IIAJ INTERNATIONAL INTEGRATED AGRICULTURAL JOURNAL
Volume 02 Number 01
May 2026
e-ISSN: 3124-8179
p-ISSN: 3124-7865

Study of Potassium KNO_3 Concentration Against Growth In Vitro Plantlets of Granola Potato (*Solanum tuberosum L.*)

Rudi Wardana[1], Jeany Zanti Ayu Maharani[1]

[1] Department of Food Crop Production Technology, Faculty of Agricultural Technology, State Polytechnic of Jember, Indonesia

Correspondence should be addressed to: Jeany Zanti Ayu Maharani maharanijeanyzantiayu@gmail.com

Abstract:
Tissue culture techniques be one of solution in multiply seed potato quality high. One of the obstacles faced in tissue culture potato is growth suboptimal plantlets, such as circumference small and not stem Sekulen. Research This study aimed to influence potassium concentration of KNO_3 to growth plantlets potato Granola varieties in vitro, as well as determine optimal concentration that supports growth best. Research carried out in the Tissue Culture Laboratory Plants , Jember State Polytechnic in June 2024 to finished , using Non- factorial Completely Randomized Design (CRD) with five levels KNO_3 concentrations (475 mg/L, 950 mg/L, 1425 mg/L, 1900 mg/L, and 2375 mg/L) each of which was repeated four times. Data analysis was carried out using the ANOVA test and continued with BNJ test at 5% and 1% levels . Research results show that KNO_3 concentration of 475 mg/L provides most significant influence on the length parameter books and length root plantlets. Therefore that, concentration the can recommended as optimal dose for increase growth plantlets Granola potatoes in vitro.

Check for updates

Article info:
Submitted:
05-08-2025
Revised:
29-10-2025
Accepted:
29-10-2025
Published:
10-05-2026

Keywords:
KNO3, increase, growth, plantlets

https://doi.org/10.53713/iiaj.v2i1.461

INTRODUCTION

Potato cultivation is one of the most important food crops. According to the Central Statistics Agency (2016), the potato harvested area in 2014 was 76,291 ha, with a production of 1,347,815 tons and a productivity of 17.67 tons/ha; the harvested area in 2015 was 66,983 ha, with a production of 1,219,269 tons and a productivity of 18.20 tons/ha. Therefore, potato productivity in Indonesia remains very low, and one of the causes is the lack of superior seeds.

Indonesia's production is declining because not enough farmers are producing high-quality potato seeds, preventing demand from being met. Potato farmers typically use seeds from their own production waste, resulting in a shortage of high-quality potato seeds. One alternative for potato propagation is tissue culture (Suliansyah et al., 2021). This method can avoid systemic diseases, especially viruses, and produce large numbers of seeds in a short time. One problem with potato plant propagation is that the resulting plantlets tend to have small stem circumferences and are succulent.

One way to increase potassium is to increase the KNO3 concentration in MS media. Research conducted by Pandiangan et al. (2024) shows that this can be by achieved to forming plants with larger, stronger, and less succulent stem circumferences. Potassium KNO3 fertilizer can increase the diameter of edamame plants. Potassium is important for increasing stem diameter because it

Volume 02 Number 01
May 2026
e-ISSN: 3124-8179
p-ISSN: 3124-7865

increases the level of stem sclerenchyma. Sclerenchyma makes the stem tissue thicker and stronger, making the plant stronger and less prone to falling (Ferdyansyah, 2022). The synthesis of simple sugars and starch results in the increase and development of plant tissue, which is the function of potassium elements in various physiological processes of plants.

Potassium is very important for leaf formation; it is needed in greater amounts than nitrogen. Nitrogen in KNO3 also helps the growth of stems, branches, and leaves, supports cell division and cell enlargement, and slows seed ripening (extending the vegetative period). The need for K significantly increases during the vegetative phase. The need for K in the vegetative phase is much greater because K is important in leaf formation (Hanafiah, 2007). This study aims to examine the best concentration of potassium element increase treatment from KNO3 on the growth of potato plantlets in vitro.

METHOD

The research was conducted at the Plant Tissue Culture Laboratory of Jember State Polytechnic, located on Jl. Mastrip, Sumbersari District, Jember Regency. The research was conducted from June to completion in 2024.

This study used a Non-Factorial Completely Randomized Design (CRD) with one treatment factor, namely KNO3, with 5 concentration levels (475 mg/l, 950 mg/l, 1425 mg/l, 1900 mg/l, 2375 mg/l), each repeated 4 times, yielding 20 units.

The research results will be analyzed using a non-factorial completely randomized design (CRD). If there is a significant effect between treatments, it will be tested using ANOVA, namely the honestly significant difference (HSD) test at the 5% level and the very significant difference (VSD) test at the 1% level. The observation variables of this study include the initial emergence of shoots, stem diameter, shoot height, number of leaves, node length, and root length.

RESULTS

Based on the research results, the parameters include the initial emergence of shoots, stem diameter, shoot height, number of leaves, length of nodes, and root length, and these variables were analyzed using ANOVA. The following summary results were obtained.

Table 1. Summary of recapitulation results for all observed variables

Variables Observation	Average
The Beginning of the Appearance of Shoots	30.4 **
Stem diameter	0.99 ns
Shoot Height	3.63 **
Number of Leaves	19.7 ns
Book Length	10.1 *
Root length	12.0 *

Information: ** (different very real), * (different real), and ns (different unreal)

Volume 02 Number 01
May 2026
e-ISSN: 3124-8179
p-ISSN: 3124-7865

The Beginning of the Appearance of Shoots

Table 2. Initial Shoot Emergence Test Results

Treatment (mg/l)	Results
K4 (1,900 mg/l)	21.0 b
K5 (2,365 mg/l)	28.0 ab
K2 (950 mg/l)	31.5ab
K3 (1,425 mg/l)	35.0 a
K1 (475 mg/l)	36.2 a
Mark BNJ 1%	12.56

Description: Results followed by the same letter indicate no significant difference.

Table 2 shows that the results of all KNO3 treatments were significantly different. The results were obtained from the K4 treatment (1,900 mg/l), which produced the fastest results, with shoots appearing when the explants were 21 days old. Meanwhile, the K1 treatment (575 mg/L) produced the longest shoots at 36 days of age.

Stem Diameter

Table 1 shows that the stem diameter parameter yielded non-significant results. This occurred because the stem diameter results showed nearly identical averages across treatments, so no further BNJ testing was conducted.

Shoot Height

Table 3. Results of the Shoot Height Test

Treatment (mg/l)	Results
K3 (1,425 mg/l)	4.25 a
K4 (1,900 mg/l)	4.25 a
K1 (475 mg/l)	3.87 a
K5 (2,365 mg/l)	3.12 b
K2 (950 mg/l)	2.62 b
Mark BNT 1%	0.72

Information: Results that followed the letters that were in the same state, different No real

From Table 3, when the plants were 2 weeks old, the results of shoot height were obtained in the K3 (1,425 mg/l), K4 (1,900 mg/l), and K1 (475 mg/l) treatments, with no significant differences, but significantly different compared to the K5 (2,365 mg/l) and K2 (950 mg/l) treatments. In the K3 (1,425 mg/l) and K4 (1,900 mg/l) treatments, the shoot height increased by 4.25 cm, and the lowest plant height was obtained in the K2 (950 mg/l) treatment of 2.26 cm.

Number of Leaves

The number of leaves observed during growth did not differ significantly. The results were based on the average number of leaves produced by the treatments, which yielded an uneven number, so further BNJ testing was not conducted.

Book Length

Table 4. Book Length Test Results

Treatment (mg/l)	Results
K3 (1,425 mg/l)	1.42 a
K4 (1,900 mg/l)	0.95 b
K1 (475 mg/l)	0.92 b
K5 (2,365 mg/l)	0.90 b
K2 (950 mg/l)	0.87 b
Mark BNT 1%	0.32

Information: Results that followed the letters that were in the same state, different No real

The highest book length was observed in treatment K1 (475 mg/l) at 1.42 cm and was significantly greater than all other treatments. Meanwhile, treatments K2 (950 mg/), K5 (2,365 mg/l), K4 (1,900 mg.l), and K3 (1,425 mg/l) showed no significant differences. Treatment K3 (1,425 mg/l) had the lowest book length, 0.87 cm.

Root Length

Table 5. Root Length Test Results

Treatment (mg/l)	Results
K1 (475 mg/l)	18.2 a
K2 (950 mg/l)	10.6 b
K3 (1,425 mg/l)	10.6 b
K4 (1,900 mg/l)	10.3 b
K5 (2,365 mg/l)	10.1 b
Mark BNJ 5%	3.53

Information: Results that followed the letters that were in the same state, different No real

Table 5 shows that the longest root was 18.2 cm in the K1 treatment (475 mg/l). This result was significantly different from all other treatments. Where K2 (950 mg/l), K3 (1,425 mg/l), K4 (1,900 mg/l), and L5 (2,365 mh/l) were not significantly different. The lowest result obtained was 10.1 cm in the K5 treatment (2,365 mg/l).

DISCUSSION

The difference in concentration, which encourages earlier shoot growth, may stem from the plant's own response. Plant metabolism can be enhanced during growth by maintaining a balance. This is consistent with Uche et al.'s opinion that MS media contains all micronutrients and macronutrients. Macronutrients in MS media include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). NPK content in plants both decreases and increases growth. Plants with sufficient NPK will grow rapidly, while plants with insufficient NPK will experience decreased growth, and plants with excessive NPK will experience toxicity (Hapsoro and Yunita, 2018).

According to Nasrullah et al. (2015), N helps increase plant growth, including stems, branches, and leaves, as well as the formation of chlorophyll, fat, protein, and other organic compounds.

Volume 02 Number 01
May 2026
e-ISSN: 3124-8179
p-ISSN: 3124-7865

Similarly, P helps increase root growth, especially in seeds and young plants, and K strengthens plant stems to prevent them from collapsing. Firman et al. (2017) found that nitrogen significantly influences plant growth because it is required by plants for protein production, leaf growth, metabolism, and photosynthesis. Because the results for stem diameter parameters were almost identical to the average, the treatment was still not optimal. Furthermore, the potato variety used can also affect growth responses, as shown by Putri et al. (2021), who found that different potato varieties can alter the growth rate of each organ.

Shoot height showed significant results, indicating that different nutrient combinations are required for each plant's growth. Young plants 2 weeks post-planting require sufficient nutrients to survive, depending on their age. Nutrient deficiencies or excesses can disrupt plant growth (Armita et al., 2022). As plants age, they require more nutrients. Most tissue culture methods can identify this through plant responses (Dewanto et al., 2018).

Increasing or decreasing the concentration of KNO3 has no impact on leaf growth. The number of leaves in plant growth is a data indicator often used to explain the process of plant growth. Explant growth is positively correlated with the number of leaves. The results show that the number of leaves formed is within the average range. Nitrogen is essential for photosynthesis and for the growth and development of leaves and other organs. At the end of the plant, there was no significant increase in yield, indicating that the KNO3 application was insufficient. Hormones can indirectly increase the number of emerging leaves. This occurs when the cytokinin hormone is activated by KNO3 application. Cytokinins are responsible for cell division (Anggraeni et al., 2018).

Node elongation is a change in plant shape. Node elongation is caused by the hormone auxin, which is responsible for cell division and elongation. This can occur due to the stimulation of protein synthesis in plant tissue. This stimulation can increase cell wall permeability and promote cell division and elongation, thereby increasing plantlet length (Dewanto et al., 2018). Therefore, a maximum dose of 475 mg/L is considered sufficient, as higher concentrations will cause potato explant nodes to become shorter.

The part of the plant responsible for absorbing nutrients is the roots. The longer the roots, the more Lots nutrients that are absorbed, which is found in addition to endogenous hormones that determine the ability to explain differentiation. Stimulation is also required to activate the endogenous hormones. The addition of KNO3 at a concentration of 475 mg/l is the best concentration because the length of the root is highest at 18.2 cm. This is comparable to the function of potassium, a nutrient, in transferring hormones to certain areas (Lestari et al., 2018).

CONCLUSION

Based on the research results, the optimal treatment concentration was 475 mg/L. This treatment provided the best results for node length and root length, with a clear and significant difference compared to the other treatments. The KNO3 concentration of 475 mg/L was optimal, as it produced the best root and node lengths, which were significantly greater than those of other treatments.

REFERENCES

Anggraini, P.D., Handayani, T.T., Yulianty, & Zulkifli. (2018). The effect of KNO3 (potassium nitrate) compound on the growth of sorghum (Sorghum bicolor (L.) Moench) sprouts. *Journal of Experimental Biology and Biodiversity, 5*(1), 37-42.

Volume 02 Number 01
May 2026
e-ISSN: 3124-8179
p-ISSN: 3124-7865

Armita, D., W. Wahdaniyah, H. Hafsan, & H. A. Amanah. (2022). Visual Diagnosis of Essential Nutrient Problems in Various Types of Plants. *Teknosains: Science and Technology Information Media, 16*(1), 139-150.

Body Center Statistics. (2016). *Wide, Production, and Productivity Horticulture Indonesia*. Jakarta

Dewanto, HA, Saraswati, D., & Hadjoeningtijas, OD. (2018). Growth of Potato (Solanum tuberosum L.) Axillary Shoot Culture with the Addition of Super Phosphate and KNO3 to Ab Mix Media In Vitro. *Agritech, 20*(2), 71-81.

Ferdyansyah, B. (2022). *The effect of potassium fertilizer type and dosage on the growth, production, and sweetness of melon (Cucumis melo L.)* (Doctoral dissertation, Riau Islamic University).

Firmansyah, I., M. Syakir & L. Lukman. (2017). The Effect of Combination of N, P, and K Fertilizer Doses on the Growth and Yield of Eggplant (Solanum melongena L.). *Horticultural Journal, 27*(1), 69-78.

Hanafiah, KA. (2007). *Basics of Soil Science*. 1st-2nd Ed. Erlangga.

Humaerah, AD. (2015). Cultivation of Curly Chili Plants (Capsicum annum L.) in Various Planting Containers with Inorganic & Organic Fertilizers. *Biological Sciences, 1*(2), 69-75

Hapsoro, D, & Yusnita. (2018). *Tissue Culture - Theory and Practice.* Andi.

Nasrullah, N., N. Nurhayati, & A. Marliah. (2015). The effect of NPK (16:16:16) fertilizer dosage and mycorrhiza on the growth of cocoa (Therobrama cacao L.) seedlings in growing media

Pandiangan, RH, Yulianti, N., & Rochman, N. (2024). Potential of Elicitors and KNO3- on Growth, Production, and Quality of Edamame (Glycine Max (L.) Merr). *Agricultural Journal, 15*(1), 42-52.

Putri, ABS, H. Hajrah, D Armita, and IR Tambunan. (2021). Tissue culture techniques for in vitro propagation and conservation of potato plants (Solanum tuberosum L.). *Biology Student Journal: PHILOGENY, 1*(2), 69-79.

Suliansyah, I., Helmi, H., Ekawati, F., & Hariandi, D. (2021). Dissemination of Biocellular and Aeroponic Technology Applications to Increase Potato Production. *LOGISTA - Scientific Journal of Community Service.* https://doi.org/10.25077/logista.5.2.314-320.2021