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RESPONSES OF POTATO PLANTLETS TO GROWING MEDIA AND MS CONCENTRATIONS DURING ACCLIMATIZATION

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ABSTRACT

Potato plantlet acclimatization is a critical stage that determines plant survival and growth after transfer from in vitro to ex vitro conditions. The selection of suitable growing media and nutrient supply is important to support plantlet adaptation and development during this stage. This study aimed to evaluate the growth responses of potato plantlets to different growing media and Murashige and Skoog (MS) medium concentrations during acclimatization. The experiment was conducted at the Agroecology Laboratory, Faculty of Agriculture, Universitas Sultan Ageng Tirtayasa, from December 2025 to February 2026. A split-plot design was used with two factors. The main plot consisted of growing media, namely rice husk charcoal, cocopeat, and perlite, while the subplot consisted of MS medium concentrations of 0, ¼, ½, and 1 MS. Each treatment was replicated three times. Growth observations included plant height increment, number of leaves, and number of shoots. Data were analyzed using analysis of variance followed by Duncan's Multiple Range Test at the 5% level when required. Cocopeat produced the highest plant height increment at 6 weeks after transplanting, reaching 1.78 cm. Plantlets supplied with 1 MS medium concentration produced the highest number of leaves at 3 weeks after transplanting, with 2.60 leaves, and the highest number of shoots at 5 weeks after transplanting, with 0.56 shoots. The results indicate that plantlet growth during acclimatization was influenced by both the physical properties of the growing media and nutrient availability. The use of cocopeat and an adequate MS medium concentration can therefore be considered to support potato plantlet growth and improve acclimatization performance under ex vitro conditions.

Key words: Acclimatization, MS medium concentration, Planting media type, Potato.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an important horticultural crop and one of the major sources of carbohydrates worldwide. In Indonesia, potatoes are widely utilized as an alternative food source and industrial raw material, resulting in increasing demand for high-quality planting materials. However, potato production in Indonesia fluctuated during 2018–2022, partly due to the limited availability of certified and high-quality seed tubers (BPS and Directorate General of Horticulture, 2023).

Through in vitro propagation, superior seedlings can be produced rapidly using limited space and resources. Nevertheless, the success of tissue culture propagation largely depends on the acclimatization stage, which represents the transition of plantlets from controlled in vitro conditions to the external environment. During acclimatization, plantlets undergo physiological and morphological adjustments, making this stage highly critical for plant survival and subsequent growth (Isnaini *et al*., 2021).

The success of acclimatization is influenced by several factors, including growing media, nutrient availability, and environmental conditions. An appropriate growing medium should provide adequate water retention, aeration, and drainage while remaining free from pathogens (Sandra, 2019). Rice husk charcoal has been reported to improve plant survival, plant height, leaf number, shoot length, and stem diameter due to its favorable physical characteristics (Saniya, 2024). Cocopeat is commonly used because of its high water-holding capacity, whereas perlite enhances substrate porosity and root aeration. In addition to the physical properties of growing media, nutrient supplementation is essential to support plantlet growth during acclimatization. Murashige and Skoog (MS) medium contains essential macro- and micronutrients required for plant development. Previous studies demonstrated that diluted MS medium can enhance acclimatization performance.

Several studies have evaluated the effects of growing media or nutrient supplementation on the acclimatization of tissue-cultured plants. However, most of these studies focused on ornamental species or investigated individual factors separately. Information regarding the combined effects of different growing media and MS medium concentrations on the acclimatization of potato plantlets remains limited. Furthermore, studies specifically addressing Granola potato plantlets under tropical lowland conditions are still scarce. Consequently, the optimal combination of growing medium and nutrient concentration for improving acclimatization success and growth performance of Granola potato plantlets has not yet been clearly established.

MATERIALS AND METHODS

This study was conducted at the Agroecology Laboratory of the Department of Agroecotechnology, Faculty of Agriculture, Sultan Ageng Tirtayasa University, from December 2025 to February 2026. The main materials used were Granola potato plantlets produced via tissue culture, rice husk charcoal, cocopeat, perlite, and MS medium. The equipment used included a mini greenhouse, seedling trays, a hand sprayer, measuring cups, an analytical balance, and other equipment necessary for acclimatization.

The plantlets were acclimatized in a medium consisting of rice husk charcoal, cocopeat, and perlite under a mini greenhouse. A total of 36 experimental units were used, with 3 plantlets per unit, resulting in 108 plants. MS solutions were prepared at concentrations of 0, ¼, ½, and 1 MS. A split-plot design was used with two factors. The main plot consisted of growing media (M), namely rice husk charcoal (M1), cocopeat (M2), and perlite (M3), while the subplot consisted of MS medium concentrations (N) of 0 MS (N0), ¼ MS (N1), ½ MS (N2), and 1 MS (N3).

The experiment was initiated by weighing the planting media for each experimental unit, which consisted of three cells in a seedling tray. The amounts of media used were 25.14 g^1 of perlite, 11.50 g^1 of rice husk charcoal, and 17.01 g^1 of cocopeat per experimental unit. A mini greenhouse and plastic cover were then prepared using a basket measuring 47 × 35 × 16 cm.

Subsequently, the plantlets and planting media were sterilized prior to planting. Plantlets with an initial height of approximately 3 cm were transplanted into the acclimatization media and maintained under a plastic cover for six weeks. During the acclimatization period, MS nutrient solution was applied by foliar spraying once a week during the acclimatization period. Approximately five sprays (≈2 mL plant^{-1}) were applied to each plantlet until the leaf and stem surfaces were evenly wetted.

The observed variables were plant height increment, leaf number, and shoot number. Plant height increment rate were assessed at 6 weeks after acclimatization (WAA), leaf number rate were assessed at 3 and 4 weeks after acclimatization (WAA). Shoot number was evaluated 5 WAA.

Data were analyzed using Analysis of Variance (ANOVA). Data that did not meet ANOVA assumptions were transformed using $\sqrt{x + 0.5}$. When significant treatment effects were detected, mean comparisons were performed using Duncan's Multiple Range Test (DMRT) at the 5% significance level.

RESULT AND DISCUSSION

Plant height increase

Plant height is one of the growth parameters commonly used to evaluate plant development. According to Ningsih *et al*. (2024), the increase in plant height occurs as a result of cell division activity in the apical meristem, known as primary growth. The division of primary meristematic cells causes stem elongation, leading to an increase in plant height. This growth is irreversible, meaning that it cannot return to its original state. The analysis of variance (ANOVA) for potato plant height increment revealed that the planting media treatment had a significant effect on plant height increment at 6 weeks after acclimatization (WAA). In contrast, the MS medium concentration treatment and the interaction between planting media and MS medium concentration did not show significant effects.

Based on the mean values presented in Figure 1, the cocopeat growing medium exhibited a highly significant effect on the height increment of potato plants during the acclimatization phase at 6 weeks after acclimatization (WAA), with the highest average increase of 1.78 cm. According to Wulandari & Widyawati (2023), cocopeat possesses numerous pores that facilitate better air circulation and sunlight penetration, as well as a high degree of porosity that promotes root development. In addition, cocopeat contains essential nutrients, particularly nitrogen (N) and phosphorus (P), has a high water-holding capacity, and exhibits a greater cation exchange capacity than rice husk charcoal and perlite. These characteristics contribute to enhanced potato plant height growth during the acclimatization stage.

Growth in leaf number

Leaf number was first recorded at 3 weeks after acclimatization (WAA) by counting newly emerged leaves at weekly intervals. Based on the mean values presented in Figure 4, the MS medium concentration treatment had a significant effect on leaf number at 3 WAP. The highest mean leaf number (2.60 leaves per plant) was obtained from the full-strength MS (1×

MS) treatment. These results indicate that full-strength MS medium provides an optimal nutrient concentration for leaf development during the acclimatization stage. Adequate availability of essential nutrients, particularly nitrogen (N), phosphorus (P), and magnesium (Mg), supports chlorophyll synthesis and photosynthetic activity, thereby promoting plant growth and the formation of new organs.

This finding is consistent with the results reported by Rahmawaty *et al*. (2021), who stated that sufficient nutrient availability enhances cell division and cell elongation, leading to an increase in leaf production. Furthermore, foliar nutrient application is considered effective because nutrients can be readily absorbed by plants, thereby improving overall plant growth, including leaf development.

The number of leaves was significantly affected by MS concentration, whereas growing media and the interaction between growing media and MS concentration showed no significant effects. This result indicates that nutrient availability supplied by the MS solution played a more important role in leaf development than the physical characteristics of the growing media during acclimatization. Higher MS concentrations likely provided greater amounts of essential nutrients, particularly nitrogen, which is required for chlorophyll formation, protein synthesis, and leaf development. In contrast, the growing media used in this study appeared to provide relatively similar conditions for leaf growth, resulting in comparable responses across media types. The absence of a significant interaction suggests that the effect of MS concentration on leaf number was consistent regardless of the growing medium used.

Shoot number growth

Shoot number is an important indicator of vegetative growth and is commonly used to assess the capacity of plants to generate new shoots under different growing media and MS medium concentrations. Based on the data presented in Table 1, the full-strength MS (1× MS) treatment significantly increased shoot number at 5 weeks after acclimatization (WAA). This finding suggests that plants require an adaptation period to overcome stress during the early vegetative stage. Following successful acclimatization, nutrients provided by the MS medium can be absorbed and utilized more efficiently, thereby supporting shoot initiation and development.

The application of full-strength MS (1× MS) significantly affected shoot formation at 5 weeks after transplanting (WAT). This result indicates that full-strength MS medium provides higher concentrations of nitrate and potassium, which enhance protein synthesis and ensure an adequate nutrient supply to support plant growth. Shoot development is closely associated with nitrogen availability in the MS medium. Nitrate (NO_3^-) absorbed by the plant is reduced to ammonium (NH_4^+) and subsequently assimilated into amino acids. These amino acids serve as essential building blocks for proteins and nucleic acids, which are required for metabolic activities and cell division. Increased cell division stimulates meristematic tissue development and organ differentiation, ultimately leading to the formation of new shoots. Therefore, sufficient nitrogen availability in the growth medium plays a crucial role in supporting shoot formation in potato plantlets. These findings are consistent with those reported by Pratama and Nilahayati (2018), who demonstrated that full-strength MS medium enhances plant growth and accelerates the development of new shoots.

MS concentration significantly affected shoot number, whereas growing media and the interaction between growing media and MS concentration had no significant effects. This finding suggests that shoot formation was mainly determined by nutrient availability from the MS medium. Adequate nutrient supply, particularly nitrogen, supports cell division and the development of new shoots during the acclimatization stage.

CONCLUSION

1. Cocopeat was identified as the most suitable growing medium for potato plantlet acclimatization, as indicated by the highest plant height increment (1.78 cm) at 6 WAA.
2. The application of 1 MS nutrient solution enhanced vegetative growth, resulting in the highest leaf number (2.60 leaves plantlet^{-1}) at 3 WAA and the highest shoot number (0.56 shoots plantlet^{-1}) at 5 WAA.
3. No significant interaction was observed between growing media and MS concentration on the growth of potato (Solanum tuberosum L.) plantlets during acclimatization, indicating that both factors acted independently in influencing plant growth.

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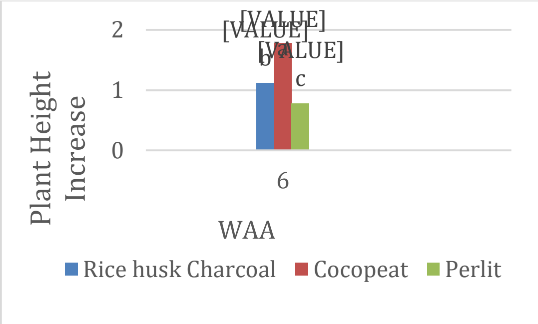

Figure 1. Plant Height Increase Response under Different Growing Media

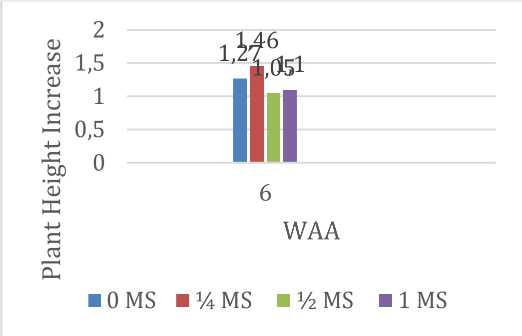

Figure 2. Plant Height Increase Potato Plantlets under Different MS Medium Concentrations.

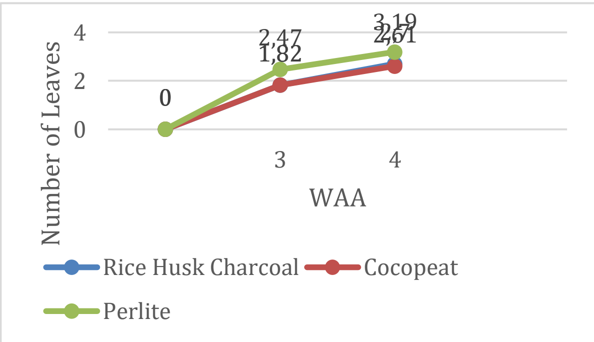

Figure 3. Growth chart in Leaf Number of Potato (*Solanum tuberosum* L.) Plantlets under Different Growing Media

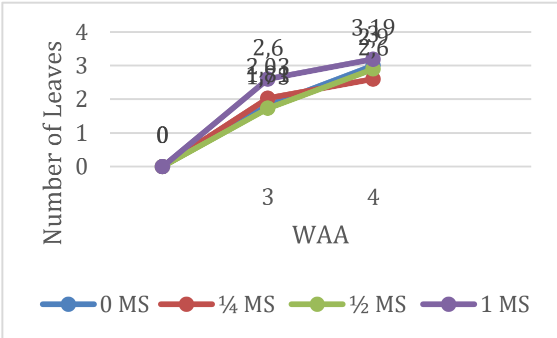

Figure 4. Growth in Leaf Number of Potato (*Solanum tuberosum* L.) Plantlets under Different MS Medium Concentrations.

Table 1. Average Number of Shoots of Potato (*Solanum tuberosum* L.) Plantlets as Affected by Growing Media and MS Medium Concentrations

Plant Age (WAA)	Planting Media Type (M)	MS Medium Concentration (N)				Mean
		0 MS	¼ MS	½ MS	1 MS	
		-----Number of Shoots-----				
5	Rice husk charcoal	0.00	0.12	0.12	0.67	0.22
	Cocopeat	0.00	0.12	0.12	0.34	0.14
	Perlite	0.23	0.67	0.23	0.67	0.45
Mean		0.07 b	0.30 ab	0.15 b	0.56 a	0.27

Explanation: Means followed by the same letter are not significantly different according to Duncan's Multiple Range Test (DMRT) at the 5% significance level.

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a b c d

Explanation: a-d. plantlets 3-6 WAA

Figure 5. Plant height and shoot growth during acclimatization