate especially light intensity, evapotranspiration and humidity, the researcher use two pot positioning model which are lying and hanging model.

2. Methodology
The study was conducted in the tissue culture laboratory of AIAT North Sumatra from March to May 2017. The materials used were the Dendrobium orchid plantlet, ferns, coconut fibre, charcoal, wood charcoal, broken bricks, fungicides, and vitamin B1. Tools used are plastic cups, plastic straps, plastic trays, and hand sprayers.

The study was conducted in AIAT North Sumatra screen house with 2 factors namely planting media (M) and Pot Positioning (P). The planting media consists of 5 types, namely fern and wood charcoal (M0); fern and coconut fibre (M1); ferns and broken bricks (M2); fern, wood charcoal and coconut fibre (M3); also ferns, wood charcoal, coconut fibre, and broken bricks (M4). The positioning consists of 2 models, namely the lying (P0) and hanging model (P1).

Planting media that have been prepared are mixed according the treatment. The orchid plantlets are removed from the culture bottle and was cleaned then soak it in a fungicide solution for 15 minutes. Each pot was filled with 3 plantlets and placed in the screen house. Plant watering was done according to plant conditions while fertilization was done 2 times a week. The research design used was a completely randomized factorial design with 5 replications. Data from the test results are tabulated, then analysed by ANOVA and further tests in the form of DMRT tests at 5% significance level. The parameters observed were the percentage of growing plant, plant height, number of leaves, number of roots, and root length.

3. Result and discussion

3.1. Percentage of growing plants
The analysis result showed that the combination of planting media and pot position treatment significantly affected the percentage of growing Dendrobium orchid during the acclimatization process (Table 1). with the growing plant percentage ranging from 46 to100%. The highest growing percentage of Dendrobium orchid (100%) was found in the M0P0, M2P0 and M4P0 treatments but were not significantly different with M1P0, M0P1, M2P1, M4P1, and M3P0 treatments. The lowest growing percentage of Dendrobium orchids (46.67%) was shown on M3P1 treatment.
Based on Table 1, it can be concluded that generally the planting media produced the highest of growing percentage are the combination of fern + wood charcoal (M0), fern + broken bricks (M2), and fern + wood charcoal + coconut fibre + broken bricks (M4) while the best pot position is the lying pot position (P0). The domination of the fern and coconut coir in the M1 and M3 planting media combination which are very good in binding water caused moisture excess so planets that are still soft become easy to rot. In addition, besides the ability of coconut fibre to bind much water and supply organic nutrients, also often become a pests and diseases source that attack plant roots [4].

| Combination | Growing Percentage (%) | Plant height (cm) | Number of Leaves | Number of roots | Root length (cm) |
|-------------|-------------------------|-------------------|------------------|----------------|----------------|
| M0P0        | 100 c                   | 5.67 cd           | 5.06 b           | 9.30 c         | 4.59 ab        |
| M0P1        | 86.67 bc                | 5.82 d            | 5.27 b           | 8.13 abc       | 4.14 ab        |
| M1P0        | 93.33 bc                | 5.64 cd           | 5.03 b           | 8.30 abc       | 3.45 ab        |
| M1P1        | 66.67 ab                | 4.56 bc           | 4.30 ab          | 5.40 ab        | 4.20 ab        |
| M2P0        | 100 c                   | 5.90 d            | 5.00 b           | 9.00 bc        | 4.02 ab        |
| M2P1        | 86.67 bc                | 5.74 cd           | 5.63 b           | 8.40 abc       | 5.22 b         |
| M3P0        | 73.33 abc               | 5.04 bc           | 5.06 b           | 8.53 abc       | 2.81 a         |
| M3P1        | 46.67 a                 | 2.85 a            | 2.70 a           | 6.20 abc       | 2.79 a         |
| M4P0        | 100 c                   | 4.30 bc           | 3.73 ab          | 5.73 abc       | 3.17 ab        |
| M4P1        | 80 bc                   | 3.80 ab           | 2.70 a           | 4.70 a         | 3.75 ab        |

Means values followed by the same letter in the same column is not significantly different 5% Duncan’s Multiple Range Test.

3.2. Plant height

The analysis results showed that the combination of the planting media and the pot position treatment significantly affected the height of the Dendrobium orchid during the acclimatization process. The plant height average ranged from 2.85 to 5.90 cm. The highest plant height (5.90 cm) was found in the M2P0 but was not significantly different with M0P1, M2P1, M0P0, and M1P0 treatment. The lowest plant height (2.85 cm) was obtained in the M3P1 but it was not significantly different with M4P1 treatment (3.80 cm).

Generally, the highest plant produced by fern + wood charcoal (M0) and fern + bricks (M2) treatment while the best position was the lying pot position (P0). The combination of planting media in the M0 and M2 treatments between ferns and wood charcoal /brick supported the increase of plant height. Ferns have the ability to absorb and bind water and nutrients that needed for plant growth combined with wood charcoal/brick that has good drainage and aeration also not easily overgrown of fungi/bacteria so it can be optimize the quality and condition of the planting media. Another advantage is that fern also is not easily weathered so the absorption of its nutrients can last for a long time [8].

3.3. Number of leaves

The analysis results showed that the combination of planting media and pot position treatment significantly affected the number of Dendrobium orchid leaves during the acclimatization process (Table 1) ranging between 2.70 - 5.63 strands. The highest number of Dendrobium orchid leaves (5.63) strands was found in the M2P1 treatment but was not significantly different from M0P1, M0P0, M3P0, M1P0, M2P0, M1P1 and M4P0 treatment. The lowest number of Dendrobium orchid leaves was found in M3P1 and M4P1 (2.70 strands) and was not significantly M4P0 and M1P1 treatment.
Generally, the treatment produced the highest number of leaves in a row were planting media combination of fern + broken brick (M2), fern + wood charcoal (M0), and fern + coconut husk (M1) while the best pot position is the lying pot position (P0). The optimal condition for Dendrobium plantlet development which require high humidity are supported by planting media combination of ferns with wood charcoal/brick and remain controlled with a lying pot model that is able to reduce plant evapotranspiration.

3.4. Number of roots

The analysis results showed that the combination of planting media and pot position treatment significantly affected the number of Dendrobium orchid roots during the acclimatization process (Table 1) ranging from 4.70 to 9.30 units. The highest number of roots (9.30 units) was shown by the combination of M0P0 treatment, but the number was not significantly different from M2P0, M3P0, M2P1, M1P0, M0P1, M3P1, and M4P0. The lowest number of roots (4.70 units) in the M4P1 treatment was only significantly different with M0P0 and M2P0 treatments.

The combination of fern + wood charcoal (M0) and fern + bricks (M2) generally are the treatments that produces the highest number of roots. While the best pot position that produced the highest number of roots is the lying pot position. Dendrobium is an epiphytic orchid that lives attached to a part of a dead tree or a living tree without becoming a parasite for its host plants with some roots attached to the growing medium and some dangling freely in the air. The planting media combination of fern and wood/brick charcoal has complementary traits so that it is optimal for Dendrobium orchid growth including the number of roots. No excessive water content in the combination of planting media avoids root rot so roots can develop properly.

3.5. Root length

The analysis results showed that the combination of planting media and pot position treatment significantly affected the root length of the Dendrobium orchid during the acclimation process (Table 1) with an average root length of around 2.79-4.59 cm. The average value of the highest root length in the M2P1 treatment combination (5.22 cm) was significantly different from the lowest root length in the two treatments combinations which are M3P1 and M3P0 with values of 2.79 and 2.81 cm but was not significantly different from the other 7 treatment combinations. Referring to the average of root length values as shown in Table 1, it can be concluded that the longest root lengths in a row are shown in the planting media combination of fern + broken brick (M2), fern + wood charcoal (M0), fern + coconut coir (M1), and fern + wood charcoal + coconut coir + broken bricks (M4).Unlike the other parameters, the pot position that produces a longer root length is the hanging model (P1). Air circulation from all directions in the hanging pot model plays a role in reducing humidity around the roots so the roots can develop properly.

4. Conclusion

The combination of planting media and pot position treatment during acclimatization process has a significant effect on all parameters observed including growth percentage, height, number of leaves, number of roots, and root length of Dendrobium orchid plants. The best combination of planting media to produce the best growth of Dendrobium orchid is the combination of ferns and wood charcoal (M0) and ferns and bricks (M2) combination while the best pot position is the lying position (P0)

Reference

[1] Mahadi I 2016 Propagasi In Vitro Anggrek (Dendrobium Phalaenopsis Fitzg) terhadap Pemberian Hormon Iba dan Kinetin (In Vitro Propagation of Orchid (Dendrobium phalaenopsis Fitzg) on The Addition Iba and Kinetion Hormones Agrotechnology Journal 7(1) p15-18
[2] Ginting B P W and Sutater T 2004 Media Tumbuh untuk Varietas Baru Anggrek Dendrobium (The media grew for new varieties of Dendrobium) Proc Florikultura Nasional Conference Bogor Aug 4th-5th p 65-70

[3] Tirta I G 2005 Pengaruh Beberapa Jenis Media Tanam dan Pupuk Daun terhadap Pertumbuhan Vegetatif Anggrek Jamrud (Dendrobium macrophyllum A. Rich.) (The effects of planting media and leaf fertilizers on the growth of jamrud orchid (Dendrobium macrophyllum A. Rich.) Biodiversitas p 81-84

[4] Febrizawati, Murniati and Yoseva S 2014 Pengaruh Komposisi Media Tanam dengan Konsentrasi Pupuk Cair terhadap Pertumbuhan Tanaman Anggrek Dendrobium (Dendrobium SP.) (The Effect of The Composition of Planting Media With The Concentration of Liquid Fertilizer Toward The Growth of Dendrobium Orchid (Dendrobium sp) Jom Faperta 1 (2)

[5] Iswanto H 2002 Petunjuk Perawatan Anggrek (Orchid Care Instructions) Jakarta: Agromedia Pustaka

[6] Wijayanto T and Boer D 2013 Kemajuan Tahap Aklimatisasi Plantlet Kedelai (Glycine max) Hasil Kultur In-Vitro Immature Embrio (Progress on the Acclimatization Phase of Soybean (Glycine max) Plantlets from In-Vitro Immature Embryo Culture) Agriplus 23 (1) p 72 – 76

[7] Mahayu W M, Mawardi S and Mashud N 2014 Optimasi Daya Adaptasi Planlet Kelapa Kopyor Hasil Kultur Embrio (Optimization of Coconut Coopyor Planlet Adaptation from Embrio Culture) Prosiding Konferensi Nasional Kelapa VIII p 185 - 192

[8] Andalasari T D, Yafisham and Nuraini 2014 Respon pertumbuhan anggrek dendrobium terhadap jenis media tanam dan pupuk daun (Responses of Dendrobium Orchid Growth on Type of Growth media and Foliar Fertilizer) Jurnal Penelitian Pertanian Terapan 14 (1) p 76-82