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# Effect Of Different Light Conditions On The Growth Of Potato (*Solanum Tuberosum* L.) Variety Granola L. In Vitro

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**Abstract**

Potatoes are crops that have economic value and are rich in benefits because they contain good and relatively beneficial substances. In producing of the Granola L potato variety, tissue culture propagation is used. Many factors affect the growth and development of potato plants, one of which is light. Light is needed by plants to perform photosynthesis, and the photosynthate will be distributed to all parts of the plant through the transport network. The purpose of this research is to see the effect of various light conditions on the growth of Granola L potato explants. The design used is a Completely Randomized Block Design with variance analysis and further testing using Duncan's Multiple Range Test. The treatments used are neon light (1000 lux) (A), room light (250 lux) (B), and no light (C). The variables observed were the number of living explants, plant height, number of leaves, and root length. Observations showed that the number of living explants is strongly influenced by the planting media and the environment, which must be sterile. For the variables of plant height and root length, the highest data were shown by treatment C compared to treatments A and B. This is because the explants experienced etiolation, leading to stem and root elongation. For the number of leaves, the highest data were shown by treatment A, followed by treatment B, and the lowest by treatment C. Therefore, for good growth, Granola L potato explants require light.

Keywords: crop, economic, growth, light, photosynthesis.

## 1. Introduction

Potatoes (Solanum tuberosum L.) are tuber plants from the Solanaceae family with significant economic value worldwide. Potatoes play an important role in the food chain as they are a good and relatively cheap source of carbohydrates, vitamins, minerals, and proteins. aThey have many advantages both for daily consumption and industrial purposes (Hoque, 2010). Superior potato varieties are those that have undergone genetic selection and have proven to have several advantages such as high yield levels, disease resistance, good taste, or other desirable traits. The Granola potato variety is a variety widely developed in Indonesia (Sambeka, 2016). Granola varieties, when developed in highlands, will morphologically produce flowers (Oping, 2022). In addition, the production of Granola potato varieties is influenced by the altitude (Mailangkay et al., 2022). Potato plants generally grow well when planted in highlands of 1,500 meters above sea level (masl) to 3000 masl.

Tissue culture is a biological technique that involves growing biological cells or tissues in a controlled environment outside the parent organism. Potatoes can be propagated generatively using seeds and vegetatively with tubers. However, these propagation methods have disadvantages such as low propagation rates and a high risk of various diseases (Mohapatra and Batra, 2017). Tissue culture techniques can be an alternative method for vegetative propagation of plants with the advantage of having a very fast propagation rate in a relatively short time (Mohapatra and Batra, 2017). The development of tissue culture techniques has become the basis for high-quality, disease-free plants on a mass scale, especially in vegetatively propagated plants (Kaur et al., 2015).

Factors affecting plant growth include internal and external factors. Internal factors involve aspects within the plant body such as genetic factors and hormones. On the other hand, external factors are related to influences from the environment around the plant. External factors affecting growth include light, nutrients, water, humidity, and temperature (Mustika Ningsih, 2019). Light is a significant factor in the photosynthesis process of plants. Photosynthesis is an important process in plants that converts solar energy into chemical energy stored in organic compounds. Plants need sunlight as an energy source to carry out two stages of reactions in photosynthesis. The first stage is the light reaction or light-dependent reaction (LDR) that occurs in the thylakoid, while the second stage is the Calvin cycle or light-independent reaction (LIR) that takes place in the stroma (Yustiningsih, 2019). Therefore, this study aims to observe the growth response of potatoes (Solanum tuberosum L.) Granola L variety explants in vitro to different light conditions.

## 2. Materials and Methods

### A. Time and Place

The research was conducted from January to March 2024 in the Tissue Culture Laboratory of the Potato Seed Institute Kayu Aro, Kerinci Regency, Jambi Province.

### B. Tools and Materials

The materials used are potato planlets of Granola L. variety, jelly powder, ½ MS instant (Phytotech Lab) culture planting medium and the tools used are culture bottles, rubber bands, plastic bottle caps, petridish, culture scissors, tweezers, tissue, 96% alcohol, Bunsen, matches, Air Conditioner (AC),spatula, detergent, betadine, bayclin, autoclave, gloves, HCL 1N, NaOH 1N, Cardboard and paper glue.

### C. Work Procedures

This research was carried out through several stages, namely sterilisation of tools and materials, making media, and subculture of potato plants Granola L.

### D. Sterilisation of tools and materials

Tools are sterilised by soaking the bottle in water containing detergent and bayclin for 1 hour. The bottles were then rinsed using running water, arranged in a cage, then put into an autoclave and sterilised for 1 hour at 121°C with a pressure of 1 atm. The sterile bottles were put into plastic that had been sprayed with 70% alcohol. Then tied with rubber and arranged neatly.

### E. Media Creation

The step of making planting media is by weighing the petridish cup first after which a little jelly powder is added until it weighs 7 grams and MS weighs 4.43 grams on a petridish cup. After the ingredients were weighed, theywere mixed into a 1 L measuring cup and added with 0.75 L distilled water and then checked the pH level with the right pH of 5. After mixing and stirring all the ingredients are put into a panic and immediately cooked using a gas stove over medium heat. Stir continuously and evenly until boiling. After boiling, it is put into a 2 L measuring cup. Then poured into a culture bottle that has been neatly arranged on a push rack. Followed by closing the culture bottle with plastic tied with rubber. All planting media were sterilised using an autoclave. After being sterilised, all planting media were transferred to a sterile room and left for approximately 3 days. If there is no contamination, then the planting media is ready for use.

### F. Subculture of Potato Explants

Sterilise the explants by separating or cutting the explants if there is media that is still attached and cutting dead or blackened explants using a scalpel that was previously burned and put in a solution of sterile water and betadine. Prepare the media to be used. When the

media is opened, the mouth of the media bottle is burned using a bunsen flame. Discarding the liquid contained in the bottle first if there is liquid in the bottle. Ensuring the mouth of the media bottle is sterile so that bacteria and microbes do not fall into the media. Next is to insert the explants into the media. Each culture bottle contains 3 explants. When the media is filled, burn the mouth of the bottle again to ensure that the culture bottle remains sterile, then close the media and give rubber until tight, this is done repeatedly until the subculture explants run out.

**G. Treatment**

The experiment consisted of three light-intensity treatments: (A) fluorescent light (1000 lux), (B) room light (250 lux), and (C) no light. Each treatment consisted of 3 replicates and each replicate consisted of 20 samples. The treatment was given when the explants were 1 week after planting.

**H. Observation**

The observed variables consisted of the number of living explants, plant height, number of leaves, and root length.

## Data Analysis

The data analysis method used is an analysis of variance; if a significant effect is found, further testing will be conducted using Duncan's Multiple Range Test at the 5% level.

## 3. Results and Discussion

**Research Results**

The results of the analysis of variance showed that the treatment had a significant effect on the variables of plant height, number of leaves, and root length. However, the treatment did not significantly affect the variable number of living explants (Table 1). In Table 2, it can be seen that the highest variable number of living explants is shown by treatment A, which is 70%, while the lowest number of living explants is treatment C, which is 60%. In the treatment of plant height, the highest plant was shown by treatment C which was 7.20 cm while the lowest was treatment B which was 3.15 cm. The highest number of leaves was shown by treatment A which was 9 leaves and the least number of leaves was found in treatment C which was 1.22 leaves. In the root length treatment, the longest number of roots was found in treatment C which was 5.4 cm while the shortest root length was found in treatment B which was 3.2 cm.

Table 1. The calculated F value in the analysis of variance for all observed variables.

| No | Variabel | F value |
|---|---|---|
| 1 | Number of Living Explants (%) | 2,96 ns |
| 2 | Plant Height (cm) | 7,45 * |
| 3 | Number of leaves (leaflet) | 6,22 * |
| 4 | Root length (cm) | 9,23 * |

*Explanation: * = significant effect at the 5% level, ns = not significant at the 5% level, F table value at 5% = 5,14*

Table 2. Performance of explanatory variables of Granola L. potato.

| Treatment | Variables | | | |
|---|---|---|---|---|
| | Number of Living Explants (%) | Plant Height (cm) | Number of leaves (leaflet) | Root length (cm) |
| A | 70 | 3,41 b | 9,00 a | 3,5 b |
| B | 65 | 3,15 b | 7,44 ab | 3,2 b |
| C | 60 | 7,20 a | 1,22 b | 5,4 a |

*Explanation : A = neon light (1000 lux), B= room light (250 lux), C= no light.*

**Discussion**

**Number of living explants (%)**

The success of tissue culture techniques depends on many factors, including explants, media, and the physical environment of the culture. Table 1 shows that the variable "Number of living explants" was not significantly affected by light intensity treatment. However, as seen in Table 2, treatment A showed the highest percentage of living explants at 70%, compared to treatments B and C, which had 65% and 60%, respectively. This difference in the percentage of living explants is due to bacterial contamination. Bacterial contamination can be characterized by the presence of

yellow and brownish bacterial colonies that can make the explants wet or slimy. Karjady and Buchory (2007) explained that contamination can be caused by internal and external factors. Internal factors are due to microorganisms living within the tissues, while external factors are due to non-sterile media conditions, an unsupportive environment, and improper techniques (Zulkarnain, 2009; Fitriyani et al., 2014).

**Plant Height (cm)**

Plant height is one of the factors in the response of plant growth. According to Sitompul and Bambang (1995), plant height is a measurement often observed both as an indicator of growth and as a parameter used to assess the impact of the environment or treatment applied. Table 2 shows that the highest plant height is found in treatment C compared to treatments A and B, which is without light. This occurs because the plants experience etiolation. Etiolation can occur because seedlings do not get enough sunlight during their growth period. Etiolation is a condition that occurs in plant seedlings that grow taller or elongated with stems and leaves that appear somewhat pale and exhibit symptoms of disproportionate growth (Djoemairi, 2008). Lack of sunlight can cause plants to grow abnormally, namely elongated (etiolation), thin, weak, and pale (Mukaromah, et al., 2019). According to Sudomo (2009), light intensity that is too high or too low can inhibit plant growth because it affects the performance of leaf stomata cells in the transport process. Therefore, although treatment C shows the highest plant height, the best plant height variable is shown in treatment A, which is 3.41 cm (Table 2).

**Number of Leaves (leaflet)**

The leaf is the site of photosynthetic activity in plants. The result of the photosynthesis process is photosynthate (CnH12 ON), which will convert carbohydrates into proteins, proteins into fats, and some vitamins and minerals will be translocated to all parts of the plant. In this experiment, taller plants were not accompanied by an increase in the number of leaves. This is because, under treatment C, the growth was abnormal due to etiolation. Etiolation caused the explants to be slow in forming leaves because the explant stems continued to elongate, resulting in abnormal growth. In the absence of light, auxin stimulates cell elongation, causing them to grow longer. In contrast, under treatments A and B, with the presence of light, auxin is degraded, resulting in normal plant growth.

**Root Length (cm)**

In the observation results of Table 1, it is shown that treatment C exhibits higher values compared to treatments A and B. This is due to differences in auxin hormone activity in each plant, influenced by light conditions. Hormones as growth regulators are organic molecules produced by a part of the plant and transported to other affected parts. In plants, hormones are integral to the regulation of growth and development. Several hormones known in plants include auxin, cytokinin, gibberellin, abscisic acid, ethylene, and traumalin acid (Debitama et al., 2022). The hormone responsible for root elongation is auxin. According to Khairuna (2019), auxin hormone exerts physiological effects on plants, including cell enlargement, abscission, inhibition of lateral buds, root growth, and activity rather than cambium. Auxin hormone does not function optimally under direct sunlight. This can be evidenced by plants that exhibit significantly faster growth in darkness compared to those exposed to sunlight (Mahardika et al., 2023).

## 4. Conclusions

From the results of this study, it can be concluded that differences in light conditions significantly influence the growth of potato explants of the Granola L variety. The darker the light conditions, the explants grow imperfectly and can even grow abnormally (etiolation). The variable data indicate that explants treated with neon light (1000 lux) and room light (250 lux) are better than those without light, especially in terms of the number of living explants and the number of leaves variables.

## 5. Acknowledgments

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