

Research Article

 OPEN ACCESS

THE EFFECT OF ADMINISTRATION OF PAITAN (*Tithonia diversifolia*) LIQUID EXTRACT ON THE GROWTH OF TISSUE CULTURAL PRODUCTS OF BARANGAN BANANA (*Musa acuminata* L.) SEEDLINGS

Zhikry Fadhillah Miswar¹⁾, Friza Elinda^{2*)}, Andre Sparta¹⁾, Aulia Meyuliana²⁾,

Jon Hendri²⁾

¹⁾BPSI Tanaman Buah Tropika, Aripan, Solok, West Sumatera, 27301, Indonesia

²⁾Department of Agrotechnology, Faculty of Agriculture, Mahaputra Mubammad Yamin University, Solok, West Sumatera, 27361, Indonesia

Article Info

Received:

28 October 2023

Accepted:

21 December 2023

Published:

31 December 2023

Competing Interest:

The authors have declared that no competing interest exists.

Corresponding Author:

Friza Elinda, Departemen of Agrotechnology, Faculty of Agriculture, Mahaputra Yamin University, Solok, West Sumatera, Indonesia
Email: frizaelinda.friza@gmail.com

© 2023 The Authors. This is an open access article under the CC BY license.

Abstract

Bananas (*Musa* spp.) are tropical plants that are very popular in Indonesia. Banana plants in the nursery require a planting medium that contains the nutrients the plants need. Tithonia is an annual weed that is suitable for use as a source of plant nutrients. This research aims to determine the effect of giving Tithonia liquid extract on the growth of Barangan banana seedlings resulting from tissue culture at the seedling stage and the best dose for using Tithonia liquid extract. This research was conducted at the Germplasm Nursery and Breeding Laboratory of the Tropical Fruit Plant Research Institute, West Sumatera, from September to December 2020. This research used the CRD method (Completely Randomized Design) with four treatments and six replications, in the form of 1) Without Tithonia extract, 2) Giving 1 ml of Tithonia extract, 3) Giving 2 ml of Tithonia extract, and 4) Giving 3 ml of Tithonia extract. The parameters observed were plant height, number of leaves, leaf length, leaf width, and stem diameter. The results of the research showed that giving Tithonia liquid extract had an effect on the growth of Barangan banana seedlings resulting from tissue culture. Significantly different results were obtained for the leaf width increase parameter. On the other hand, the results were not significantly different for other parameters such as plant height, number of leaves, leaf length and stem diameter. Giving 1 ml of Tithonia liquid extract was the best dose in this study.

Keywords: barangan variety, tithonia, liquid extract



1. Introduction

Bananas (*Musa* spp.) are tropical plants that are popular in Indonesia because their fruit is delicious and rich in nutrients. Therefore, it is beneficial for the health of the human body. This plant can be used from fruit, flowers, stems, leaves, skin to tubers. Banana plant propagation can be done using conventional techniques, namely using sucker shoots and propagating bananas by seed by dividing the tubers according to the buds. However, seed propagation using conventional techniques cannot meet the need for banana seeds on large-scale plantations. This is due to the limited propagation materials that can be used. One alternative to overcome this obstacle is to use clonal propagation techniques through tissue culture. Tissue culture techniques can produce uniform and quality seeds in large quantities quickly.

Banana seeds resulting from tissue culture that can be planted in the field must have a minimum height of 30 cm. On average, reaching a height of 30 cm takes 3-4 months after planting. Therefore, the addition of nutrients is intended to stimulate seedling growth so that the time needed to reach the required height is shorter.

Nutrients can be added through fertilization to increase the growth rate of plants during sowing. Fertilizing plants is a maintenance activity that needs to be carried out during the growth period of seeds in the nursery so that the availability of nutrients needed by the soil can be met and the seeds produced are of good quality.

Organic fertilizer is fertilizer made from plant or animal remains that contain organic material and have undergone a decomposition process to become additional nutrients for plants. Sufianto (2014) said that adding organic material to the soil will affect the physical, biological and chemical conditions of the soil.

2. Materials and Methods

The research was carried out in the nursery of the Germplasm and Breeding Laboratory of the Tropical Fruit Plant Research Institute, Solok, West Sumatra, from September to December 2020, at an altitude of 340 meters above sea level. The materials and tools used include banana seeds from tissue culture of the Barangan Merah variety (1 month old after acclimatization); polybag measuring 18 cm x25 cm; planting medium consisting of soil, manure, and husk charcoal (1:1:1); *Tithonia diversifolia* Extract; label; stationery; ruler; and calipers.

This research used the CRD (Completely Randomized Design) method with four treatments, six replications and six samples. So, the number of plants to be observed is 144 stems. The treatments given are: K: Without *Tithonia* Extract; M: Giving 1 ml of *Tithonia* extract; H: Giving *Tithonia* extract 2 ml; and B: Giving 3 ml of *Tithonia* extract. If the results of the F analysis are obtained, calculate the amount of treatment from the F table of 5%, followed by Duncan's New Multiple Range Test (DNMRT).

Organic fertilizer given in liquid form will be more easily absorbed by plants.

The paitan plant (*Tithonia diversifolia*) can be used to produce liquid organic fertilizer which is useful in addition to being a plant nutrient. Paitan is an annual weed that is suitable for use as a source of plant nutrition (Opla et al. 2009; Crespo et al. 2011). Purwani (2011) reported that paitan has a nutritional content of 2.7-3.59% N; 0.14-0.47%P; 0.25-4.10% K. Research by [5] also showed that paitan has a nutrient content of 3.59% N, 0.34% P, and 2.29% K. The parts of the paitan plant that can be used as green manure are the stems and leaves. The use of paitan as a source of nutrients can be in the form of fresh green manure, liquid green manure, or compost [6,7,8,9].

Tithonia liquid extract is a form of organic paitan fertilizer that is environmentally friendly and can be used as an alternative to increase nutrient levels for plants because the nutrients in the liquid extract have been decomposed so plants can more easily absorb them through the roots. The results of nutrient testing in the Tropical Fruit Plant Research Institute laboratory show that *Tithonia* liquid extract contains 0.65% C, 0.16% N, 0.085% P, and 0.62% K, so its use is expected to stimulate the growth of banana seedlings after plant acclimatization phase. Several previous studies have shown that liquid paitan fertilizer can stimulate plant growth in seeds and land. The research results of Pangestu and Tyasmoro, (2017) showed that the application of Liquid Organic Fertilizer and Paitan Compost had an effect on increasing the number of tendrils, number of branches, number of leaves, leaf area, wet weight and dry weight of mint plants.

The aim of this research is to look at the effect of giving Paitan (*Tithonia diversifolia*) liquid extract on the growth of Barangan banana seeds (*Musa acuminata* L) from tissue culture results.

Tithonia liquid extract is made by cutting the tip of *Tithonia* 40 cm -50 cm long. The chopped product is put into a sack and then hung for \pm 3 weeks until no liquid extract drips out. This process aims to obtain pure *Tithonia* liquid extract without a mixture of water so that the shelf life is longer (\pm 6 months) and does not become moldy. Banana seeds are planted upright, and each polybag is filled with one banana seed. In the polybag, the seeds that have been planted are then labeled according to their treatment.

Maintenance is carried out by watering every three days if the planting medium is dry. Watering is done to maintain the humidity of the media so as not to interfere with the growth of banana seedlings. Watering is done only to wet the media or not flood the media because watering that is too wet will cause the banana seedlings to die.

Treatment is carried out once a week, with a predetermined dose, namely 1 ml of *Tithonia* extract per plant, 2 ml of *Tithonia* extract per plant, and 3 ml of *Tithonia* extract per plant. Treatment is carried out

by pouring Tithonia liquid extract into each planting medium according to the specified dose. So that it can be completely absorbed by plants and makes application easier, each Tithonia extract treatment is dissolved first using water according to the watering volume (± 60 ml).

3. Results and Discussion

A. Plant height

The results of analysis of variance in plant height increase in the 12th week with Tithonia liquid extract

The treatment was carried out 12 times, starting a week after the seeds were planted.

The observation parameters carried out were plant height (cm), Number of leaves (strands), leaf length (cm), leaf width (cm), and stem diameter (cm). treatment on Barangan variety banana seedlings showed results that were not significantly different. The average results for increasing the height of banana seedlings are presented in Table 1. Average Height Increase of Barangan Banana Seedlings with Tithonia Liquid Extract in the 12th Week.

Table 1. Average Height Increase of Barangan Banana Seedlings with Tithonia Liquid Extract in the 12th Week

Treatments	Plant height (cm)
without ekstrak Tithonia	30.92
1 ml ekstrak Tithoni	34.05
2 ml ekstrak Tithonia	33.05
3 ml ekstrak Tithonia	32.37

KK = 10.27

In Table 1, it can be seen that the treatment of giving Tithonia liquid extract to the Barangan variety banana seedlings did not significantly increase the height of the banana plants. The average results at the end of the observation (week 12) of Tithonia liquid extract (dose 1 ml, 2 ml and 3 ml) showed better results (34.05 cm, 33.05 cm and 32.37 cm). compared to without Tithonia extract (30.92cm). The best results were obtained when treating Tithonia liquid extract with a dose of 1 ml (34.05 cm).

The height of banana seedlings is in line with the increase in the number and length of leaves. Newly grown leaves are larger in size. This will affect plant height because observation of plant height is done by measuring the root collar (base of the plant) which is located on the surface of the planting medium to the tip of the longest leaf.

The results of the observations showed that administering Tithonia liquid extract, which is an organic material, could increase the height of the Barangan variety banana seedlings. However, it may take longer in research to get maximum results. According [11], organic fertilizer has bulky properties

and is needed in large quantities. The content of macro and micro nutrients in organic fertilizer is also small so it will take a long time to determine its effect.

The results of this study are different from those obtained [12] research shows that giving fermented Tithonia liquid extract can provide better plant height growth compared to controls. What is different from this research is the Tithonia extract used by [12] added young coconut water and liquid organic plant concoction to the fermentation. Similar results were also obtained by [13] who found that Tithonia extract could stimulate the growth of processed banana seeds of the Big-Ebanga variety.

B. Leaf Width

Analysis of variance in leaf width at the 12th week with Tithonia liquid extract treatment on Barangan banana seedlings showed significantly different results. However, at each treatment dose (1 ml, 2 ml, and 3 ml), there were no significant differences according to statistical tests. The average results of observations of increasing leaf width are presented in Table 2.

Table 2. Average Leaf Width of Banana Seedlings of Barangan Variety with Tithonia Liquid Extract 12th Week

Treatments	Leaf Width (cm)
without ekstrak Tithonia	6.10 a
1 ml ekstrak Tithoni	7.97 b
2 ml ekstrak Tithonia	7.60 b
3 ml ekstrak Tithonia	8.27 b

KK = 15.28

Figures with the same lowercase letters in the same column are not significantly different according to DNMR level of 5%

The final results of the observations showed that administration of Tithonia liquid extract, either 1 ml, 2 ml or 3 ml, gave better results than treatment without Tithonia liquid extract. Providing Tithonia liquid extract is thought to ensure the availability of sufficient nitrogen for plant growth compared to not providing Tithonia liquid extract. Experiments by [14] showed that giving Tithonia resulted in the widest leaf width in *Brassica napus* plants compared to the control treatment.

In general, the length and width of leaves also influence the growth of leaf area, thus determining the amount of photosynthesis produced by a plant. Therefore, increasing leaf width will indirectly increase plant growth and development. According to [15], nutrients can influence the size of the leaf area. If the nutrient content is sufficient, the leaves of a plant will become wider because most of the assimilate is allocated to leaf formation so that the leaf area increases. [16] added that leaf area and a high amount of chlorophyll will cause the photosynthesis process to run well.

The nutrient content Nitrogen (N) in Tithonia liquid extract is believed to be necessary for the formation of vegetative parts of a plant (such as leaves, roots and stems). This resulted in the growth of banana seedlings given Tithonia liquid extract having a better growth tendency than without Tithonia liquid extract. [17] stated that Nitrogen plays an important role in the formation of green leaves, helps the photosynthesis process, forms proteins, fats and various organic compounds, improves the quality of leaf-producing plants, and increases reproduction. microorganisms in the soil. [18] added that Nitrogen is a primary macro nutrient which is the main component in the plant body, where growing plants must contain Nitrogen to form new cells.

C. Stem diameter

Analysis of variance in stem diameter at week 12 with Tithonia liquid extract treatment on Barangan banana seedlings showed that the results were not significantly different. The average results of observations of increases in stem diameter are presented in Table 3.

Table 3. Average Stem Diameter of Barangan Banana Seedlings with Tithonia Liquid Extract 12th Week

Treatments	Stem diameter (cm)
without ekstrak Tithonia	0.59
1 ml ekstrak Tithoni	0.65
2 ml ekstrak Tithonia	0.67
3 ml ekstrak Tithonia	0.74

KK = 16.11

The best results were obtained in the treatment of giving 3 ml Tithonia liquid extract per plant (0.74 cm), followed by the treatment giving 2 ml Tithonia liquid extract (0.67 cm) and the treatment giving 1 ml (0.67 cm). . Meanwhile, the lowest results were obtained in the treatment without Tithonia liquid extract, namely 0.57 cm. This shows that the administration of Tithonia liquid extract has an influence on the growth of stem diameter of the Barangan banana variety.

In this study, it was seen that the administration of Tithonia liquid extract showed better results on the growth of Barangan variety banana seedlings compared to treatment without Tithonia. This can be seen in the parameter of increasing leaf width which shows significantly different results when giving Tithonia liquid extract compared to the treatment without giving Tithonia liquid extract at the end of the observation. Other observation parameters included plant height, number of leaves, leaf length and stem diameter,

although statistically they were not significantly different but had a tendency for better results at the end of the observation.

Giving Tithonia liquid extract at a dose of 1 ml per plant was the best dose in this study, because a dose of 1 ml gave better results in increasing leaf width compared to without giving Tithonia liquid extract and the increase in leaf width was the same as when given. Tithonia liquid extract with higher dosage. Apart from that, Tithonia liquid extract contains macro and micro nutrients which can support the growth and development of Barangan variety banana seedlings.

Several research results show that giving Tithonia gives positive results on plant growth. The research results of [19] show that giving Tithonia extract supports better growth and yield in cowpea plants. The application of Tithonia to other plants, namely tomatoes [20], bananas [21], and beans [22] shows positive results on the growth and yield of these plants

. . This cannot be separated from the function of the Tithonia plant which is able to stimulate plant growth, provide macro and micro nutrients and increase soil microbial biomass [23]. However, in this study not all

4. Conclusions

The Research shows that giving Tithonia liquid extract has an effect on the growth of the Barangan variety

References

- [1] Sufianto. 2014. Analisis Mikroba pada Cairan Sebagai Pupuk Cair Limbah Organik dan Aplikasinya Terhadap Tanaman Pakcoy (*Brassica chinensis* L.). Jurnal GAMMA, 9(2) : 77 – 94.
- [2] Opala, P.A., C.O. Othieno, J.R. Okalebo, and P.O. Kisinyo. 2009. Effects of Combining Organic Materials with Inorganic Phosphorus Source on Maize Yield and Financial Benefits in Western Kenya. *Exp. Agric.* 46:23-34.
- [3] Crespo, G., T.E. Ruiz, and J. Alvarez. 2011. Effect of Green Manure from *Tithonia* (*T. diversifolia*) on the Establishment and Production of Forage of *P. Purpureum* cv. Cuba CT-169 and on Some Soil Properties. *J. Agric. Sci.* 45:79-82. Adeniyani, B.O., S.O. Ojeniyi, and M.A. Awodun. 2008. Relative Effect of Weed Mulch Types on Soil Properties and Yield of Yam in Southwest Nigeria. *J. Soil Nature* 2:1-5.
- [4] Purwani, J. 2011. Pemanfaatan *Tithonia diversifolia* (Hamsley) A. Gray untuk Perbaikan Tanah. Balai Penelitian Tanah. Hal : 253-263.
- [5] Bintoro, H.M.H., R. Saraswati, D. Manohara, E. Taufik, dan J. Purwani. 2008. Pestisida Organik pada Tanaman Lada. Laporan Akhir Kerjasama Kemitraan Penelitian Pertanian antara Perguruan Tinggi dan Badan Litbang Pertanian (KKP3T).
- [6] Muhsanati, A. Syarif, dan S. Rahayu. 2008. Pengaruh Beberapa Takaran Kompos *Tithonia* terhadap pertumbuhan dan hasil tanaman jagung manis (*Zea mays Saccharata*). *Jerami* 1:87-91.
- [7] Hakim, N., Agustian, and Y. Mala. 2012. Application of Organic Fertilizer *Tithonia* Plus To Control Iron Toxicity and Reduce Commercial Fertilizer Application on New Paddy Field. *J. Trop. Soils* 17:135-142.
- [8] Liasu, M.O. and A.K.K. Achakzai. 2007. Influence of *Tithonia diversifolia* Leaf Mulch and Fertilizer Application on the Growth and Yield of Potted Tomato Plants. *American-Eurasian : J. Agric. & Environ. Science* 2(4):335-340.
- [9] Permatasari, D.A., N. Augustin, dan Widiwurjani. 2020. Pertumbuhan Bibit Pisang Cavendish (*Musa acuminata* L.) Pasca Aklimatisasi pada Berbagai Ukuran Polibag. *Prosiding Seminar Nasional Virtual*. UNIB Press Universitas Bengkulu. Hal : 39-45.
- [10] Vezina, A. 2020. Banana Leaf. <http://www.promusa.org/Banana+leaf>. [diakses 15 September 2021]
- [11] Sentana, S. 2010. Pupuk Organik, Peluang dan Kendalanya. *Prosiding Seminar Nasional Teknik Kimia “Kejuangan” Pengembangan Teknologi Kimia untuk Pengolahan Sumber Daya Alam Indonesia*. Yogyakarta.
- [12] Sparta, A., A. Rahmi, P.J. Santoso, dan I. Fitrianiingsih. 2021. The Potency of Mexican Sunflower Extract as the Replacement Of Manure and Rice Husk Charcoal in Banana Seedling. *Jurnal Agro* : Vol. 8 (1) : 40-54.
- [13] Tatsegoouck, R.N., C.A. Ewane, A. Meshunke, and T. Boudjeko. 2020. Plaintain Bananas PIF Seedlings Treatment observation parameters showed significantly different results. This is probably because the plants are only 12 weeks old so they have not shown significantly different results.
- [14] Chikuvire, T.J., Karavina, C., Parwada, C., & Maphosa, B.T. (2013). *Lantana camara* and *Tithonia diversifolia* Leaf Teas Improve the Growth and Yield of *Brassic napus*.
- [15] Fitriasari. C & Rahmayuni. 2017. Efektivitas Pemberian Urin Kelinci untuk Mengurangi Dosis Pupuk Anorganik pada Budidaya Putren Jagung Manis, *Jurnal Agrosains dan Teknologi*, Vol. 2 No. 2 (149) 141- 156 2017.
- [16] Hewitson, J. 2021. Influencing Leaf Size and Number of Leaves. *Science & Plants For School*. <https://www.saps.org.uk/saps-associates/browse-q-and-a/654-how-can-you-increase-the-leaf-size-on-fast-plants-how-can-you-increase-the-number-of-leaves-a-plant-will-grow> [diakses 25 Agustus 2021].
- [17] Munir, M. dan M.A.H. Swasono. 2012. Potensi Pupuk Hijau Organik (Daun Trambesi, Daun Paitan, Daun Lantoro) sebagai Unsur Kestabilan Kesuburan Tanah. *Jurnal Agromix*, Jilid 3 Terbitan 2.
- [18] Rodinah, F. Razie, C. Nisa, dan N. Hardarani. 2015. Efek komposisi Media Tanam dan Jenis Pupuk Daun terhadap Keberhasilan Aklimatisasi Pisang Talas (*Musa paradisiaca* Var. *Sapientum* L.). *Prosiding Seminar Nasional FKPTPI 2015*. Fakultas Pertanian, Universitas Lampung Mangkurat.
- [19] Taiwo, L.B., and J.O. Makinde. 2005. Influence of Water Extract of Mexican Sunflower (*Tithonia diversifolia*) on Growth of Cowpea (*Vigna unguiculata*). *African Journal of Biotechnology*, 4(4), 355–360. Retrieved from <http://www.academicjournals.org/AJB> [diakses 13 Juni 2021]
- [20] Aghofack-Nguemezi, J., Juvet, H., & Dzukam, C. (2016). *Impact Factor: RJIF 5.22 www.biotechjournals.com* Volume 1; Issue 5. *International Journal of Biology Research*. Retrieved from www.biotechjournals.com [diakses 13 Juni 2021]
- [21] Ewané, C.A., Mbanya, N.T., & Boudjeko, T. (2020). *Tithonia diversifolia* Leaves and Stems Use as Substrate Amendment Promote the Growth of Plantain Vivoplants in the Nursery. *Agricultural Sciences*, 11(09), 849–859. <https://doi.org/10.4236/as.2020.119054> [diakses 13 Juni 2021]
- [22] Mkindi, A.G., Y.L.B. Tembo., E.R. Mbega., A.K. Smith., I.W. Farrell, P.A. Ndakidemi, and S.R. Belmain. (2020). Extracts of Common Pesticidal Plants Increase Plant Growth and Yield in Common Bean Plants. *Plants*, 9(2), 149. <https://doi.org/10.3390/plants9020149> [diakses 13 Juni 2021].
- [23] Jama, B., Palm, C.A., Buresh, R.J., Niang, A., Gachengo, C., Nziguheba, G., & Amadalo, B. (2000). *Tithonia diversifolia* as a Green Manure for Soil Fertility Improvement in Western Kenya: A review. *Agroforestry Systems*, 49(2), 201–221. <https://doi.org/10.1023/A:1006339025728> [diakses 13 Juni 2021]