Effect of utilization of tomato extract and foliar fertilizer as media on shoots multiplication of banana cv Ambon in vitro

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Abstract. The good quality banana seeds are still difficult to obtain. There are two ways to provide seeds, namely conventional and tissue culture (in vitro). Tomato extract contains natural ZPT or phytohormone which can be utilized in modification of banana tissue culture media. The aim of this study was to determine the influence of media types and tomato extracts in various concentrations for multiplication of banana cv. Ambon in vitro. The study was conducted from October - December 2016 at the Tissue Culture Laboratory of Horticulture Seed Center, Salaman, Magelang. The experimental design used was completely randomized design with two treatment factors. The first factor was media type with the addition of foliar fertilizer, the second factor was modification of tomato extract with 4 levels. The results showed that the different of the treated media treatment did not affect the emerge of leaf and leaf length, the number of roots and root length. The emerge of the leaves of all treatments occurred at 6 days after planting with the highest average length was obtained in MS treatment with a combination of tomato extract 50 ml/l (10.3 cm). The use of MS medium with a combination of tomato extract 50 ml/l generated the average root number 15.5 with a root lengths 7.5 cm. Substitution of MS medium with tomato extract and foliar fertilizer did not show better results compared to the use of MS media in the multiplication of banana shoots in tissue culture.

1. Introduction
Bananas production in Indonesia is quite high, and tends to increase from year to year, but so far, the potential has not been optimally utilized. In Indonesia, the largest consumption of bananas is for the domestic market. The technology of banana cultivation has widely investigated, with the most basic and very decisive result in the provision of quality seeds [1]. The enhancement of banana production in Indonesian requires expansion of planting. Banana plantations need high quality seeds. There are two ways to provide seeds, namely conventional and tissue culture (in vitro). Conventional propagation through suckers, tubers and hemispheres takes a long time, the seeds produced are few, not uniform and their health is not guaranteed. While tissue culture techniques (in vitro) can produce healthy and large uniform banana seedlings in a relatively short period of time and are not climate dependent, thus, the availability of seeds is guaranteed [2].

Substitution of media can be done by using tomato extract containing natural ZPT or phytohormone and addition of compound fertilizer, specially leaf fertilizer as modification of tissue culture media. The use of organic material that is cheaper and easier to obtain is expected to replace
2. Methods
The study was conducted from October - December 2016 at the Tissue Culture Laboratory of Horticulture Seed Center Salaman, Magelang. The explant material used is plantlet of banana cv. Ambon from Horticulture Seed Center, Magelang. The basic ingredients media MS is a stock solution of macro nutrients composed of KNO₃, NH₄NO₃, CaCl₂, MgSO₄ and KH₂PO₄. Micro nutrients are composed of MnSO₄, ZnSO₄, H₂BO₃, KI, Na₂MoO₄, CoCl₂ and CuSO₄, vitamin solution composed of Myo-inositol, Thiamine HCl, Pyridoxine HCl, dan Nicotinic acid; as well as a buffer solution composed of FeSO₄ and Na₂EDTA. Other ingredients used are for media hardener, sugar as carbon source, BAP and IAA as growth regulator and NaOH and HCl as pH controller (5.8-6.2). The research used ripe tomatoes, fresh and red, as well as foliar fertilizer Growmore brands. Sterilization of media use an autoclave for 60 minutes at a pressure of 17.5 psi and a temperature of 121 °C followed by a drying process for 15 minutes.

The experimental design used was completely randomized design (CRD) with two treatment factors which was media types with the addition of foliar fertilizer and modification of tomato extract with 4 levels with an addition of coconut water. The first factor was media types which was consist of P₀ = MS, P₁ = ½ MS + ½ foliar fertilizer, and P₂ = foliar fertilizer. The second factor was tomato extract concentrations with an addition of coconut water 150 ml/l that were T₁ = tomato extract 50 g/l, T₂ = tomato extract 100 g/l, T₃ = tomato extract 150 g/l, and T₄ = tomato extract 200 g/l. Based on these two treatment factors, 12 treatment combinations were repeated three times, thus there were 36 experimental units. The data were analyzed using analysis of variance by F test level of 5%. If there is a significant difference, the analysis is continued with a DMRT test of 5% level.

3. Results and Discussion

3.1. The Emerge of Leaf and Leaf Length
The increase in leaf length caused by the acceleration of cell division and the process of differentiation. Cell division requires energy that can be obtained from auxin or cytokines with other nutrients. The length and width of the leaf are closely related to the direction of cleavage, enlargement, quantity, and cell distribution. The more leaf area, the number of stomata grows. Stomata play a major role in the absorption of nutrient and substances needed in the process of plant metabolism [4]. Based on the results of data analysis obtained from this study are presented in Table 1. There was no interaction as well as no effect of treatments on the emerge of leaf and leaf length (Table 1). In all media and treatments, the leaf appeared at 6 days after planting (DAP).

[5] showed that the addition of adenda increased the leaf length, root number and wet weight of plant. Organic fertilizers i.e. coconut water, banana pulp, carrot extract, tomatoes, and pineapple added in ½ MS medium supplied essential nutrients, vitamins, carbohydrates and growth regulators required for growth of Phalaenopsis orchid seedling in vitro. Table 1 showed that in MS medium generated a higher leaf length compared with other media treatments. The highest yield was obtained in MS medium treatment with the addition of 50 ml/l tomato extract with 11.5 cm leaf length. [6] reported that adenda organic materials can be added in the culture medium to enrich the basic media.
Table 1. The appearance of leaves and leaf length on media treatment and concentration of tomato extract in the multiplication of banana shoots with tissue culture

| Treatment | Tomato Extract (mL/L) | Averages |
|-----------|-----------------------|----------|
|           | 50    | 100   | 150   | 200   |
| Day of Emerge Leaves (DAP) |
| MS        | 6     | 6     | 6     | 6     | 6.0   |
| 1/2 MS + 1/2 FF | 6     | 6     | 6     | 6     | 6.0   |
| Foliar Fertilizer | 6     | 6     | 6     | 6     | 6.0   |
| Averages  | 6.0   | 6.0   | 6.0   | 6.0   | 6.0   |
| Leaf Length (cm) |
| MS        | 11.5  | 8.7   | 10.3  | 10.8  | 10.3  |
| 1/2 MS + 1/2 FF | 10.9  | 7     | 8.3   | 9.3   | 8.9   |
| Foliar Fertilizer | 11    | 7.8   | 8.3   | 7     | 8.5   |
| Averages  | 11.1  | 7.8   | 8.9   | 9.0   | 9.2   |

3.2. Number of Roots and Roots Length
According to [7] the roots are needed for nutrient absorption from the media. The more the number of roots, the more extensive the absorption of nutrients by the roots. The results of [8] showed that the addition of tomato extract into ½ MS medium increased the number of roots of *Phalaenopsis orchid*. The number of roots and roots length analysis in multiplication of banana cv. ambon are presented in Table 2. There was no effect of various media and addition of tomato extract at various concentrations as well as their interaction on the number of roots and root length. The roots yielded on MS medium treatment with the addition of tomato extract with various concentrations tended to be higher than the number of roots obtained from the use of ½ MS + ½ FF or full foliar fertilizer media.

Table 2. Number of roots and root lengths in media treatment and concentration of tomato extract in the multiplication of banana shoots with tissue culture

| Treatment | Tomato Extract (mL/L) | Averages |
|-----------|-----------------------|----------|
|           | 50    | 100   | 150   | 200   |
| Number of Roots |
| MS        | 18    | 10    | 18    | 16    | 15.5  |
| 1/2 MS + 1/2 FF | 15    | 12    | 15    | 13    | 13.8  |
| Foliar Fertilizer | 9     | 0     | 0     | 0     | 2.3   |
| Average  | 14    | 7.3   | 11    | 9.7   | 10.5  |
| Roots Length (cm) |
| MS        | 9.1   | 3.3   | 9.1   | 8.6   | 7.5   |
| 1/2 MS + 1/2 FF | 8.3   | 4.6   | 4     | 9.1   | 6.5   |
| Foliar Fertilizer | 0.8   | 0     | 0     | 0     | 0.2   |
| Average  | 6.1   | 2.6   | 4.4   | 5.9   | 4.8   |

Roots length affects the explant growth because long-rooted plants have better ability to absorb water and nutrients than short-rooted plants [9], [10] argue that organic additives include one of the basic compositions of culture media compounds other than minerals, carbon sources, amino acids and growth regulators. The addition of foliar fertilizer can be done as an alternative media in multiplication of banana in tissue culture. Compound Fertilizer Growmore (20:20:20), Hortigro (19:19:19) and Kristalon (18:18:18) have potential as media substitutes for MS because they have macro and micro nutrients that useful for plant growth and development [11].
4. Conclusion
Substitution of MS media with tomato extract and foliar fertilizer did not show better results compared with the use of MS media in the multiplication of banana cv. ambon shoots in tissue culture.

References
[1] Rugayah, Hapsoro D, Ulumudin A, and Feria W M 2012 Study of vegetative propagation technique of banana cv. ambon kuning with tube cleavage (Corm) J. Agrotropika 17(2) 58
[2] Maslukhah U 2008 Banana extract as MS media supplement in culture media of banana cv. raja bulu (Musa paradisiaca L. AAB Group) in vitro (Bachelor Thesis, Study Program of Hortikultura, Department of Agronomy and Horticulture, Faculty of Agriculture, Institut Pertanian Bogor)
[3] Rianti, Suhermiatin T, Ernawati N 2017 Optimization of the growth cattleya plantlet through strength combination of murashige-skoog and organic substances J. Agriprima 159
[4] Widyastoety D 2014 Effect of auxin and cytokinin on the growth of mokara orchid plantlets J. Hort. 24 230
[5] Maera Z 2015 Growth response planlet orchid phalaenopsis hybrids against giving two types of leaf fertilizer and benziladenin during acclimatization J. Enviagro 7 (2)
[6] Yusnita 2004 Tissue culture how to expand plants efficiently (Jakarta: Agromedia Pustaka)
[7] Yuniastuti E, Praswanto, Harminingsih I 2010 the effect of bap concentration of anthurium’s (anthurium andraeanum linden) shoot multiplication on some nutrient mediums by in vitro Carakatani XXV (1)
[8] Jayanti A 2011 effect of tomato and tripton extract on enlargement seedling orchid phalaenopsis hybrids in vitro (Lampung: Thesis Universitas Lampung)
[9] Andini N 2016 The use of coconut water and banana extract on the multiplication of temulawak shoots (Curcuma xanthorrhiza Roxb.) on in vitro (Surakarta: Universitas Sebelas Maret)
[10] Hartmann H T, Kester D E, Davies F T and Geneve R L 2002 Plant propagation principles and practice 7th Ed (New Jersey: Prentice Hall)
[11] Husnul K, Kendarini N, and Soetopo L 2016 The effect of compound fertilizer on chrysanthemum growth (Dendranthema grandiflora Tzvelev) on in vitro J. Prod. Tan. 4 352