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AN UTILIZING MARGINAL RED YELLOW PODZOLIC SOIL AS A GROWING MEDIUM FOR AUXIN-SOAKED CUTTING PROPAGATION OF RED MASTER GRAPES (*Vitis vinifera* L)

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***Abstract**. Grape (Vitis vinifera) cultivation is hampered by a lack of suitable land and challenging nurseries. Use of crimson yellow podzolic soil for vine cuttings can be suboptimal. Although podzolic soil has a low capacity to absorb macro- and micronutrients and an acidic pH, it can nevertheless be used as a growing medium. A synthetic growth regulator (ZPT) bath of naphthalene acetic acid (NAA) needs to be added to the local red master grape variety, which has started to develop as a scion in nurseries. In order to assess the impacts of NAA-soaked concentrations on podzolic soil media and identify the morphological traits of local Red Master grape cuttings, this study set out to identify these traits. Its goal was to find out how auxin affected the development and yield of grapes (Vitis vinifera L.) grown in red yellow podzolic soil. A non-factorial totally randomized design with one factor (NAA concentration) was used in the study, with a block of 4 treatments and 3 repetitions. The varied NAA concentrations used in the treatment procedure included F0 (0 g L-1), F1 (2 g L-1), F2 (4 g L-1), and F3 (6 g L-1). The variables that were observed included the number of shoot bursts, the timing of leaf emergence, the number of sheet leaves, the length of the tendrils, and the proportion of live cuttings. ANOVA was used to tabulate and analyze observational data at a 5% level, and DMRT analysis was used to continue the analysis at the same level. According to the results, soaked NAA at a concentration of 0 g L-1 (S0) as the control treatment had the best results for the variable number of shoots and leaves, while a concentration of 2 g L-1 (S1) had the best results for the variable length of tendrils. However, soaked NAA had no significant impact on the variable when leaves emerged. Soaking auxin at the bottom of cuttings had no effect on shoot formation. Reduction of auxin due to defoliation can result in the expression of the isopentenyl-transferase (IPT) gene. Auxins, such as Indole-3-acetic acid (NAA), are usually involved in the regulation of root and leaf growth. If a plant has many leaves and few roots without the use of additional NAA or auxin, several factors may play a role, such as plant genetics, environmental conditions, and environmental stress. The use of additional NAA or auxin can explicitly affect the growth of roots and leaves. The survival percentage of cuttings is still low because it is influenced by the quality (material) of the cuttings, the age of the parent tree, growing media and water availability.*
***Keywords:** auxin; nutrient adequacy; propagated cuttings; water availability*

1. Introduction

Grapevines are very easy to grow from cuttings and are generally propagated by cuttings from hard lignin-containing parts (Doğan & Gülser, 2019). Movements in the root area and shoot

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growth are strongly influenced by environmental conditions (Fritz *et al*., 2021), such as exogenous and endogenous biochemical compounds, ontogenetic age of plant material, genotype, cutting characteristics, namely stock plant growth conditions (Singh & Singh, 2018), growing media and care after cuttings (Mohsen *et al*., 2020).

The type of media significantly affected the rooting and vegetative growth of cuttings (Shanker *et al*., 2019). Consequently, the growing medium should be considered as an important part of the plant propagation system (Farooq *et al*., 2018) because the competence and competition of nutrients in the root section depends on the type of media used. By carefully selecting and regulating the growing media, practitioners may establish podzolic soil as an optimal environment for plant growth, maximize crop quality, and raise the likelihood of successful output. Moreover, consideration of the crops' individual needs, regular monitoring, and proper adjustments to the growing media can all contribute to the overall success and productivity of agricultural or horticultural operations. The biological and physic-chemical characteristics of the growing media used affect plant and root growth. In this regard, the potential of wood ash (WA) and paper sludge (PS) wastes from a pulp and paper mill as potting media, as well as their influence on the physicochemical parameters of podzolic soil, was investigated by (Farhain *et al*., 2022). WA, PS, and BC (Biochar) demonstrated significant potential for generating podzolic soil-based potting media, but their impacts on plant growth and elemental uptake must be studied further.

Choosing the most suitable planting media for the achievement of successful crop production is very important. The growth and survival of grape seeds in nurseries is strongly influenced by the growing medium. The growth medium is critical in delivering nutrients and promoting the formation of a healthy root system for cuttings. It supplies nutrients, water and oxygen, physical support, root penetration and development, and disease control. Peat-based mixes, coir-based mixes, perlite-vermiculite mixes, or mixtures of these components are common propagation growth media.

Because of its specific characteristics and beneficial properties for plant growth, podzolic soil is frequently used as a growing medium. It has a high mineral content, excellent drainage and aeration, an acidic pH, organic matter accumulation, low nutrient leaching, moisture retention, and natural erosion resistance. It also features a well-developed soil horizon with more layer that serves as a natural protective cover against soil erosion. However, depending on the plant type and desired growth conditions, its suitability as a growing medium may vary (Farhain *et al*., 2022). To maximize success rates and encourage healthy root development, it is critical to select a growing medium that meets the needs of the plant species being propagated. In addition, water holding capacity in conditions of better soil aeration, root penetration, presence of organic matter in the growing media and many other related factors are strongly influenced by the growing medium (Waite *et al*., 2015). Therefore, this research aims to investigate the potential of using this soil as an effective growing medium for the propagation of Red Master Grapes cuttings soaked in auxin solution. With this study, it is hoped that an innovative approach will be discovered to enhance the success of grape cutting propagation and support a more sustainable grape production.

2. Methods

2.1. Equipment

This study was conducted in a screen house (bamboo and wood frame with 70% shading net top and sides) which is located Sardonoharjo, Ngaglik, Sleman Regency, Yogyakarta. The research was done during August to December 2021. The first step of the research was preparing the plant growth media and planting which used polybags (12.5cm x 25 cm) as the main equipment for planting and 1000ml measuring cups and analytical balance for preparing the growth media for each variation. The next step was observation and measuring which use supporting equipment such as a logbook, label, and marker for observation, then digital camera for the documentation of each process.

2.2. Material

There are two main materials used in this research which are the material for the growing plant and the material for planting. The growing medium used consisted of a 1:1:1:1 ratio of marginal red-yellow podzolic soil/sand/manure/burnt husk charcoal. The object used in this research was grape propagated cuttings of local variety red master (the age of the mother tree is four years) obtained from the NGO Rafalfa Green (Tinggarjaya District, Banyumas Regency). The rootstock varieties of the grapes used are the red master which has a sweet and sour taste that is balanced when the level of maturity is maximum. Red Master grapevine propagation provides various benefits, including clonal integrity, speedier establishment, and consistency in attributes, disease management, and preservation of distinctive varietal characteristics.

Table 1. The various treatment of NAA auxin soaked level into the cutting propagated grape

Treatment	NAA
S_0	(0 g L^{-1})
S_1	(2 g L^{-1})
S_2	(4 g L^{-1})
S_3	(6 g L^{-1})

Clonal integrity assures that the propagated vines keep the parent plant's precise genetic features and qualities, while speedier establishment allows for rapid multiplication. Trait consistency ensures uniformity in a vineyard, whereas disease control aids in the maintenance of disease-resistant characteristics. High-quality fruit, disease resistance, high yield potential, robust growth, adaptation to diverse climatic and soil conditions, and market demand are all features of the Red Master grapevine variety. It is well-known for producing high-quality fruit, being disease resistant, having a high yield potential, growing quickly, adapting well, and being in high demand on the market (Carvalho *et al*., 2015).

Before the analysis is carried out, the first cutting propagated grape soaked by NAA auxin for 2 hours, drained for 1 hour, then soaked again for 4 hours in certain amount as shown in Table 1.

2.3. Planting and Measuring

A non-factorial Completely Randomized Design (CRD) with a single factor (NAA concentration) was used to conduct the research. In this research, the blocks were made up of 4 treatments and 3 repetitions. The treatments consisted of different concentrations of NAA. Maintenance consists of watering (2 days in the afternoon for the first month, once a day in the afternoon for the last 2 months) and the application of mixed A and B fertilizers on grape cuttings for planting media using red yellow podzolic soil/sand/manure/burnt husk charcoal with a ratio of 1:1:1:1 polybags of 1.5 kg, this amounts to 37,5 g urea once fertilized (1-month-old cuttings after planting).

Observations were made once every 1 week for 12 weeks with the observation variables namely the number of bud breaks (12 weeks after planting/wap), when the leaves appeared (week), the number of leaves (strands) was counted from the 3rd week, the length of the tendril (cm) was calculated from the 6th week and the percentage of live cuttings (%) was calculated at the 12th week.

The study started with the preparation of the screen house. Equipment and materials for grape cuttings and seeds were prepared, as was the pre-treatment of grape cuttings and seeds. Mixed planting media were used using red-yellow podzolic soil, sand, fertilizer, and burned husk charcoal in a ratio of 1:1:1:1, which resulted in 37,5 g of urea once fertilized. At the end of the study, the data obtained were tabulated and analyzed using ANOVA at the 5% level and continued using DMRT analysis at the 5% level. Data were analyzed using Statistical Product and Service Solutions (SPSS) 16.0.

3. Results and Discussion

Based on the results of the analysis, the results of the study showed that soaked NAA at various concentrations had a significant effect on the variable number of broken shoots, number of leaves and length of tendrils, while the variable at leaf emergence had no significant effect (Table 2). Treatment S1 had the highest value compared to other treatments for the number of leaves and the highest value compared to other treatments for the variable length of the tendril, while S0 treatment took the longest time compared to other treatments for the variable when leaves appeared. Treatment S2 had the highest value for the number of broken shoots compared to other treatments.

3.1. The number of broken shoots

The results presented in Table 2 indicate that NAA soaking at different concentrations significantly affected the number of broken shoots in grape-cutting seeds, with the S2 treatment indicating the best number of broken shoots as shown as in the Figure 1. The results indicated that there was no broken shoot after seven weeks of growth. To generate endogenous cytokinins, endogenous auxin is moved basipetal to the reduced lateral shoot. (Mishra *et al*., 2021). Auxin-soaked concentration at the bottom of stem cuttings had no effect on shoot formation because auxin transport from soaking NAA (exogenous auxin) was used to initiate root formation (Li *et al*., 2022).

Table 2. The results of the 12th week test of soaking concentration NAA on the morphological characters of local varieties of red master grape propagated cutting.

Treatment	The Number of Broken Shoots (wap)	Leaf Appearance at week number-	The Number of Leafs (sheet)	Tendril Length (cm)
S0	2a	3a	6.94a	6.22a
S1	2.04a	2a	7.67a	12.99a
S2	2.17a	2a	6.1a	5.99a
S3	1.71a	2a	5.86a	8.52a

Note: Numbers followed by the same letter in the treatment show results that are not significantly different according to the DMRT 5% test.

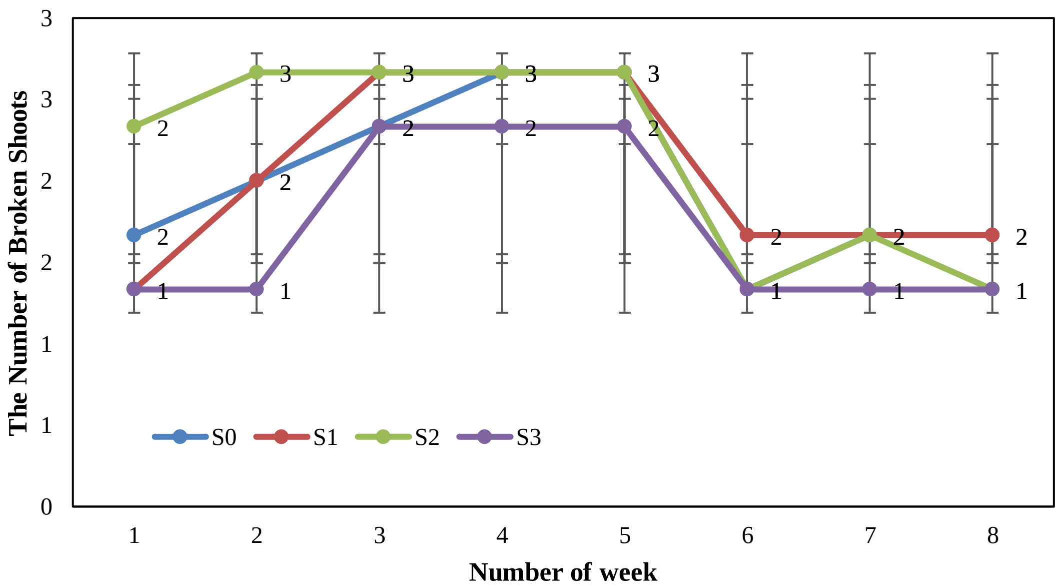

Figure 1. Effect of soaked concentration of NAA on number of shoots burst 12 weeks after planting (WAP)

Defoliation in cuttings can disturb hormone balance, increasing expression of the isopentenyl-transferase (IPT) gene, which is implicated in cytokinin production. This can promote branch growth and postpone leaf senescence, among other effects on plant growth and development. More research is required to fully comprehend the unique response to defoliation and the IPT gene (Chen *et al*., 2022); (Wang *et al*., 2022a).

The enzyme isopentenyl-transferase (IPT) catalyzes the synthesis of cytokinins, which are plant hormones that regulate plant growth and development. When auxin levels fall, this imbalance can cause an increase in cytokinin production, which can cause lateral shoots or axillary buds to grow. More research is required to fully comprehend the involvement of IPT and cytokinins in lateral shoot growth and development (Wang *et al*., 2023); (Papon & Courdavault, 2022).

Exogenous auxin given to root initiation cuttings can raise cytokinin levels, stimulating the development of transport tissue in lateral shoots. Cytokinins are plant hormones that are essential for cell division, growth, and differentiation. More research is required to fully comprehend the involvement of auxin and cytokinins in lateral shoot development and tissue differentiation (del Rosario Cárdenas-Aquino *et al*., 2022); (Domagalska & Leyser, 2011).

Auxin is a plant hormone that controls several aspects of plant growth and development, including as cell elongation, root initiation, and apical dominance. When it is generated in the root area of cuttings and transferred to the lateral shoots, it can accumulate and impede cytokinin action, suppressing lateral shoot growth and promoting apical dominance. It is critical to remember that the balance of auxin and cytokinins, as well as their transport and interactions, can be altered by a variety of parameters, including auxin concentration and distribution, cutting developmental stage, and environmental conditions (Kurepa & Smalle, 2022); (Friml, 2022).

NAA (1-naphthaleneacetic acid) is a synthetic auxin that promotes root development in plant growth. It can impede the development of lateral shoots by interfering with cytokinin action. NAA's effects on lateral shoot emergence and cytokinin activity vary depending on concentration, timing, plant type, and environmental conditions (Wang *et al*., 2022b); (Hsieh *et al*., 2022), As it promotes the development and elongation of the main stem or apical bud, higher amounts of auxin might hinder the growth of lateral shoots. This is due to hormonal balance modulation and competition for resources within the plant. Based on plant requirements and propagation goals, the appropriate auxin concentration for encouraging root development while minimizing inhibition of lateral shoot growth must be calculated (Ohbayashi *et al*., 2022); (Yu *et al*., 2022).

3.2. Leaf Emergence Time

The results in Table 2 show that the NAA soaked concentration at various concentrations (S0, S1, S2 and S3) had no significant effect on the time of emergence of leaf on grape cuttings seedlings. The leaf emergence is influenced by the interaction between auxins and cytokinins found in cuttings (Salem *et al*., 2022); (Chang *et al*., 2022). In this study, as shown in Figure 2 it was suspected that the new root system was formed in the 2nd week so endogenous auxin had not been produced because the absorption of NAA soaked concentration was used by cuttings for initiation of root formation. This statement is in accordance with the opinion of (Scheiner & King, 2020) which states that root system grape cuttings on growing media can grow after 2 to 4 weeks. Auxin together with cytokinin play a role in cell division in lateral shoots for leaf expansion it is suspected that auxin transport from the root system only occurs at week 2.

In addition to being influenced by phytohormones, leaf development is also influenced by the availability of nutrients, water and environmental conditions (Kanika & Saxena, 2020). The researchers report that the growth and development of roots in grape seeds is influenced by environmental conditions, endogenous biochemical (hormonal) content and environmental conditions. Grapevine propagation entails taking into account the exogenous and ontogenic age of cuttings, as well as how cuttings are treated before planting. Exogenous age relates to the cutting material's age, whereas ontogenic age refers to the cutting material's developmental stage. Hormone treatments, wound treatment, callus production, and antifungal treatments are all used to prepare cuttings for planting. Treatment methods, concentrations, and durations may differ based on the intended rooting results, grapevine variety, and environmental circumstances.

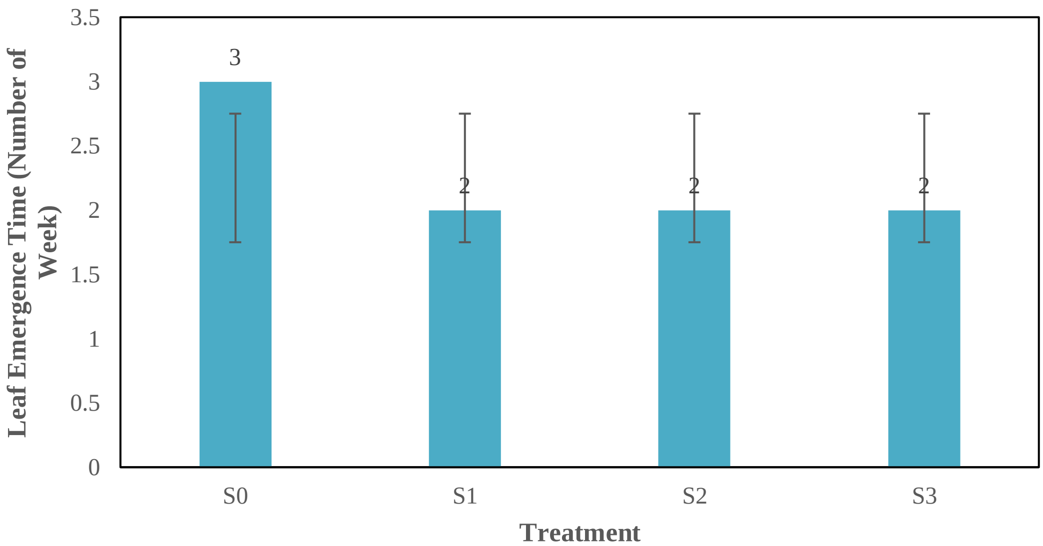

Figure 2. Effect of soaking concentration NAA on leaf emergence

The nutrient that affects leaf formation is nitrogen (N), but it is suspected that the application of N fertilizer used in this study (37,5 g urea fertilizer) was not optimal so that it inhibited the emergence of leaves. N fertilizer given to plants can increase growth including accelerating the emergence of leaves and increasing the number of leaves (Banerjee *et al*., 2022). Appropriate use of N fertilizer can affect the time of leaf emergence and the number of leaves on seedlings from cuttings (Li *et al*., 2021). N uptake in grapes is also influenced by the availability of water as a nutrient solvent that is absorbed by plant roots (Lang *et al*., 2019). In this study, it is suspected that the availability of water is not optimal because the media used has a fairly high porosity. According to (Samburova *et al*., 2023) if it is suspected that the availability of water is not optimal due to the high porosity of the media used in podzolic soil, it is important to consider the characteristics of the soil and the media composition to address the issue, the ability of the media to bind water is low. In accordance with the results of research by (Ephrem *et al*., 2022) which stated that nursery media with high porosity resulted in lower N availability when compared to the availability of phosphate (P) and potassium (K). Lack of water in the vegetative phase of grape seeds results in slow cell division which can affect leaf formation (Caruso *et al*., 2022). A sufficient amount of N fertilizer but not accompanied by sufficient availability of water (as a solvent) resulted in the inhibition of nutrient uptake and transport (Tanaka *et al*., 2022). Water availability can be improved by the water-holding capacity of podzolic soils, as well as the presence of organic matter in manure and husks. It is critical to provide plants with adequate water as well as nitrogen (N) fertilizer to enable nutrient uptake and transport. It would be ideal to refer to specific research studies or scientific literature that have investigated this topic in the context of podzolic soils and grapevines in order to provide reference support for the statement regarding the inhibition of nutrient uptake and transport when sufficient water availability is not accompanied by N fertilizer.

3.3. The Number of Sheet Leafs

The results in Table 2 show that NAA soaking at various concentrations significantly affected the number of leaves on grape cuttings seeds with the best number of leaves in the S1 treatment show as in the Figure 3. In this study, it was found that the treatment without exogenous auxin had more leaves. The fact that grapevines propagated without exogenous auxin had more leaves suggests that the lack of exogenous auxin may have aided in leaf development (Altamura *et al*., 2023).

Auxin is a plant hormone that regulates the commencement and expansion of leaves. Exogenous administration of auxin has been shown to hinder shoot development and leaf formation. Endogenous auxin, which is produced spontaneously within the plant, is critical in regulating growth processes. More investigation and testing are required to determine the particular mechanisms driving the observed increase in leaf development. The number of leaves on cuttings is influenced by the content and interaction of hormones (auxins and cytokinins), nutrient uptake (N and K) and water availability (Tammam *et al*., 2022). Excessive amounts of auxin can suppress the function of cytokinins in leaf formation and expansion. When the root system is formed, auxin transport increases so that the expression of the IPT gene as a cytokinin catalyst decreases (Kurepa & Smalle, 2022). If auxin increases, cell division becomes dominant resulting in more meristematic areas so that it can increase the length of the tendrils on grape cuttings.

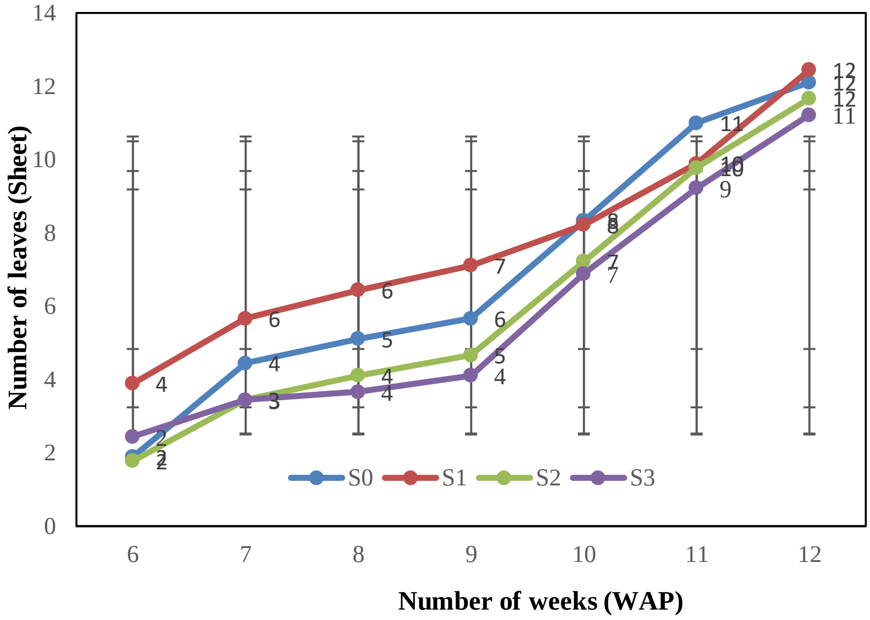

Figure 3. Effect of soaked concentration of NAA on number sheet leaves at 12 weeks after planting (WAP)

The application of mixed A and B fertilizers on grape cuttings for planting media using red-yellow podzolic soil, sand, manure, and burnt husk charcoal with a ratio of 1:1:1:1 polybags of 1.5 kg, which is 37,5 urea fertilizer, was not optimal so that the availability and uptake of important nutrients such as N and K for vegetative development were not optimal.

The amount of fertilizer used in propagation planting media study varies depending on the type of cultivated plant, the nutritional requirements of the plant, and the properties of the planting medium. Local agricultural or research agencies make fertilizer dosage recommendations, however there is no one dose that may be deemed the ideal dose. The best fertilizer dose should be calculated using the aforementioned factors, as well as ongoing testing and adjustment (Somasiri *et al*., 2023).

The application of mixed A and B fertilizers on grape cuttings for planting media using red yellow podzolic soil/sand/manure/burnt husk charcoal with a ratio of 1:1:1:1 polybags of 1.5 kg, which is 37,5 g urea fertilizer was not optimal so that the availability and uptake of important nutrients such as N and K for vegetative development was not optimal.

Nutrient N is closely related to seedling growth in cell division and is dominant in leaf formation. The provision of inorganic N fertilizers is soluble and volatile, N fertilizers should be applied at the appropriate time during the growing season to maximize their effectiveness and minimize potential negative consequences. Timing, split applications, soil testing, and proper formulation are all important considerations to ensure optimal nutrient availability and minimize potential losses. N fertilizers have varying solubility and volatility characteristics, so slow-release or controlled-release fertilizers can help provide a more sustained nutrient supply. Placement and application methods should be considered to minimize environmental impacts. Follow recommended application rates and follow local regulations and best practices to protect water quality and minimize environmental impacts. By considering these guidelines and implementing appropriate nutrient management practices, the application of N fertilizers can be optimized to provide adequate nutrition for plants while minimizing the potential negative consequences associated with solubility and volatility.

So that if there is a shortage of water, N is not dissolved and is not absorbed by plants, high temperatures can enhance the possibility for nitrogen (N) loss via volatilization, which results in the release of ammonia gas (NH^3) into the atmosphere. This can diminish plant N availability and lead to inefficient fertilizer use. When there is a shortage of N in the media, N compounds in the leaves undergo autolysis to transfer protein compounds to the more meristematic juvenile regions, resulting in slowed growth and an increase in the number of leaves. In addition, it is suspected that the soil organisms in the planting medium did not develop properly so that the ammonization process did not run optimally. Complex N compounds in the growing media will be used by these organisms and released again through excretion in the form of simpler N compounds, namely ammonium. This ammonium will be used by plant seeds to increase N uptake in the growing medium.

Ammonization is largely a microbiological process in which soil microorganisms degrade organic nitrogen molecules to produce ammonium ions. Although earthworms play an important role in soil fertility and organic matter breakdown, they do not directly perform ammoniation. With their unique features and characteristics, podzolic soils can have both good and negative effects on grapevine growth and development. Because of their coarse texture and high permeability, podzolic soils are often well-drained. This trait is beneficial in grapevine cultivation since excessive water accumulation around the roots can cause root rot and other water-related concerns. Good drainage prevents waterlogging and offers an adequate supply of oxygen to the root zone, supporting healthy root development and overall vine growth.

Because key elements like calcium, magnesium, and potassium are prone to leaching due to their sandy or gravelly structure, podzolic soils are generally low in fertility. This poor fertility might make grapevine cultivation difficult because these minerals are essential for plant growth and development. To correct nutritional deficits and maintain optimal nutrient levels in grapevines, regular soil testing and suitable nutrient management measures, such as the application of organic matter or tailored fertilizers, are required.

The acidity of podzolic soils can affect grapevine development and nutrient availability. Some grapevine cultivars are more acidity tolerant, while others may require supplements or pH modifications for optimal growth. Soil pH testing and liming can assist raise pH levels to a range optimal for grapevine cultivation, guaranteeing proper nutrient uptake and minimizing nutrient deficits or toxicities.

Organic matter level in podzolic soils may be low. Organic matter is important for soil fertility, structure, and water-holding ability. Organic additives, such as compost or well-rotted manure, can increase the organic matter content of the soil and improve its ability to retain moisture and nutrients. This approach can help grapevine growth by creating an environment that promotes root development and nutrient availability.

Some grapevine varietals have been adapted to specific soil types, notably podzolic soils. These types may have drought tolerance, disease resistance, or efficient nitrogen uptake, making them ideal for growing in podzolic soils. Grapevine types that are naturally acclimated to or have been bred for podzolic soil conditions can improve performance and reduce problems associated with this soil type (Shi *et al*., 2023). Overall, grapevine growth on podzolic soils necessitates careful soil management measures such as nutrient management, pH adjustment, and organic matter incorporation. Grapevines can grow and produce high-quality grapes in podzolic soils by addressing the special characteristics of podzolic soils and modifying cultivation procedures accordingly.

3.4. Tendril Length

The results in Table 2 showed that soaking NAA at various concentrations significantly affected the length of the tendrils of grape cuttings with the best tendril length in the S1 treatment. The growth and elongation of the vines are influenced by auxin activity and the environment, especially light. Auxin can stimulate root growth, the more roots the auxin content increases and is distributed to the meristematic parts of the plant. High auxin can inhibit cytokinin synthesis so that apical dominance occurs which can cause meristematic tissue such as tendrils to continue to elongate. Auxin is a type of plant hormone that has the ability to support cell elongation, resulting in an increase in the length of the tendrils. Physiologically, hormones in plants can support each other, the presence of auxin at certain concentrations can encourage changes in the ratio of cytokinin formation in plants (Kurepa & Smalle, 2022).

Figure 4 found that the increase in the length of the tendrils due to the increase in auxin was not followed by the increase and expansion of leaves on the grape propagated cuttings. Auxins are involved in cell division whereas cytokinins along with auxins are involved in cell elongation. The administration of NAA is thought to stimulate cell elongation in the tendrils due to the stimulation of protein synthesis to activate enzymes that play a role in the synthesis of endogenous hormones. In these conditions according to Figure 4 implied that there is an increase in the plasticity of the cell wall in tendril length measurement so that it becomes loose, allowing water to enter the cell by osmosis which causes the cell to widen and elongate.

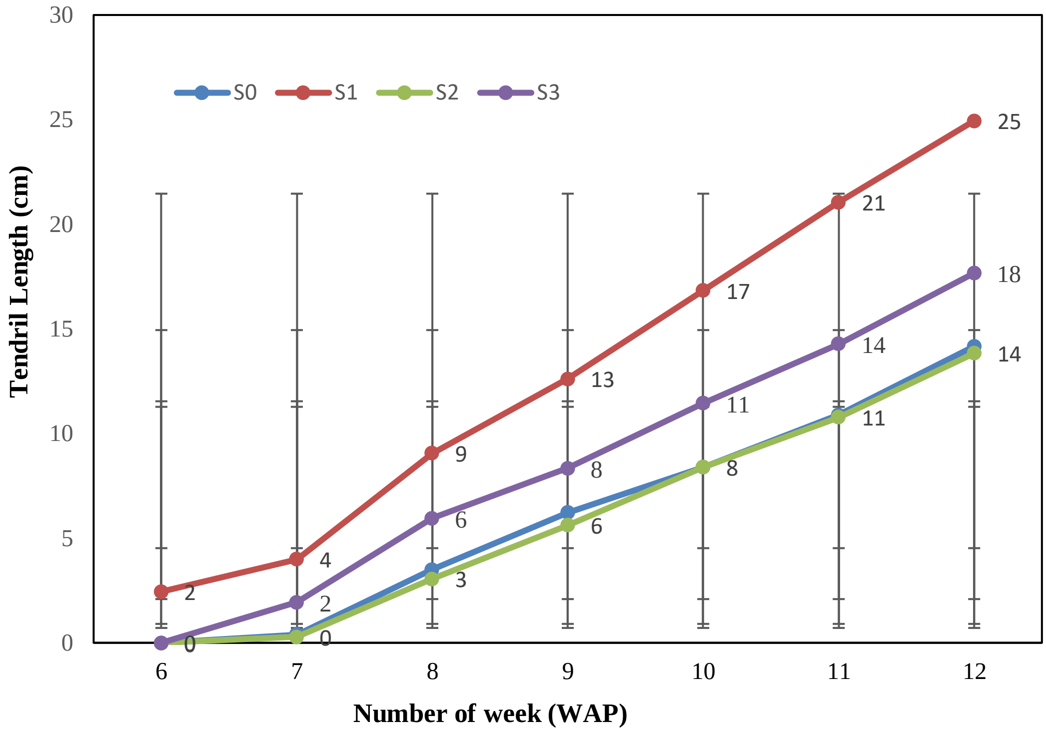

Figure 4. Effect of soaked concentration of NAA on tendril length at 12 weeks after planting (WAP)

In addition to the influence of NAA, the growth of tendrils was thought to be influenced by light. The screen house used has a shade (mesh size) of 70% meaning that the intensity of incoming light is 30%, the elongation of tendrils and branches occurs faster in conditions of low light intensity, but the formation of leaves can be hampered. Auxins at 30% (low) light intensity can work optimally together with cytokinins in cell division and elongation. Sufficient light intensity can affect the expression of proteinase inhibitor genes that play a role in auxin transport in plants. Auxins play a role in the activation of cell division cycle 2 (CDC2) gene expression, while endogenous cytokinins activate cyclin dependent kinase (CDKs) genes encoded by the CDC2 gene). CDC2 gene activity and expression is regulated by auxin, CDKs are encoded by Cdc2 so that auxin indirectly plays a role in tendril elongation (Zheng, 2022).

3.5. Media Composition (Podzolic Soil) and Seed Dormancy Auxin

Plant growth and development can be significantly impacted by the usage of podzolic soils and other various media compositions. Particularly in podzolic soils, there are some features that can affect plant performance. Acidic and infertile are common characteristics of podzolic soils. They are distinguished by the nutrients like calcium, magnesium, and potassium that they leach, which can cause plant nutrient shortages. In order to offer sufficient nutrition for plant growth when utilized as a growing medium, the nutrient availability and balance in the podzolic soil must be properly maintained (Tingskou & Unc, 2023).

Due to their coarse texture and low water-holding capacity, podzolic soils often have superior drainage characteristics. As it helps avoid waterlogging and guarantees proper oxygen delivery to the roots. Consequently, this might be advantageous for plant growth. A healthy root system and overall plant vitality depend on proper drainage and aeration. Acidity in podzolic soils can affect nutrient availability and plant growth. While some plant species may do best in an acidic environment, others may do better with pH modifications or amendments. To suit the particular needs of the plants being produced, the pH of the podzolic soil needs to be carefully checked and modified as needed (Huntley, 2023).

Organic matter levels in podzolic soils may be quite low, which may have an impact on the soil's structure, ability to retain water, and nutrient availability. Compost or well-rotted manure are examples of organic amendments that can be added to soil to increase its organic matter content, soil fertility, and water-holding capacity. Plant species that have evolved to these soil conditions frequently live in podzolic soils, which are connected to certain biological zones. It may be useful to choose plant species or cultivars that are well-suited to certain soil properties when employing podzolic soils as a growing medium in order to maximize their growth potential (Tingskou & Unc, 2023).

It is crucial to highlight that the specific effects of podzolic soils as a growing medium might vary based on factors such as soil composition and qualities, plant species being cultivated, and management strategies used. Soil tests, consultation with soil science specialists, and adaptation of cultivation practices can help maximize the use of podzolic soils for optimal plant development and production.

Seed dormancy and germination are critical stages in the life cycle of plants, and ongoing research in the molecular biology of these processes highlight the significance of genetic elements, particularly seed quality, in influencing plant production performance (Klupczyńska & Pawłowski, 2021).

Seed dormancy is a phenomenon in which a viable seed fails to germinate despite good environmental conditions. A complex interaction of genetic and environmental factors regulates it. Several important genes and phytohormones play critical roles in modulating seed dormancy and the germination process (Nautiyal *et al*., 2023).

Abscisic acid (ABA) and gibberellins (GAs) are known to be important regulators of seed dormancy and germination. ABA is commonly connected with seed dormancy promotion, whereas GAs are implicated in seed dormancy break and germination promotion. The appropriate regulation of these activities is dependent on the balance of ABA and GA levels, as well as their interactions with other hormones and environmental signals (Del Bel *et al*., 2023).

For the purpose of increasing plant production, it is useful to understand the molecular underpinnings of seed dormancy and germination. It can assist in formulating plans to improve seed quality, encourage uniform germination, and increase crop establishment and yield.

In order to get more knowledge about the underlying genetic elements and molecular mechanisms governing seed dormancy and germination, researchers are still looking into the intricate regulatory networks that control these processes. This information supports improvements in crop management techniques, seed technology, and plant breeding, which eventually boost agricultural output and guarantee healthy plant growth and development.

In highlighting the role of auxin in seed dormancy and germination, while auxin has historically been associated with plant growth, current research has thrown light on its role in seed dormancy regulation. Auxin has been shown to have a beneficial influence on seed dormancy. It can interact with other hormones, like as ABA, to control seed dormancy. Auxin levels beyond a certain threshold can promote seed dormancy by blocking germination processes such radicle emergence and cell expansion (Dong *et al*., 2023).

Auxin aids in the maintenance of seed dormancy over time. It can operate as a signal to avoid premature germination and keep seeds viable during adverse conditions like as drought or cold stress. Auxin has the ability to influence the expression of particular genes and signaling pathways involved in the maintenance of dormancy (Swain *et al*., 2023). Auxin can also increase seed germination by breaking seed dormancy in some situations. This usually happens under certain climatic conditions or when auxin levels in the seed fall. A decrease in auxin levels can set off a chain of events that activate germination processes like cell elongation and radicle emergence (Jyoti *et al*., 2023).

To regulate seed dormancy and germination, auxin interacts with other phytohormones like as ABA and GAs. The balance of these hormones is critical for regulating seed dormancy and the transition to germination. The complicated interaction of auxin with ABA and GAs aids in the fine-tuning of germination time and circumstances (Del Bel *et al*., 2023). Environmental signals can impact the effect of auxin on seed dormancy and germination. External elements such as light, temperature, and moisture levels can influence auxin levels and signaling pathways, altering seed dormancy and germination potential (Sybilska & Daszkowska-Golec, 2023).

While research into the role of auxin in seed dormancy and germination is still ongoing, recent studies have underlined its importance as a regulator of both processes. More research is needed to completely understand the molecular mechanisms underpinning auxin's role in seed dormancy and germination. The scientific literature, particularly research on auxin's role in seed biology, will provide more detailed information on the exact biochemical pathways and regulatory processes involved in auxin-mediated seed dormancy and germination.

3.6. The Quality (Material) of The Cuttings, The Age of The Parent Tree

The quality of the propagation cuttings is critical in determining the success of root development and subsequent plant growth. Healthy, disease-free cuttings with well-developed buds have a better chance of establishing and growing successfully. To reduce the possibility of transmitting diseases or inheriting unwanted features, cuttings should be taken from disease-free and strong parent vines (Mežaka *et al*., 2023).

The age of the parent tree or vine might have an impact on the quality of the cuttings and their performance. In general, younger vines generate more vigorous and healthier cuttings than older, senescent vines. Younger vines have a stronger proclivity for roots and may develop faster than cuttings from older vines. However, depending on the grape variety, rootstock, and environmental conditions, the best age for grapevine cuttings may vary (Yin *et al*., 2023).

Grapevine cuttings are normally taken while the plant is dormant and not actively growing. Cutting collection is crucial, and it is normally advised to take cuttings in late winter or early spring. Collecting cuttings during the right dormancy period guarantees that they have the physiological requirements for roots and subsequent growth (Hawezy, 2023).

Depending on the desired outcome and grapevine variety, various propagation procedures such as hardwood cuttings, softwood cuttings, or grafting may be utilized. In terms of cutting quality, age, and climatic circumstances, each technique has its own set of requirements. Understanding and applying the proper propagation procedures depending on the grapevine variety and intended results is critical for successful propagation (Nezami & Gallego, 2023). While these elements are vital, good grapevine multiplication also requires proper rooting conditions, appropriate growing material, favorable climatic factors (temperature, humidity, light), and appropriate aftercare methods.

4. Conclusions

According to the study's results, soaking NAA at a concentration of 0 g L-1 (S0) formed the most productive results in terms of the number of shoots and leaves. To clarify, grape cuttings treated without NAA (1-naphthaleneacetic acid) are likely to grow more leaves but fewer roots. Soaking NAA at a concentration of 2 g L-1 (S1) had the best results for the variable length of the tendrils, but had no effect on the period of leaf emergence. The life percentage of vegetative propagation cuttings soaked in various concentrations of NAA is still low since it is controlled by multiple aspects, including quality (material).

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