The Effects of Pineapple Peel in Media In Vitro on The Phalaenopsis amabilis Growth

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Abstract. Phalaenopsis sp is an orchid with a relatively high economic value. In vitro propagation of this orchid on growth media and additional nutrition influence its seedling growth. Pineapple peel provides the required nutrients for a seedling to grow. It contains 81.72% water, 20.87% fiber, 17.53% carbohydrate, 4.41% protein, and 13.65% sugar. It also supplies minerals including Ca (3.31 mg/L), SO2 (169.7 mg/L), PO3 (223.8 mg/L), Mg (62.50 mg/L), Mn (13.97 mg/L), Fe (5.43 mg/L), Co (0.07 mg/L), Cu (2.02 mg/L) and Na (8.61 mg/L). The study aimed to determine the effects of pineapple peel on Phalaenopsis sp growth, and to obtain the best concentration of pineapple peel for the orchid. The experiments applied Completely Randomized Design with five treatments of pineapple peel levels, i.e., control, 50 g/L, 100 g/L, 150 g/L, and 200 g/L. Each treatment was replicated three times. The parameters observed consisted of leaf number and length, root number and length after 12 weeks. The results showed that pineapple peel affected the growth of Phalaenopsis amabilis seedlings. The best concentration for leaf length (3.06 cm) and root length (5.85 cm) was 100 g/L.

1. Introduction

Phalaenopsis (moth orchid) is one of the popular orchid genera commonly used in the hybridization. One species, Phalaenopsis amabilis, is recognized for its beautiful flower, to which it is crowned as the captivating flower of Indonesia [1]. Moth orchids require 3-5 years to blossom and additional 3-4 months to form new buds after flower fall [2]. Overexploitation of P. amabilis leads to a decline of the population in nature. The species is reported for being threatened to extinct [3]. Thus, efforts to increase nursery and propagation of the orchids are required. Orchid propagation can be performed in vegetative and generative means. Vegetative propagation is ineffective because the seedlings produced are very limited in number. On the other hands, generative propagation generates large numbers of seedling, but it faces a problem with long duration of seeds to germinate [4]. Orchid seed germination in nature results in a very low (< 1%) viability. This problem can be overcome by aseptically growing the seeds on an artificial medium. This technique is often called as in vitro culture [5].

Subculturing is one attempt to substitute media with the new one; hence, nutrients required for seedling growth are provided [6]. Subculturing is important to maintain nutrient availability in the media. Vacin and Went are basic media commonly used for orchid propagation because they contain many macro- and micro-elements, vitamins, and hormones [7]. Plant growth requires vitamins and hormones, which can be obtained from added organic matters such as fruit (tomato, banana, avocado) and sprout extracts. Pineapple (Ananas comosus L. Merr) is common fruit of Indonesia where the people consume it as fresh fruit. In industry, pineapple is used, for instance, as raw material for jam,
chip, beverage essence and syrup. The industries mostly use the flesh [8], which is only 53% of the fruit. The remaining pineapple fruit might constitute a large part (47% of the peel), and the core [9]. Pineapple peel contains sufficiently high nutrition contents including water (81.72%), crude fiber (20.87%), carbohydrate (17.53%), protein (4.41%) and reduced sugar (13.65%) [10]. It also contains Ca (3.31 mg/L), SO2 (169.7 mg/L), PO3 (223.8 mg/L), Mg (62.50 mg/L), Mn (13.97 mg/L), Fe (5.43 mg/L), Co (0.07 mg/L), Cu (2.02 mg/L) and Na (8.61 mg/L) [8].

Based on the background, a study concerning the effect of pineapple peel on the growth of moth orchid seeds is required. Furthermore, the best concentration of the peel for its growth is necessary to determine.

2. Methods

The experiments used Completely Randomized Design (CRD) with four treatments, i.e., pineapple peel applications of 0 g/L (control), 50 g/L, 100 g/L, 150 g/L, and 200 g/L. Each treatment was subjected to three replications. The parameters examined were number and length of leaves, number and length of roots. All parameters were measured after 12 weeks of planting. The data were analyzed using ANOVA. Further analysis of LSD (Least Significant Difference) was performed when significant difference among treatments was observed.

3. Results

The ANOVA showed no significant effects of pineapple peel extracts applied for leaf and root numbers (Table 1).

Table 1. ANOVA for the effect of pineapple peel application on leaf and root numbers of Phalaenopsis amabilis (ns: not significant).

| Parameter       | Source of Variation | Degree of Freedom (DF) | Sum of Square (S) | Mean Square (MS) | F calculated | F table 0.05 | F table 0.01 |
|-----------------|---------------------|------------------------|-------------------|------------------|--------------|--------------|--------------|
| Leaf number     | Treatment           | 4                      | 4.8008            | 1.2002           | 2.42<sup>ns</sup> | 3.48         | 5.99         |
|                 | Error               | 10                     | 4.9615            | 0.4961           |              |              |              |
|                 | Total               | 14                     | 9.7623            | 1.6963           |              |              |              |
| Root number     | Treatment           | 4                      | 15.8259           | 3.9565           | 3.44<sup>ns</sup> | 3.48         | 5.99         |
|                 | Error               | 10                     | 11.5119           | 1.1512           |              |              |              |
|                 | Total               | 14                     | 27.3378           | 5.1077           |              |              |              |

Figure 1. The leaf and root numbers of Phalaenopsis amabilis seedling over various concentrations of pineapple peel extracts on the growth media (blue: root, red: leaf).
Table 2. ANOVA for the effect of pineapple peel application on leaf and root lengths of *Phalaenopsis amabilis* (**: highly significant)

| Parameter | Source of Variation | Degree of Freedom (DF) | Sum of Square (S) | Mean Square (MS) | F calculated | F table 0.05 | F table 0.01 |
|-----------|---------------------|------------------------|-------------------|------------------|--------------|--------------|--------------|
| Leaf length | Treatment          | 4                      | 6.9624            | 1.7406           | 21.98**      | 3.48         | 5.99         |
|            | Error               | 10                     | 0.7917            | 0.0792           |              |              |              |
|            | Total               | 14                     | 7.7541            | 0.7917           |              |              |              |
| Root length | Treatment          | 4                      | 30.7322           | 7.6830           | 56.88**      | 3.48         | 5.99         |
|            | Error               | 10                     | 1.3508            | 0.1351           |              |              |              |
|            | Total               | 14                     | 32.0830           | 1.8198           |              |              |              |

The effects of pineapple peel on leaf and root lengths of *P. amabilis* was highly significant difference (Table 2). LSD test revealed that pineapple peel of 100g/L was the best for the orchid leaf and root lengths (Table 3).

Table 3. LSD test for the effect of pineapple peel application on leaf and root lengths of *P. Amabilis* (numbers followed by the same letter in each column show no significant difference at LSD level of 5%)

| Pineapple peel concentration (g/L) | Leaf length (cm) | Root length (cm) |
|-----------------------------------|------------------|------------------|
| 0                                 | 1.25 a           | 1.64 a           |
| 50                                | 2.48 b           | 3.70 c           |
| 100                               | 3.06 c           | 5.85 d           |
| 150                               | 1.59 a           | 2.73 b           |
| 200                               | 1.51 a           | 2.57 b           |

Figure 2. Performance of *P. amabilis* seedlings grown on the media with addition of various concentrations of pineapple peel extract.

4. Discussion

The applications of pineapple peel extracts on the growth media had no significant effects on the orchid leaf and root numbers. This condition is presumably because the nutrients and organic matter
contents in the extracts have not been able to stimulate both leaf and root cell formations. The leaf and root growth can be affected by both genetic and environmental factors. The latter includes nutrients, exogenous auxin, pH, and water [11, 12]. The nutrients affected the increasing of leave and root numbers are nitrogen, potassium, sulfur, iron, and zinc. Physiologically, potassium plays an active role in the ionic pump that will influence the increment of mineral adsorption [13]. As a result, it can increase cell number and shoot formation. Nitrogen, sulfur, iron, and thiamine can stimulate cell division, causing an increase of axillary shoot and leaf growth. Either shortage or excess of nitrogen, potassium, sulfur, and iron in seedlings will cause the increment or inhibition of leaf and root number [14].

Figure 1 shows that leaf number and root number increase with the increment of pineapple peel extract concentration up to 100 g/L. This increase indicates that the 100 g/L concentration produced an optimal average of leaf and root number. VW media contains many nitrogen and potassium; and when the media were enriched with pineapple peel containing SO2 (169.7 mg/L), and Fe (5.43 mg/L), the minerals stimulated leaf and root to increase in number [15]. Besides, the organic matters of pineapple peel magnify the nitrogen, embedded as protein, and serve as a source of energy for leaves and roots formation. A study reported that application of banana peel extract of 100g/L was the best treatment to increase leaf and root number in Dendrobium sp [16]. The significant element playing a role in the addition of root is phosphor (P) because it stimuliates the initiation of root growth, plant maturation, and generative growth [17]. Phosphor applied in a large quantity may cause the increment of root number [14].

The pineapple peel extract highly significant affected leaf and root lengths of the orchid seedlings (Table 2). This is because the nutrients in the pineapple peel can stimulate the development of leaf and root primordial cells. Ca plays roles in the leaf and root elongation by the formation of a cell wall, and joining cells by forming pectic calcium [18]. Fe takes part in the chlorophyll formation process in leaves, which is essential for photosynthesis [19]. In addition, carbohydrate, vitamins C, and B1 (thiamine) are essential for leaf formation [20, 21, 22]. Carbohydrate is the raw material in energy production by respiration, and new cell formation, used in the metabolism and biosynthesis of endogenous hormones such as auxin, cytokinin, and gibberellin. The auxin and gibberellin produced can interact in the cell elongation [20]. It is reported that application of cassava on orchid culture media stimulated the increasing number of leaves, which possibly due to its high amount of vitamin C [22].

Table 3 shows that, concerning leaf and root length, the pineapple peel extract of 100g/L indicates the best effects for the orchid growth. This result confirms that nutrients in pineapple peel (100 g contain 3.31 mg/L Ca, 5.43 mg/L Fe, 17.53 g carbohydrate, 24 mg vitamin C, 0.08 mg vitamin B1) sufficiently increases leaf and root elongation in P. Amabilis seedlings. Another work reported that the application of 50 g/L cassava containing 17.65 g carbohydrate significantly affected the increment of leaf area including leaf length and width in Dendrobium sp. [22].

5. Conclusion

In conclusion, application of pineapple peel on VW media for Phalaenopsis amabilis sub-culturing showed a significant effects on leaf and root lengths with the best application demonstrated by 100 g/L media.

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