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# Effect Of The Combination of Concentration of Naphtalene Acetic Acid (NAA) and Kinetin On The Growth of Fig Plants (*Ficus carica* L.) of the Green Jordan Variety in Vitro

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**Abstract**
**Background.** The fig plant is one of the plantation commodities that experiences a decline in production every year. The cause of the decline in fig production is the low multiplication of fig plants due to less-than-optimal plant cultivation. Fig plants have high economic value, where market demand is increasing, but production of fig plants is decreasing. Therefore, efforts are needed to increase productivity, one of which is the use of in vitro propagation techniques with the addition of NAA and Kinetin growth regulators.
**Aims**. This research aims to investigate the growth response to the combination of Naphthalene Acetic Acid (NAA) and Kinetin concentrations on the growth of fig (Ficus carica L.), specifically the Green Jordan variety, in vitro.
**Methods.** This experiment was carried out at the Tissue Culture Laboratory of the Regional Technical Implementation Unit, Horticulture Seed Center, Hegarmanah, Jatinangor District, Sumedang Regency, West Java. Conducted from March to May 2024, the experiment employed a Simple Randomized Environmental Design (SRE) consisting of 5 treatment combinations, repeated 4 times, resulting in 20 experimental units. A = (0 mg L-1 NAA + 4 mg L-1 Kinetin ), B = (0.5 mg L-1 NAA +3 mg L-1 Kinetin ), C = 1 mg L-1 NAA +2 mg L-1 Kinetin, D = (1.5 mg L-1 NAA + 1 mg L-1 Kinetin ), E = (2 mg L-1 NAA + 0 mg L-1 Kinetin ), Observational data were analyzed using the F test and if there is an effect followed by Duncan's Multiple Range Test at the 5% level.
**Conclusion.** The results showed that the combination concentration (4 mg L-1 Kinetin) had a better effect on the percentage of leaves.

**Keywords:** Tin, Growth Regulator, In vitro, NAA, Kinetin.

## INTRODUCTION

Tin (*Ficus carica* L.) is a type of fruit-producing plant native to Western Asia. The name "tin" is derived from the Arabic language, which means "fig" or "fig tree." At the same time, in English it is called *fig*.. Historical literature records that figs originated in Arabia and have been cultivated for approximately 4000 years BC. Figs that taste sweet contain substances that are very important for the human body because they can reduce bad cholesterol, strengthen the heart, and normalize breathing for people with shortness of breath. Fig plants were first cultivated in Indonesia 10 years ago and are growing rapidly (Handriatni & Mariska, 2022).

Currently, fig plants in Indonesia that bear fruit are Green Jordan (GY), Purple Jordan (PY), and Brown Turkey (BT) varieties. These three varieties are tin varieties characterized by a distinctive green-yellow color. The GY variety has the advantage of growing faster than the PY and BT varieties, and its fruit tastes sweet and rich in flavor. The PY variety has larger fruits than GY and BT and is resistant to fungal diseases. (Handriatni & Mariska, 2022).

According to the Food and Agriculture Organization (FAO), in 2013, there were 52 tin-producing countries with a total production of 1,129,522 tons. This number increased by 18,684 tons from the previous year. Then, over the last two years, the fig plant has become increasingly popular among the Indonesian people. The price of figs is quite expensive in the world market, so fig plants are suitable for cultivation in Indonesia (Winarso *et al*., 2022)

The tissue culture technique is one of the vegetative propagation methods carried out by isolating plant parts that are used as explants to be grown in certain media under aseptic conditions and a controlled environment. The advantages of tissue culture include the production of seeds uniformly in a short time, the elimination of disease, and the ability to grow seeds year-round (Khazija, S, 2021).

According to Khazija S (2021), the success of plant propagation in vitro is influenced by the type of plant factor, the type of growing medium used, and the accuracy of the concentration of growth regulators given.

Growth regulators that play a role in sprout propagation in in vitro tissue cultures are auxins and cytokinins. Cytokinin growth regulators are used to stimulate plant growth and morphogenesis in tissue cultures. Types of cytokinins commonly used in tissue culture include BAP, Kinetin, Zeatine, and TDZ, all of which serve the same functions. Kinetin is a type of

cytokinin widely used for plant propagation in vitro (Putri, 2019) and *deep (Khazija*, S, 2021). According to Bonga and Durzan (1982), Kinetin is the most common cytokinin that potentially induces bud growth. Auxin, as a hormone in plants, is found in the roots, tips of stems, and flowers.

## RESEARCH METHODS

This research was conducted at the Network Culture Laboratory of the Regional Technical Implementation Unit at the Horticultural Seed Center, Hegarmanah, Jatinangor District, Sumedang Regency, West Java. The equipment used in this study includes Laminar Air Flow, autoclave, dissection tools (tweezers, knives, spatulas), culture bottle racks, cooking utensils (gas stoves, pots, mixing spoons), beaker glass, petri dishes, glass stirrers, funnels, analytical scales, hand sprayers, culture bottles, pH meters, tissues, aluminum foil, plastic wrap, rubber bands, thick plastic, label paper, rulers, stationery and mobile phone cameras. Ingredients: The plants used in this study consisted of explants of fig plants (Ficus carica L.), Murashige & Skoog (MS) medium, Growth Regulators NAA and Kinetin, agar-agar, glucose, sucrose, and distilled water. The sterilizing materials used to sterilize the appliance are Clorox, detergent, and alcohol. The research was conducted using an experimental method with a Simple Randomized Complete Block Design (SRCD) consisting of 5 treatments and repeated 4 times. The combination of NAA and Kinetin growth regulator treatments is as follows:

A: ( 0 mg $^{L-1}$ NAA + 4 mg $^{L-1}$ Kinetin )

B : ( 0.5 mg $^{L-1}$ NAA + 3 mg $^{L-1}$ Kinetin)

C : ( 1 mg $^{L-1}$ NAA + 2 mg $^{L-1}$ Kinetin )

D : ( 1.5 mg $^{L-1}$ NAA + 1 mg $^{L-1}$ Kinetin)

E: ( 2 mg $^{L-1}$ NAA + 0 mg $^{L-1}$ Kinetin )

To determine the effect of observation treatment, observations were made on the following parameters: temperature and humidity, light intensity, percentage of dead plants, percentage of contaminated plants, height of plantlets, number of leaves, number of shoots, length of roots, number of roots, and fresh weight of plantlets. The data obtained from all observation parameters were then subjected to statistical analysis, followed by the Duncan multiple comparison test at the 5% significance level.

## RESULTS AND DISCUSSION

### Temperature and Humidity

The average temperatures for March, April, and May are 23 °C, and the average air humidity for these months is around 75%. Based on this temperature and humidity, fig plants can grow well because they are in accordance with the growing conditions of the fig plant.

### Light Intensity

The average light intensity is about 75%. Based on the intensity of the light, the fig plant grows well because it is in accordance with the conditions for growing the fig plant. Percentage of Dead Plants. No plant that suffered death. Percentage of Contaminated Plants: There is one bottle of affected plants. Contamination is the condition of the culture environment that is disturbed due to the entry of fungi and bacteria (Saragih, Benny Winson, Maryanto Setyowati, Nanik, Prasetyo Nurjanah, 2019).

### Height of the plantlet

Based on Table 1, Treatment of NAA and Kinetin growth regulators on the height of fig plant plantlets at the ages of 2 MST, 4 MST, 6 MST, and 8 MST, there is a combined effect of NAA and Kinetin concentrations on plantlet height. Table 2 Combination of NAA and Kinetin growth regulator concentrations on planlet height at age 2 MST, 4 MST, 6 MST treatment 0 mg L-1 NAA + 4 mg L-1 Kinetin (A) showed better results compared to other treatments. Meanwhile, at the age of 8, MST shows different results that are not real. The results of the analysis of the effect of the combination of NAA and Kinetin concentrations are shown in Table 1.

Table 1. Treatment of NAA and Kinetin growth regulators against the height of the fig Plantlets

| Treatment | Plantlet Height (mm) | | | |
|---|---|---|---|---|
| | 2 MST | 4 MST | 6 MST | 8 MST |
| A | 1,288 b | 1,438 b | 1,518 b | 1,590 A |
| B | 1.052 ab | 1,119 ab | 1.135 A | 1,477 A |
| C | 1,070 ab | 1,145 ab | 1,179 A | 1,295 A |
| D | 1,006 to | 1,068 A | 1,068 A | 1,245 to |
| E | 1,054 AB | 1,127 AB | 1,133 A | 1,119 to |

Remarks: The average number followed by the same letter in the same column shows a statistically insignificant difference according to the Duncan Multiple Distance Test at the 5% level.

This is because kinetin is a collection of ZPT cytokinins that have an impact on growth, so an increase in kinetin can affect the plant at the cellular level. In addition, the root of the explant contains regular (endogenous) cytokinins, so that when the exogenous cytokinin ZPT is added, it will trigger an increase in cytokinin in the explant root, reaching the point of Balance and can increase plant height.

The statement supports this (Ningrum et al., 2024). The development of kinetin can result in higher levels of plants because the cytokinin content in the explants has reached a point of equilibrium. The level of the plant is associated with when the roots appear on the explant. In particular, explants that are immediately removed have a higher size. A good plant is produced by roots that absorb nutrients in their living medium, which can be used for the plant growth process and can increase the plant's level.

**Number of Buds**

Based on Table 2, the Treatment of NAA and Kinetin growth regulators on the number of shoots of figs at the ages of 2 MST, 4 MST, 6 MST, and 8 MST, there was a combined effect of NAA and Kinetin concentrations on the number of shoots. Table 2 Combination of NAA and

kinetin treatment concentrations on the number of fig buds at age 2 MST showed a combination of 2 mg $^{L-1}$ NAA + 0 mg $^{L-1}$ Kinetin concentration treatment (E) gave a significantly different response as well as at age 4 MST with a combination of treatment concentration of 2 mg $^{L-1}$ NAA + 0 mg $^{L-1}$ Kinetin (E) showed a noticeably different response. Meanwhile, at the ages of 6 MST and 8 MST, they showed different results that were not real. The results of the analysis of the effect of the combination of NAA and Kinetin concentrations are shown in Table 2.

Table 2. Treatment of NAA and Kinetin growth regulators on the number of shoots of fig plants

| Treatment | Number of Bu | | | |
|---|---|---|---|---|
| | 2 MST | 4 MST | 6 MST | 8 MST |
| A | 1,000 b | 1,056 b | 0.982 A | 0.909 A |
| B | 0.926 ab | 0.926 ab | 0.676 A | 0.676 A |
| C | 1,000 to | 1,000 ab | 0.9267 A | 0.853 A |
| D | 0.676 A | 0.780 A | 0.603 A | 0.426 A |
| E | 0.926 ab | 0.926 ab | 0.780 A | 0.780 A |

Remarks: The average number followed by the same letter in the same column shows an intangible difference according to the Duncan Multiple Distance Test at the level of 5%.

According to Ningrum et al. (2024), without the addition of growth regulators in the medium, growth is severely stunted and may not occur at all. Meanwhile, in treatment E, it is suspected to be caused by the absence of kinetin in the growing medium, which is a spurbud growth inhibitor, resulting in delayed bud growth.

This is due to cell division, enlargement, and lengthening. These cells begin to form leaves and shoots with a green color. The interaction between the growth regulators given in the medium and those produced by endogenous cells determines the direction of development of a culture. The addition of exogenous auxins and cytokinins, altering the level of endogenous growth regulators, then morphogenesis (Tabuni *et al*., 2018)

**Number of Leaves**

Based on Table 3, the Treatment of NAA and Kinetin growth regulators on the number of leaves of figs at the ages of 2 MST, 4 MST, 6 MST, and 8 MST. Table 3 The combination of treatment concentrations on the number of fig leaves at the age of 8 MST showed a combination of treatment concentrations of 0 mg $^{L-1}$ NAA + 4 mg $^{L-1}$ Kinetin (A), 0.5 mg $^{L-1}$ NAA + 3 mg $^{L-1}$ Kinetin (B) gave a noticeably different response While at age 2 MST, 4 MST and 6 MST showed different results that were not real. The results of the analysis of the effect of the combination of NAA and Kinetin concentrations are shown in Table 3.

Table 3. Treatment of NAA and Kinetin growth regulators on the number of leaves of fig plants

| Treatment — | Number of Leaves (stran | | | |
|---|---|---|---|---|
| | 2 MST | 4 MST | 6 MST | 8 MST |
| A | 1,190 to | 1,832 A | 2,563 A | 2,802 c |
| B | 0.25 A | 1,351 to | 1,672 A | 1,765 b |
| C | 0.982 A | 1,039 to | 1,159 to | 1,248 ab |
| D | 0.176 A | 0.176 A | 0.925 A | 0.963 A |
| E | 0.603 A | 0.603 A | 0.853 A | 0.926 A |

Remarks: The average number followed by the same letter in the same column shows an intangible difference according to the Duncan Multiple Distance Test at the level of 5%.

The number of leaves can be seen that the combination of NAA and kinetin concentration treatments has an effect, but no significant difference between treatments on the number of leaves at each age of the fig plant. The number of tin leaves aged 2 to 6 MST increased, but did not have a different effect between treatments. The use of cytokinins plays an important role when accompanied by auxin, which stimulates cell division in tissues derived from explants and promotes the growth of shoots and leaves (Witherell, 1982; Yuwindasari, 2010).

Growth regulators, such as auxin and cytokines, work independently; however, the two ZPTs are inactive in directing the growth and development of the explant. Cytokinins stimulate plant cell division and interact with auxins in stimulating the direction of cell differentiation. If the ratio of cytokinin concentrations is greater than that of auxin, then the growth of shoots and leaves will be stimulated over root growth. If the ratio of cytokinin and auxin is balanced, the growth of buds, leaves, and roots is balanced (Karjadi, 2007).

**Root Length**

Based on Table 4, the Treatment of NAA and Kinetin growth regulators on the root length of fig plants at the age of 8 MST. Table 4: The combination of treatment concentrations on the root length of fig plants shows significantly different results.

Table 4. Treatment of NAA and Kinetin growth regulators on the root length of fig plants

| Treatment | Root Length (mm) |
|---|---|
| | 8 MST |
| A | 0.913 b |
| B | 0.679 ab |
| C | 0.757 ab |
| D | 0.612 ab |
| E | 0.703 A |

Remarks: The average number followed by the same letter in the same column shows an intangible difference according to the Duncan Multiple Distance Test at the level of 5%.

Thing Ini because the combinationof NAA and kinetin can improve plant morphogenesis in the growth of plantlets, including the arrangement of the roots, so that the combination of the two can provide a good boost to root growth. NAA in media is a compound that can animate development calluses, strengthen cell and root development, and regulate morphogenesis. Auksin is widely used in tissue culture for inducing the array sprout, enhancing cell expansion, and suspending cells and organs. According to Bairwa and Mishra (2017), the arrangement of the roots is also affected by exogenous auxin chemicals added to the media, in addition to the arrangement being influenced by the exogenous auxin chemicals. However, there is also the influence of the plant's endogenous auxin hormone. The additional zpt concentration is customized based on the type of organ or plantette used, the tissue culture method, and the level of tissue culture. The hormones Kinetin and 2,4-D, combined in a balanced manner, can spur the morphogenesis process in the explant. Kinetin is one of the types of cytokinins that regulates morphogenesis and cell division. Media that contains higher cytokinins as compared to auxins supports bud growth and suppresses root growth (Wulannanda *et al*., 2023)

**Number of Roots**

Based on Table 5, the Treatment of NAA and Kinetin growth regulators on the root length of fig plants at the age of 8 MST. Table 5: The combination of treatment concentrations on the root length of fig plants showed significantly different results.

Table 5. Treatment of NAA and Kinetin growth regulators on the root count of the fig plant.

| Treatment | Number of Roots (strands) |
|---|---|
| | 8 MST |
| A | 1,925 c |
| B | 1.729 c |
| C | 1,488 cb |
| D | 1,450 b |
| E | 1,440 to |

Remarks: The average number followed by the same letter in the same column indicates a statistically significant difference, as determined by the Duncan Multiple Distance Test at the 5% level.

These results are thought to occur because endogenous auxins are already able to stimulate root formation in explants, and the addition of Kinetin as cytokinin at A concentration of 5 mg/L provides the best response to root growth.

According to Fauzan et al. (2021), ZPT plays a role in the development of explants. If cytokinin is lower than auxin, it will stimulate leaf formation, and vice versa if the auxin is greater than cytokinin, it will stimulate root formation.

**Fresh Weight Plantlet**

Based on Table 6, the Treatment of NAA and Kinetin growth regulators on the root length of fig plants at the age of 8 MST. Table 6: The combination of treatment concentrations on the root length of fig plants showed significantly different results.

The addition of NAA to the media causes callus cells to divide, enlarge, and increase the osmotic pressure. The more stable auxin, in addition to NAA, tends to cause the occurrence of callus growth from the explant. One of the mechanisms of action of auxin is to affect cell elongation. Auxin induces elongation in the plant sections. Cell elongation primarily occurs in the vertical direction and is accompanied by cell enlargement and an increase in wet weight (Wattimena, 1998).

Table 6. Treatment of NAA and Kinetin growth regulators against the fresh weight of fig plant

plantlets

| Treatment | Fresh Weight (g) |
|---|---|
| | 8 MST |
| A | 0.568 b |
| B | 0.6106 b |
| C | 0.483 b |
| D | 0.3845 to |
| E | 0.412 b |

Remarks: The average number followed by the same letter in the same column shows a statistically insignificant difference according to the Duncan Multiple Distance Test at a 5% significance level.

## CONCLUSION

1. The combination of the concentration of NAA and Kinetin Growth Regulators affects the growth of fig plants as indicated by the height of the plantlet, the number of shoots, the number of leaves, the length of the roots, the number of roots, and the weight of fresh.
2. Treatment with a concentration of 4 mg of $^{L-1}$ Kinetin showed the best effect on the number of leaves.

### Suggestion

It is necessary to do in vitro cultivation of Fig Plants. This can be done on the medium with the addition of 4 mg of L-1 Kinetin, and it is necessary to carry out further research until the age of the plant reaches 4 months, so that it can reach the acclimatization stage of fig plants.

## BIBLIOGRAPHY

Ai Komariah, & Romiyadi. (2022). Potato Seed Production with In *Vitro Cultivation Techniques*. CV Budi Utama.

Dewi, A. F., Sutanto, A., & Achyani, A. (2017). Effect of the composition of planting media and application of LCN (Pineapple Liquid Waste) fertilizer on the growth of fig plants (Ficus carica L.) as a source of biology learning. *Journal of Education Lanterns, Research Center of Lppm Um Metro, 2*(2), 188–200.

Dewi, A. F., Sutanto, A., & Achyani, A. (2017). Effect of the composition of planting media and application of LCN (Pineapple Liquid Waste) fertilizer on the growth of fig plants (Ficus carica L.) as a source of biology learning. *Journal of Education Lanterns, Research Center of Lppm Um Metro, 2*(2), 188–200.

George, EF, & Sherrington, PD (1984). Plant propagation by tissue culture.Handbook and Directory of Commercial Laboratories. Exegetics Limited, Egland, pp. 184–244.

Handriatni, A., & Mariska, N. (2022). The concentration of natural zpt and some varieties against the growth of tin plant cuttings in saline land. *Innofarm: Journal of Agricultural Innovation*, *24*(1),87–93.https://doi.org/10.33061/innofarm.v24i1. 6890

Handriatni, A., & Mariska, N. (2022). The concentration of natural zpt and some varieties against the growth of tin plant cuttings in saline land. *Innofarm: Journal of Agricultural Innovation*, *24*(1) 87–93. https://doi.org/10.33061/innofarm.v24i1. 6890

Khazija.S. (2021). Effect of Kinetin and NAA on the growth of pineapple plantlets (*Ananas comosus* (L) Merr) in *vitro*. Faculty of Agriculture and Animal Husbandry, Islamic University of Negri Sultan Syarif Kasim Riau. Pekanbaru. *Thesis*, *5*(L), 1– 40.

Khazija.S. (2021). Effect of Kinetin and NAA on the growth of pineapple plantlets (Ananas comosus (L) Merr) in *vitro*. Faculty of Agriculture and Animal Husbandry, Islamic University of Negri Sultan Syarif Kasim Riau. Pekanbaru *Thesis*, *5*(L), 1– 40.

Mathematics, J. I., Palestine, D. A. N. R. E. D., & Jakfar, M. (2024). *58904-Article Text- 129939-1-10-20240318*. *12*(02), 292–298.

Mathematics, J. I., Palestine, D. A. N. R. E. D., & Jakfar, M. (2024). *58904-Article Text-129939-1-10-20240318*. *12*(02), 292–298.

Ningrum, W. C., Jumadi, R., & Lailiyah, W. N. (2024). Effect of NAA and Kinetin administration on the growth of Cavendish banana explants (M*usa paradisiaca* L.) through in vitro tissue culture techniques. *Tropicrops (Indonesian Journal of Tropical Crops)*, *7*(1), 11.

Ningrum, W. C., Jumadi, R., & Lailiyah, W. N. (2024). Effect of NAA and Kinetin administration on the growth of Cavendish banana explants (M*usa paradisiaca* L.) through in vitro tissue culture techniques. *Tropicrops (Indonesian Journal of Tropical Crops)*, *7*(1), 11.

Saragih, B. W. M. S., Nanik, P. N., U. (2019). Land Optimization in the Sweet Corn Intercropping System. *Agroqua Journal*, *17*(2),115–125. https://doi.org/10.32663/ja.v

Saragih, B. W., Maryanto, S., Nanik, P., Nurjanah, U. (2019). Land Optimization in the Sweet Corn Intercropping System. *Agroqua Journal*, *17*(2),115–125. https://doi.org/10.32663/ja.v

Sukmadewi, E. (2019). Effect of Fig Fruit Extract (Ficus carica L.) As an Antioxidant for the Histopathological Picture of the Glomerulus of Mice Exposed to Rhodamine B. *Thesis*, *53*(9), 1689–1699. file:///C:/Users/user/Downloads/Docume nts/15670044_2.pdf

Sukmadewi, E. (2019). Effect of Fig Fruit Extract (Ficus carica L.) As an Antioxidant for the Histopathological Picture of the Glomerular Glomerulus of Mice Exposed to Rhodamin B. *Thesis*, *53*(9), 1689–1699. file:///C:/Users/user/Downloads/Docume nts/15670044_2.pdf

Sulichantini, E. D. (2016). The Effect of Growth Regulator Concentration on the Regeneration of Garlic (Allium sativum L) by Tissue Culture. *AGRIFOR Journal*, *15*(1), 29–36.

Tabuni, D., Polii-Mandang, J., & Tilaar, W. (2018). Use of NAA (Napthalene Acetic Acid) and Kinetin (6-furfurylaminopurine) on the Induction of White Flower Cabbage Shoots (Brassica oleracea L. var. Botrytis) in vitro (Use of NAA (Naphtalene acetic acid) and Kinetin (6-furfurylaminopurine) For In-Vitro S. *Bios Logos Journal*, *8*(2), 52. https://doi.org/10.35799/jbl.8.2.2018.233 55

Wardani, I. W. (2019). Isolation and Identification of the Endophytic Function of Fig Plants (Ficus carica L.) and Their Utilization as Non-Text Books. *Mathematics and Natural Sciences Education*.

Winarso, M. A., Suwardi, S., & Arifien, M. N. (2022). Growth Response to Various Lengths Of Tin Stem Cuttings ( Ficus carica L) With Various Other Concentrations. *National Proceedings 2022 Abdurachman Saleh Situbondo University*, 288–293.

Wulannanda, A., Anwar, S., & Kusmiyati, F. (2023). Study of the Addition of Kinetin and 2,4-D to the Growth of Tissue Cultures of Banana Plants (Musa paradisiaca L.) in the Subculture Phase. *Agrotechnics*, *6*(1), 1–12. https://doi.org/10.55043/agroteknika.v6i 1,161