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# Response Growth of Explant Organs Seed of Red Dragon Fruit (*Hylocerus polyrhizus*) On MS Media (Murashige and Skoog) by Adding Kinetin And Sucrose

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**Abstract**

Dragon fruit, also known as pitaya, is a plant that originates from Central and South America and is classified as a type of cactus. It belongs to the genus Hylocereus and the family Cactaceae. This research investigates the growth response of explant organs from red dragon fruit (*Hylocereus polyrhizus*) on Murashige and Skoog (MS) media by adding kinetin and sucrose. The study was conducted in the UPT Seed Network Plant Food Horticulture Laboratory in Riau Province, located on Kaharudin Nasution Road, Crossroads Three Sub-district, Bukit Raya District, Pekanbaru City, for 4 months. This research This Design Random Complete (RAL) Factorial consists of 2 level treatment with three repetitions. The results of the study indicate that the concentrations of Kinetin and Sucrose have a significant impact on the observed parameters. The treatment with kinetin yielded the best results for the number of shoots, shoot height, and thorns compared to the control treatment without kinetin. Specifically, the average results were 1.47 shoots, a shoot height of 1.65 cm, and 16.83 thorns in the control group. In contrast, the treatment with 5 mg/L Kinetin produced an average of 3.50 shoots, while the treatment with 2.5 mg/L Kinetin resulted in a root length of 6.88 cm. For the Sucrose treatment, the optimal concentration was found to be 60 g/L, which resulted in an average of 1.42 shoots, a shoot height of 1.18 cm, and a root length of 7.64 cm. The treatment with 40 g/L Sucrose yielded an average of 10.94 thorns and 3.69 roots. The study also revealed a significant interaction between Kinetin and Sucrose, particularly affecting the number of thorns. The treatment with 2.5 mg/L Kinetin and 40 g/L Sucrose resulted in an average of 14.22 thorns, while the combination of 2.5 mg/L Kinetin and 20 g/L Sucrose produced an average root length of 8.65 cm. These findings provide valuable insights into the effects of Kinetin and Sucrose on the growth parameters of Hylocerus Dragon Fruit (*Hylocereus polarizes*).

**Keywords:** Dragon Fruit, Kinetin, MS Media, Sucrose

## 1. Introduction

The dragon fruit is a plant that originates from Central and South America and is classified as a type of cactus. It belongs to the genus Hylocereus and the family Cactaceae. Originally from Indonesia, this plant was once used as an ornamental plant due to its unique and exotic appearance and its beautiful flowers and fruit (Rakhmadhan, 2016).

The dragon fruit plant is a tropical species that easily adapts to its environment, thriving in various weather conditions such as sunlight, wind, and rainfall (Miswan et al., 2018). In terms of morphology, this plant is classified as incomplete because it lacks true leaves, possessing only thorns, roots, stems, branches, flowers, fruits, and viable seeds (Sudarjat et al., 2018).

The cultivation of dragon fruit begins with the preparation of high-quality seeds. Using a culture network is incorrect for multiplying plant materials that can produce healthy seeds in large quantities quickly. The plant culture technique involves the multiplication of plants by growing and developing parts of the plants, which can be in the form of cells, tissues, organs, and seeds, under aseptic conditions in vitro. This technique is characterized by aseptic culture conditions, artificial culture media that contain complete nutritional content and growth-regulating substances (ZPT),

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and controlled environmental conditions, including temperature and lighting (Yasmin et al., 2018).

Murashige and Skoog (MS) medium is widely used due to its rich composition, which includes essential nutrients such as nitrate, potassium, and high ammonium levels necessary for plant growth. However, the high salt content in the medium is not always optimal for the growth and development of in vitro plantlets (Istiqhomah et al., 2019). Propagation in a culture network generally experiences obstacles, such as slow growth. Therefore, adding ZPT (plant growth regulators) is necessary; however, kinetin is not the only option. Kinetin is a type of cytokinin hormone that functions as a regulator of cell division and morphogenesis. It was first discovered by Wetherell in 1982 and is a type of cytokinin naturally produced in actively growing tissues, particularly in roots, embryos, and fruits (Yudhanto et al., 2015).

Based on a study previously conducted by Wulannanda et al. (2023), the results indicate that a Kinetin concentration of 5 mg/L significantly affects various parameters. Specifically, the treatment resulted in an average of 2.3 shoots, a shoot height of 3.6 cm, and 3.7 roots. The optimal time for shoot emergence was observed at a Kinetin concentration of 2.5 mg/L, with shoots emerging in an average of 4.2 days. Besides, the administration of kinetin in the culture network is also needed as a source of energy. The most common sugar used is sucrose. Sucrose in culture media functions as a source of energy because, generally, part plant or cultured explants are not autotrophic and have a low rate of photosynthesis(Khaerasani et al., 2017).

Sucrose play an essential role in the growth of vegetative plants, including the growth roots, leaves, and new stems. This is happen because of on time division, cell cells just needed carbohydrates in large amounts For build the walls of cells containing protoplasm And cellulose, whereas cellulose And protoplasm are arranged part big by sugar (Ernayunita et al., 2016). Based on research conducted by Ni'mah et al. (2012) on the Granola cultivar of potato, it was concluded that a combination of sucrose and kinetin affects the number of shoots and the number of nodes. The optimum treatment was 40 g/L sucrose and 5 ppm kinetin, which resulted in the highest number of shoots and nodes. This concentration is suitable for developing explant organs in red dragon fruit.

## 2. Material and Methods

Study carried out in the Laboratory Culture UPT Seed Network Plant Food Horticulture And Riau Province Plantation, CCMV + MXQ, Kaharuddin Nst Street, Marpoyan Stops, Marpoyan Damai District, Pekanbaru City, Riau 28284

This study employed a Randomized Complete Block (RCB) factorial design, focusing on the effects of kinetin and sucrose. The treatments for kinetin and sucrose each consisted of four levels, resulting in 16 combinations with three replications. Consequently, the total number of experimental units was 48, with each experimental unit (bottle) containing four explants, of which three were used as samples. Thus, a total of 192 dragon fruit explants were utilized in this study. The treatment levels for kinetin (Factor A) included four concentrations: 0 mg/L (control), 2.5 mg/L, 5 mg/L, and 7.5 mg/L. The levels for sucrose (Factor B) were as follows: 0 g/L (control), 20 g/L, 40 g/L, and 60 g/L.

The tools utilized in this study include a laminar air flow cabinet, spatula, glass measuring cylinder, glass beaker, petri dish, dropper, autoclave, analytical scales, Erlenmeyer flask, spirit lamp, hand sprayer, pH meter, knife, culture bottle, gas stove, rubber gloves, plastic containers, pan, strainer, scissors, label paper, aluminum foil, writing tools, and equipment for washing activities within the culture network study. The materials used in this study consist of dragon fruit seeds obtained from the dragon fruit itself, culture media composed of Murashige and Skoog (MS) medium, growth regulators such as kinetin, sucrose, alcohol, agar powder, sterile aquades, soap for washing, and bleach (Proclin). Additionally, supporting materials for the study are included. Reason: The revised text improves clarity, corrects grammatical errors, and enhances technical accuracy while maintaining the original meaning. The research data analysis method utilizes two applications: Microsoft Excel, which serves as the repository for unprocessed data, and R Studio, employed for data analysis. Below (Figure 1) are the stages of the study's implementation.

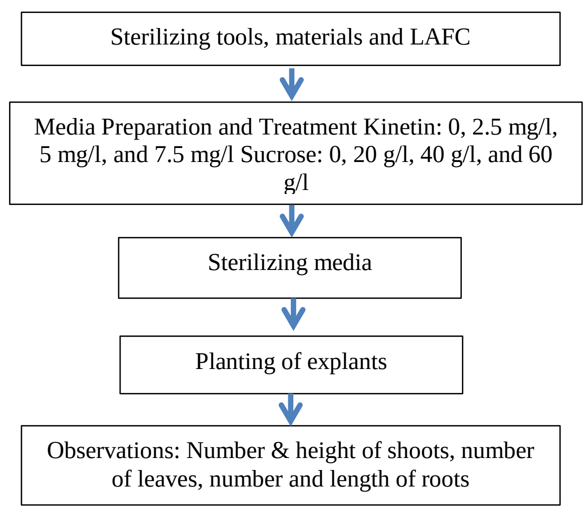


**Figure 1.** Research flw diagram

## 3. Results and Discussion

### 3.1. Number of Shoots (Fruit)

Based on the observed results regarding the parameters of the number of dragon fruit explant shoots after data analysis, it is evident that the administration of kinetin and sucrose individually significantly affects the number of dragon fruit explant shoots. However, combining kinetin and sucrose treatment does not demonstrate a significant effect.

Data presented in Table 1 indicates that the highest number of shoots occurs in the treatment without adding kinetin (0 mg/l) to the MS media, yielding an average of 1.47 shoots. The subsequent Honest Significant Differences (HSD) test results at the 5% level indicate that this treatment significantly differs from the others. This phenomenon occurs because the dragon fruit seeds already contain sufficient endogenous plant growth regulators (PGRs), allowing the growth of bean sprouts or shoots to proceed effectively. However, if the concentration of the growth regulators added is inappropriate, it may hinder growth. According to Finna et al. (2015), dragon fruit seeds possess endogenous PGRs that adequately support sprout growth. Therefore, the addition of hormones must be properly balanced to promote optimal plant growth, which was not achieved in this case.

**Table 1.** Average Number of Explant Shoots Dragon Fruit with Administration of Kinetin and Sucrose (fruit).

| Providing Kinetin | Providing Sucrose | | | | Average Kinetin |
|---|---|---|---|---|---|
| | 0 g/l | 20 g/l | 40 g/l | 60 g/l | |
| 0 mg/l | 1.22 | 1.44 | 1.44 | 1.78 | 1.47 ± 0.06 a |
| 2.5 mg/l | 1.00 | 1.00 | 1.00 | 1.67 | 1.17 ± 0.08 b |
| 5 mg/l | 1.00 | 1.00 | 1.00 | 1.22 | 1.06 ± 0.02 bc |
| 7.5 mg/l | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 ± 0.00 c |
| Average Sucrose | 1.06 ± 0.03 a | 1.11 ± 0.06 a | 1.11 ± 0.05 a | 1.42 ± 0.09 a | |
| | KK = 9.17% | | | BNJ A = 0.12 BNJ B = 1.08 | |

Note: numbers in rows and columns followed by the same lowercase letter are not significantly different according to the further significant difference test (BNJ) at the 5% level.

Results study This, If compared to the previous study by Wulannanda et al., (2023), obtained different results Where administration of 2.5 mg/l kinetin in MS media resulted in a number of shoots as many as 0.8 pieces on explanation banana goods. This shows that the administration of kinetin will produce different responses to different plant types.

The application of sucrose significantly influences the number of shoots produced. The B3 treatment, which involved a sucrose concentration of 60 g/L, resulted in the highest average number of shoots, measuring 1.42. This outcome occurs because sucrose is a source of energy and carbon essential for shoot formation (Heriansyah, 2019). In comparison, research conducted by Karimah et al. (2021) demonstrated that a sucrose concentration of 40 g/L applied to Dendrobium sp. orchids yielded an average of 3.42 shoots. Additionally, the interaction between kinetin and sucrose did not significantly affect the number of shoots produced from dragon fruit explants.

Kinetin is a cytokinin hormone that can stimulate the formation of shoots. According to Mustikawaty et al. (2021), this substance acts as a growth regulator in tissue culture, promoting cell division and shoot formation. Meanwhile, sucrose plays a crucial role as an energy supplier for forming new shoots. According to Kalve et al. (2014), sucrose is an energy source and a carbon framework for cells.

### 3.2. Shoot height (cm)

Based on the observed results regarding the height of dragon fruit explant shoots, data analysis indicates that kinetin treatment and sucrose significantly affect shoot height. However, the interaction between kinetin and sucrose does not significantly impact the height of dragon fruit explant shoots. The results of the observations can be seen in Table 2.

**Table 2.** Average Explant Shoot Height Dragon Fruit with administration of Kinetin and Sucrose (cm)

| Giving Kinetin | Giving Sucrose | | | | Average Kinetin |
|---|---|---|---|---|---|
| | 0 g/l | 20 g/l | 40 g/l | 60 g/l | |
| 0 mg/l | 1.16 | 1.54 | 1.64 | 2.27 | 1.65 ± 0.11 a |
| 2.5 mg/l | 0.33 | 0.54 | 1.02 | 1.23 | 0.78 ± 0.10b |
| 5 mg/l | 0.30 | 0.62 | 0.70 | 0.83 | 0.61 ± 0.05 c |
| 7.5 mg/l | 0.33 | 0.63 | 0.36 | 0.38 | 0.43 ± 0.03 d |
| Average Sucrose | 0.53 ± 0.10 a | 0.84 ± 0.11 a | 0.93 ± 0.13 a | 1.18 ± 0.20 a | |
| KK = 3.13 % BNJ A = 0.37 BNJ B = 1.08 BNJ AB = 0.8 | | | | | |

Note: numbers in rows and columns followed by the same lowercase letter not significantly different according to the further significant difference test (BNJ) at the 5% level.

Data presented in Table 2 indicates that treatment without administering kinetin (0 mg/L MS medium) resulted in the highest average shoot height of 1.65 cm. The follow-up test results, which employed the Honestly Significant Difference (HSD) method at the 5% level, indicate that the treatment without kinetin administration significantly differed from the other treatments. This phenomenon occurs because the nutrients in the MS medium are already sufficient for the optimal growth of explant shoots, allowing the plants to develop effectively even without the addition of kinetin. In fact, a decline in shoot height was observed as the concentration of kinetin increased. This finding aligns with the statement by Heriansyah (2019), who noted that high concentrations of kinetin can inhibit shoot development. In contrast, research conducted by Praseptiana et al. (2017) yielded different results, where the administration of kinetin at a concentration of 2.5 mg/L produced an average shoot height of 2.40 cm in sugarcane shoots (Saccharum officinarum L.). This discrepancy can be attributed to the different plant species being cultured, which results in varying responses to kinetin concentrations.

Based on data in Table 2, sucrose, which produces the best shoot height, was obtained by adding 60 g/l MS medium with a height of 1.18 cm. The higher the concentration of sucrose, the height of the shoots will increase. Compared to the results study Fatonah et al., (2016), sucrose with treatment as much as 60 g/l on MS media produces shoots with a height 3.80 cm against the explanation orange Siamese. Interaction administration of kinetin and sucrose: tall shoots have no real influence on explaining dragon fruit.

### 3.3. Amount Thorn (Fruit)

Based on the observed results against the parameters regarding the number of thorns on dragon fruit, data analysis indicates that the administration of kinetin and sucrose significantly influences the number of thorns. Additionally, the interaction between kinetin and sucrose also has a notable effect on the number of thorns on dragon fruit. The results of the tests can be seen in Table 3. Data in Table 3 shows that the treatment with the highest number of thorns occurred in the group that did not receive kinetin, with an average of 16.83 thorns. The results of the follow-up test, which employed the Honestly Significant Difference (HSD) method at the 5% level, indicate that the treatment without kinetin is significantly different from the treatments with 2.5 mg/l, 5 mg/l, and 7.5 mg/l of kinetin. This difference occurs because kinetin functions optimally when its concentration is not excessive and aligns with the plant's needs. An increase in the number of thorns may decline if the concentration of kinetin is inappropriate. According to Wahidah (2011), an incorrect concentration of kinetin can negatively impact organ formation. In contrast, a previous study conducted in 2015 on the Semar pocket plant yielded different results, showing that the administration of 2.5 mg/l of kinetin resulted in an average of 17.7 leaves after 10 MST.

Data presented in Table 3 indicates that the highest amount of thorns, averaging 10.94 pieces, was obtained with a sucrose concentration of 40 g/L in MS media. The treatment with 40 g/L of sucrose did not show a significant difference compared to those with 20 g/L and 60 g/L. However, there was a significant difference compared to the control group, which contained 0 g/L of sucrose. This difference occurs because sucrose serves as a source of energy and carbon, essential for forming leaves and thorns. This finding aligns with the statement by Inda Hidayati Rachmani et al. (2021), who noted that the application of sucrose influences developmental processes, as it provides the necessary energy and carbon.

Compared to research conducted on plant tacca leontopetaloides by Hapsari et al., (2015), adding sucrose with a concentration of 40 g/l produces amount of leaf as many as 2.04 pieces on 8 weeks old.

**Table 3.** Average Amount Thorns Explanation Dragon Fruit with administration of kinetin and sucrose ( fruit )

| Giving Kinetin | Giving Sucrose | | | | Average kinetin |
|---|---|---|---|---|---|
| | 0 g/l | 20 g/l | 40 g/l | 60 g/l | |
| 0 mg/l | 11.56 cd | 18.22 b | 16.89 ab | 20.67 a | 16.83 + 0.96 a |
| 2.5 mg/l | 10.67 de | 11.11 d | 14.22 c | 8.67 e | 11.17 + 0.57 b |
| 5 mg/l | 4.67 f | 8.67 e | 8.67 e | 5.56 f | 6.89 ± 0.52 c |
| 7.5 mg/l | 4.22 f | 3.33 f | 4.00 f | 4.89 f | 4.11 ± 0.16 d |
| Average Sucrose | 7.78 ± 0.96b | 10.33 ± 1.54 a | 10.94 ± 1.43a | 9.94 ± 1.83a | |
| KK = 9.03 % BNJ A = 0.96 BNJ B = 1.08 BNJ AB = 2.63 | | | | | |

Note: numbers in rows and columns followed by the same lowercase letter are not significantly different according to the further significant difference test (BNJ) at the 5% level.

### 3.4. Amount Root (Fruit)

Based on the observation results regarding the root biomass of dragon fruit, data analysis indicates that the application of kinetin treatment and sucrose, when administered individually, significantly affects root biomass. However, the interaction between kinetin and sucrose does not significantly impact the root biomass of dragon fruit. Data presented in Table 4 indicates that administering kinetin at a concentration of 5 mg/l in MS media resulted in an average of 3.50 roots. The results of the subsequent Honest Significant Differences (HSD) test at the 5% significance level reveal that the 5 mg/l treatment does not significantly differ from the 2.5 mg/l treatment but does show a significant difference when compared to the 0 mg/l and 7.5 mg/l treatments. This occurs because applying an appropriate concentration of kinetin positively influences root growth. According to Praseptiana et al. (2017), kinetin, as a cytokinin hormone, promotes shoot development and affects root development at suitable concentrations.

Compared to other research conducted to plant Banana goods by Wulannanda et al. (2023), giving a kinetin concentration of 5 mg/l produces an amount root as many as 3.7 pieces.

**Table 4.** Average Amount Root Explanation Dragon Fruit with administration of kinetin and sucrose

| Giving Kinetin | Giving Sucrose | | | | Average Kinetin |
|---|---|---|---|---|---|
| | 0 g/l | 20 g/l | 40 g/l | 60 g/l | |
| 0 mg/l | 2.00 | 4.44 | 3.00 | 3.00 | 3.11 + 0.25 b |
| 2.5 mg/l | 3.67 | 3.44 | 4.11 | 2.67 | 3.47 + 0.15 a |
| 5 mg/l | 2.56 | 3.56 | 4.22 | 3.67 | 3.50 + 0.17 a |
| 7.5 mg/l | 2.33 | 2.22 | 3.44 | 3.22 | 2.81 + 0.15 c |
| Average Sucrose | 2.64 + 0.18 b | 3.42 + 0.22 ab | 3.69 + 0.14 a | 3.14 + 0.10 ab | |
| KK = 7.76 % BNJ A = 0.27 BNJ B = 1.08 BNJ AB = 0.75 | | | | | |

Note: numbers in rows and columns followed by the same lowercase letter not significantly different according to the further significant difference test (BNJ) at the 5% level.

Applying 40 g/L sucrose in MS media yielded an average of 3.69 roots. This treatment significantly differed from the control group, which received no sucrose (0 g/L). The presence of sucrose is crucial as it provides the energy necessary for vegetative plant growth. In contrast, the absence of sucrose leads to reduced root formation due to a lack of energy and carbon required for root development. According to Wijayanti et al. (2015), adding sucrose accelerates the growth of explants in the media and facilitates the uptake of essential nutrients for growth and development. When compared to previous research by Aulia Nurul et al. (2023), which demonstrated that a sucrose concentration of 40 g/L produced an average of 6.40 roots in potato plants, it is evident that the interaction between kinetin and sucrose does not significantly influence the number of roots in dragon fruit explants.

### 3.5. Length Root (cm)

Based on observation of length root explanation fruit dragon after done data analysis shows that the administration of kinetin and sucrose in a way single influential real to long root explanation fruit dragon, and interaction between both of them Also show results influential real. Data presented in Table 5 indicate that administering kinetin at a concentration of 2.5 mg/L in MS media resulted in the longest root length, measuring 6.88 cm. The honestly significant difference (HSD) test results at the 5% level show that the administration of 2.5 mg/L kinetin did not differ significantly from the treatments of 5 mg/L and the control group without kinetin. However, it did differ significantly from the treatment with 7.5 mg/L kinetin. This phenomenon occurs because kinetin must work synergistically with the auxin hormone (Mahadi, 2016). Consequently, its effect on rooting is not significantly different from that of the control group (A0, without kinetin). However, if a higher concentration is used, it may slightly hinder root elongation. In comparison, the study by Kadafi et al. (2023) on Siamese orange demonstrated that the administration of kinetin at a concentration of 3 ppm produced the longest root length, measuring 14.92 cm.

The sucrose application at a concentration of 60 g/L in MS medium resulted in the longest root length, measuring 7.64 cm. The follow-up test results, which employed the Honestly Significant Difference (HSD) method at the 5% significance level, indicate that the administration of 60 g/L sucrose significantly differed from the other two treatments, except for the treatment with 40 g/L sucrose. This effect occurs because sucrose plays a crucial role in cell differentiation in roots; thus, providing sucrose at a specific concentration can promote cell enlargement in the roots. The result of this study is compared to research conducted by Karimah et al. (2021) to explain the orchid Debdrobium sp, which shows that giving a concentration of sucrose as much as 40 g/l indicates an average length value root highest that is by 2.39 cm.

**Table 5.** Average Long Root Explanation Dragon Fruit with kinetin and sucrose (cm) administration.

| Giving Kinetin | Factor B Sucrose | | | | Average A |
|---|---|---|---|---|---|
| | B0 | B1 | B2 | B3 | |
| 0 mg/l | 2.70 d | 5.94 c | 6.22 bc | 8.67 a | 5.88 + 0.61 a |
| 2.5 mg/l | 3.67 d | 8.56 a | 7.17 b | 8.11 a | 6.88 + 0.55 a |
| 5 mg/l | 1.41 e | 5.44 c | 8.44 a | 6.89 b | 5.55 + 0.75 a |
| 7.5 mg/l | 1.63 e | 4.44 cd | 6.33 bc | 6.89 b | 4.83 + 0.59 b |
| Average Sucrose | 2.35 + 0.26c | 6.10 + 0.44 b | 7.04 + 0.26ab | 7.64 + 0.22a | |
| KK = 5.99% BNJ A = 0.38 BNJ B = 1.08 BNJ AB = 1.03 | | | | | |

Note: numbers in rows and columns followed by the same lowercase letter not significantly different according to the further significant difference test (BNJ) at the 5% level.

The interaction between kinetin and sucrose significantly influences root elongation, with the optimal treatment observed at 2.5 mg/L of kinetin and 20 g/L of sucrose, resulting in a root length of 8.65 cm. This effect occurs because kinetin, a cytokinin hormone, stimulates cell division and promotes vegetative growth. Additionally, sucrose serves as a vital energy source, facilitating root elongation.

The results of this study, when compared to the research conducted by Heriansyah (2019), demonstrate that the interaction between sucrose and kinetin significantly affects the percentage of root formation in the orchid plant Dendrobium sp. The optimal treatment was 50 g per liter of sucrose and 1.0 ppm of kinetin.

## 4. Conclusion

The application of various concentrations of kinetin and sucrose significantly influenced the observed parameters. The treatment with 0 mg/l of kinetin (control) resulted in an average of 1.47 shoots, a shoot height of 1.65 cm, and an average of 16.83 thorns. In contrast, the optimal root development was observed at a kinetin concentration of 5 mg/l, yielding an average of 3.50 roots, while the longest roots, measuring 6.88 cm, were achieved with the administration of 2.5 mg/l of kinetin.

Providing sucrose at a concentration of 60 g/L resulted in the highest number of shoots, specifically 1.42 shoots, a shoot height of 1.18 cm, and a root length of 7.64 cm. In contrast, with a sucrose concentration of 40 g/L in MS medium, there were 10.94 thorns and 3.69 roots. The interaction between kinetin and sucrose significantly influenced the production of 14.22 thorns and a root length of 8.65 cm.

Based on a study of dragon fruit, it is recommended to use a higher concentration of kinetin. However, further research is needed to explore the use of auxins and cytokinins for optimal root and stem growth. For sucrose concentration, a recommended level is 40 g/L, which serves as a source of energy and carbon. Nevertheless, additional studies are required to investigate the effects of higher sucrose concentrations on the growth of dragon fruit seeds in MS media.

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