



## RESEARCH ARTICLE

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# Improvement Growth Root Plant Kesum (*Polygonum minus*) in System Hydroponics with various Potassium Concentration

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## Abstract

The Kesum plant, scientifically known as *Polygonum minus*, is a herbaceous species native to Southeast Asia (Malaysia, Indonesia, Vietnam, Thailand) that thrives in damp, waterlogged environments, such as the edges of ditches and lakes. This study aims to investigate the effect of potassium concentration on root growth of Kesum (*Polygonum minus*) plants grown in a floating raft hydroponic system. The experiment was conducted at the MARDI Greenhouse in Serdang, Selangor, Malaysia, employing a Randomized Block Design (RBD) with five potassium concentration treatments (0, 50, 100, 150, and 200 mg/L) and five replications. Kesum cuttings, each 15 cm in length, were planted in hydroponic containers measuring 1 m × 3 m × 0.3 m, with the nutrient solution adjusted to a pH of 5.5-6.5 and electrical conductivity (EC) of 2.0-2.5 mS/cm. Observed parameters included plant height, stem diameter, canopy area, SPAD value, fresh weight, dry weight, root fresh weight, root dry weight, and root length. Data were analyzed using ANOVA followed by Duncan's Multiple Range Test (DMRT) at a significance level of 0.05. Results indicated that a potassium concentration of 150 mg/L yielded the highest fresh root weight (31.15 g) and optimal root length (22.31 cm), while a 100 mg/L potassium concentration supported the greatest plant height (82.77 cm). This study offers practical recommendations for farmers and agrotechnologists to apply potassium concentrations of 100-150 mg/L in hydroponic Kesum cultivation to achieve optimal root and vegetative growth and enhance production yields.

**Keywords:** ANOVA, Nutrition, Parameters, Production, Raft Floating

## 1. Introduction

The Kesum plant, scientifically known as *Polygonum minus*, is a herbal plant native to Southeast Asia, including Malaysia, Indonesia, Vietnam, and Thailand. It thrives in damp, watery environments such as the edges of ditches and around lakes. Kesum leaves naturally contain secondary metabolites, including flavonoids, aldehydes, terpenoids, geraniol, and phenolic compounds. The saponins in Kesum leaves serve as a defense mechanism against fungal attacks, flavonoids disrupt the integrity of cell membranes, and alkaloids target and damage lipophilic compounds (Syari et al., 2022). The kesum plant contains phenol, terpenoid, alkaloid, flavonoid, saponin, and tannin compounds. Apart from being used as a herb to scent cooking, kesum is also used in medicine. The kesum plant (*Polygonum minus*) is very popular among people in Indonesia, especially in West Kalimantan, as a flavoring ingredient in many types of food. Traditionally, boiled

water from kesum leaves is used to get rid of dandruff on the head and as a drink after giving birth (Inayah et al., 2024)

Kesum (*Polygonum minus*) belongs to the Polygonaceae family. Kesum is a creeping plant that can reach 1.0 m in the lowlands and up to 1.5 m in the highlands. The leaves are long and pointed, arrow-shaped, 5-7 cm long and 0.5-0.2 cm wide (Latif & Towid, 2022). The kesum plant originates in Southeast Asia, namely Malaysia, Thailand, Vietnam, and Indonesia. The kesum plant (*Polygonum minus*) is very popular among Indonesians, especially in West Kalimantan, as a flavoring ingredient in many types of food. Kesum plants can grow in various places, especially cool areas (Junaedi et al., 2023). Kesum leaves have a fragrant aroma, a distinctive flavor, and a sharp, slightly spicy taste. Kesum requires large, fertile land with a spacing of 20–30 cm between plants. However, urbanization has led to the conversion of

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agricultural land into housing, increasing the carbon footprint as Kesum must be supplied from rural areas. To address this, hydroponic systems enable tiered vertical planting using PVC pipes, allowing for more efficient cultivation in limited spaces, such as narrow plots or building rooftops, thereby promoting optimal plant growth (Ramadhani et al., 2025).

Hydroponics is a method of plant cultivation that uses water and nutrient-rich media. One of them provides optimal nutrition with adequate care, making it easy (Roidah, 2014). Nutrition in the system raft floating is more efficient because there is no settling, so this technique is hydroponics. This can increase the quality and quantity of plants in a hydroponics raft floating system. This allows plants to absorb nutrients in a more stable way. System: This uses a styrofoam receptacle to keep the solution nutrition and can also save production costs. Plants are planted with roots immersed in nutrient solution using net pots; ensure roots can directly contact the nutrient solution (Putriani et al., 2023). According to the literature (Tjahjono et al., 2021), the system hydroponics is a method of delivering nutrients to the roots of the plant through a solution. There are several types of hydroponic systems, such as NFT (Nutrient Film Technique), DFT (Deep Flow Technique), *Dutch Bucket*, aquaponics, and the raft floating system, which uses Styrofoam floating on top of the nutrient solution. For system raft floating can also be made from materials like wood or steel.

Potassium (K) plays an important role in plant growth and root development (Nabillah, 2024). Elements help increase the formation of strong, healthy roots, which help maintain important cell turgor, support elongation of root cells, and facilitate water absorption and nutrient uptake. Potassium also supports the synthesis of enzymes and proteins involved in cell distribution cells, so that speeds up development of the root system. A potassium deficiency can cause growth-helping roots plant more easy on pressure, such as drought or attacks by pathogens (Ardi, 2022). Provision of adequate potassium through fertilizer or good soil management is also important to ensure an optimal root system, thereby increasing yield and plant quality.

Potassium fertilizer contains the essential macronutrient  $K^+$  (or  $K_2O$ ) required by plants for photosynthesis, stomatal regulation, enzyme activation, carbohydrate and protein synthesis, pest and disease resistance, and structural strengthening. Plants absorb potassium in the form of  $K^+$  ions. In soil, potassium exists in several forms: soluble K (directly available), exchangeable K (easily released), fixed K (slowly available), and structural K (bound within minerals, very slowly available) (Agriculture, 2022). Potassium regulates water balance and improves plant tolerance to drought, as well as strengthening plant structure. Besides that, potassium plays a role in physiological processes such as

cell division, photosynthesis, regulation of stomatal opening and closing, and water distribution in the network and within cells (Astutik et al., 2019). Loading positive ions from potassium will help neutralize the charge caused by the negative charge on nitrate, phosphate, or other content elements (Rewur et al., 2019). Therefore, research was done to determine the influence of potassium concentration on the growth of root plant kesum (*Polygonum minus*) in a hydroponic system.

## 2. Material and Methods

### 2.1. Research Location

Study This was carried out at the Research Center Plant *Malaysian Agriculture Research and Development (MARDI) Industry, Serdang, Selangor, Malaysia*, at coordinates 2.9911°N, 101.7016°E, 50 masl within House Glass starting from September 22 to October 10, implementation study This started with preparation of media and materials, implementation Study done during two month and ends with Observation.

### 2.2. Research Plant Material

Kesum plants can be grown hydroponically. Kesum plants approximately 15 cm long, with 7–9 nodes, are selected as planting material. The leaves and side shoots on the cuttings are removed, leaving only the leaves on the main shoot to support growth. The kesum plants are then clamped with a damp sponge so they can hang, then inserted into the planting hole in the Styrofoam. In the hydroponic system, the kesum plant will be submerged to a depth of 7.5 cm in the nutrient solution, with the top 7.5 cm above the surface of the Styrofoam. Hydroponic planting of kesum plants is best done in the afternoon to minimize stress on the planting material. Roots on kesum cuttings usually begin to form after three days.



**Figure 1.** Planting materials used

**2.3. System Planting Hydroponics**

Planting in Hydroponics is done using the deep-water culture (Deep Culture) or raft-floating method. The easiest hydroponics system implemented and managed at an economical cost. Size of the container on the system hydroponics: 1m long × 3m wide × 0.3m high. Suitable plants are planted with the technique. This plant has a short life cycle. This technique is very practical for planting leafy vegetables like mustard greens, water spinach, and kale. It also reduces electricity use, conserves water, and makes it easier to purchase materials and equipment.



**Figure 2.** Sponge used as a germination medium

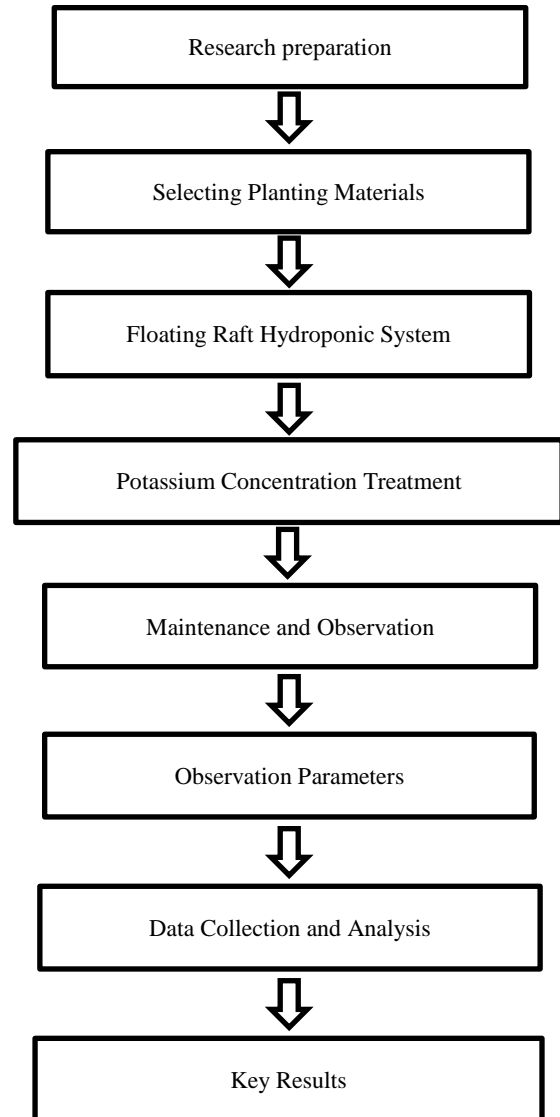


**Figure 3.** Planting plants in a hydroponic container

**2.4. Method Study**

Study: This uses a Design Random Group (RAK) with

five repetitions. Each One receptacle consists of 30 plants. An experiment involving five levels of potassium (K) concentration.



**Figure 4.** Research flow diagram

**2.5. Observation Parameters**

Every Growth plant is measured for plant height, stem diameter, canopy area, SPAD, wet weight, Heavy Dry, Heavy Wet Root, dry root weight, and Root Length. Three tens plants upset every treatment taken and, in determining results, the plants' growth was upset after two Sunday plantings.

**2.6. Research Data Analysis**

Data obtained were analyzed using the statistical procedure Analysis of Variance (ANOVA) to test for significant effects across all variables studied, using the SAS application (Version 9.2, SAS Institute, Cary, NC, USA). Mean and Standard Deviation (SD) from the test were determined using Analysis of Variance (ANOVA),

and Duncan's multiple range test (DMRT) was used to determine significant differences between treatments. Significance level statistics set at 0.05 for all tests.

### 3. Results and Discussion

Based on Table 1, the analysis results show that potassium concentration had a highly significant effect (\*\*P < 0.01) on all measured growth parameters of the plant, including plant height, stem diameter, canopy area, SPAD value, fresh weight, dry weight, fresh root weight, dry root weight, and root length. The calculated F values

far exceeded the critical F values. The highest average growth was observed in fresh weight ( $138.09 \pm 6.82$  g) and canopy area ( $52.22 \pm 2.55$  cm<sup>2</sup>). The coefficient of variation (CV%) ranged from 8.02% to 15.63%, indicating relatively low data variability, except for fresh root weight and root length, which had a CV of 15.63%. These results suggest that potassium plays an important role in enhancing vegetative growth and root development, likely through its involvement in enzyme activation, osmoregulation, and nutrient transport, thereby increasing overall plant biomass and health.

**Table 1.** Analysis ANOVA on Growth of Kesum Plant

Parameter	Test	Treatment	Mean±SE	CV %
Plant Height	25.36	53160.30**	69.74±3.39	8.42
Stem Diameter	0.22	47.57**	6.43±0.31	8.28
Canopy	11.46	9628.41**	52.22±2.55	8.45
SPAD	12.27	1973.09**	46.58±2.30	8.58
Heavy Wet	132.40	445888.82**	138.09±6.82	8.58
Heavy Dry	1.07	21326.89**	33.96±1.69	8.65
Heavy Wet Root	9.82	56475.69**	19.12±1.72	15.63
Heavy Dry Root	0.56	2810.37**	12.21±0.57	8.02
Root Length	9.51	5039.70**	19.12±1.70	15.63

**Table 2.** Effect of Potassium on the Growth of Kesum Plants at 60 HST in the Hydroponic System

Treatment (mg L <sup>-1</sup> K)	Plant height (cm)	Bar diameter (mm)	Canopy (cm <sup>2</sup> )	SPAD	Heavy wet (g)	Heavy dry (g)
0 mg/L	32.35 ± 1.8 b	5.39 ± 0.26 b	36.81 ± 2.9 b	41.58 ± 1.6 a	32.02 ± 2.8 b	12.15 ± 0.9 a
50 mg/L	75.70 ± 3.4 c	7.06 ± 0.31 c	53.12 ± 2.8 a	44.09 ± 1.7 b	144.57 ± 6.9 c	35.16 ± 2.2 b
100 mg/L	82.77 ± 3.7 d	6.75 ± 0.29 d	54.55 ± 2.5 a	45.96 ± 1.9 c	177.86 ± 8.1 a	42.78 ± 2.6 c
150 mg/L	79.23 ± 3.5 a	6.41 ± 0.28 a	57.06 ± 2.6 c	49.74 ± 2.1 d	177.99 ± 8.0 a	46.43 ± 2.9 d
200 mg/L	78.63 ± 3.4 a	6.49 ± 0.27 a	59.54 ± 2.7 d	51.50 ± 2.2 e	157.99 ± 7.3 d	33.26 ± 2.1 e

Based on Table 2, the administration of potassium (K) to kesum (*Persicaria odorata*) plants significantly influences growth and biomass, with an optimal response at 100–150 mg L<sup>-1</sup>. Plant height increased sharply from 32.35 cm (0 mg L<sup>-1</sup>) to 82.77 cm (100 mg L<sup>-1</sup>), then decreased slightly at 150–200 mg L<sup>-1</sup> (79.23–78.63 cm), indicating a point of feeding up or stress at this dose level. Stem diameter and area canopy Keep going increase up to 150 mg L<sup>-1</sup> (6.41 mm and 57.06 cm<sup>2</sup>), while SPAD value (index greenish leaves) consistently increased to 51.50 at 200 mg L<sup>-1</sup>, reflecting the improvement in chlorophyll synthesis, the consequence of K's role in activating enzymes and electron transport. Weight, wet and dry, reaches a peak at 150 mg L<sup>-1</sup> (177.99 g and 46.43 g), but decreases significantly at 200 mg L<sup>-1</sup> (157.99 g and 33.26 g), possibly a consequence of an imbalance in osmotic pressure and disturbance of water absorption. Overall, a K concentration of 100–150 mg L<sup>-1</sup> provides the best vegetative growth, accumulation of biomass, and physiological efficiency in kesum; meanwhile, excessive doses (>150 mg L<sup>-1</sup>) in fact cause inhibition.

Basically, every treatment can have an impact on plant

growth (Rezaldi & Hidayanto, 2022). Growth Plant becomes different with every treatment, caused by the ability of the root to absorb nutrients. According to Weihaan et al. (2024), at the vegetative growth stage, there is no significant difference in water absorption between treatments, but at the reproductive stage, it is superior in a consistent manner. In a way, overall, proven increase capacity and efficiency in water absorption and nutrition, at the same time, guard efficiency in potassium utilization and balance nutrition essential in tomatoes, substrate at home in glass. Besides that, according to Sulistiani et al. (2023), increasingly concentrated fertilizer given will result in a faster increase in the development of plant organs.

Canopy and SPAD parameters show improvement with increasing concentration, with the highest values of 59.54 cm and 51.50 at 200 mg/L, respectively, depicting increased leaf development and chlorophyll content. However, the weights Wet and Heavy Dry reach peak at 150 mg/L (177.99 g and 46.43 g) before decreasing at 200 mg/L (157.99 g and 33.26 g), suggesting a toxic effect. According to literature (Alfarabbi, 2024) state that concentration the proven as balanced optimal threshold For

support growth vegetative at a time accumulation biomass, while the above dose potential cause loss productivity consequence stress nutrition, decline significant long root consequence potassium toxicity, which interferes with

absorption nutrition essential like calcium and magnesium, inhibit expansion cells, as well as trigger stress osmotic, so that hinder the elongation process root in a way overall.

**Table 3.** Effect of Potassium on Rooting Plant Kesum on the 60 HST system Hydroponics

Treatment (mg L <sup>-1</sup> K)	Heavy Wet Root (g)	Heavy Dry Root (g)	Root Length (cm)
0 mg/L	9.26 ± 0.85 b	4.19 ± 0.37 a	12.19 ± 1.10 a
50 mg/L	22.01 ± 1.95 a	16.05 ± 1.45 b	17.90 ± 1.45 b
100 mg/L	21.55 ± 1.90 a	15.69 ± 1.35 c	28.52 ± 2.35 c
150 mg/L	31.15 ± 2.90 c	13.63 ± 1.20 d	22.31 ± 1.95 d
200 mg/L	22.78 ± 2.10 a	11.44 ± 1.05 e	14.65 ± 1.25 e



**Figure 5.** Effect of Potassium on the Growth of Plant Kesum

Based on Table 3, potassium administration to the hydroponic system disrupted root growth, with optimal responses at 150 mg L<sup>-1</sup> K for biomass and 100 mg L<sup>-1</sup> K for long roots. The weight of wet root increased significantly from 9.26 g (0 mg L<sup>-1</sup>) to a peak of 31.15 g at 150 mg L<sup>-1</sup>, then decreased at 200 mg L<sup>-1</sup> (22.78 g), indicating the existence of stress osmotic consequences of excess K ions. The weight of dry root reaches a maximum of 16.05 g at 50 mg L<sup>-1</sup> and decreases with increasing dose, up to 11.44 g (200 mg L<sup>-1</sup>), indicating a decline in the efficiency of material accumulation and a disturbance of metabolism. Root length was highest, recorded 28.52 cm at 100 mg L<sup>-1</sup>, decreasing sharply at 150–200 mg L<sup>-1</sup> (22.31–14.65 cm), possibly because of inhibition of growth end roots by K toxicity. Overall, a K concentration of 100–150 mg L<sup>-1</sup> provides the best balance between root development and elongation roots, while deficiency (0 mg L<sup>-1</sup>) and excess (>150 mg L<sup>-1</sup>) inhibit root system development in a significant way. According to Mazlina et al. (2024), potassium plays a role in improving plant metabolism, leading to the formation of proteins, carbohydrates, and starch that make up the heavy wet.

Besides that, according to Fernandus (2022). stated that an unstable temperature can lower results because it affects physiological and biochemical processes in plants, such as photosynthesis, respiration, and turgidity. Weight wet high roots often reflects consistent absorption of water and nutrients, with improvement significant at 150 mg/L.



**Figure 6.** Effect of Potassium on Plant Rooting

Heavy Dry Root shows different patterns, with a maximum of 16.05 g at 50 mg/L, followed by a gradual decrease up to 11.44 g at 200 mg/L. Decline: This shows that a higher concentration of treatment is required beyond 50 mg/L; no support for accumulation of biomass in Dry Roots; possibility of consequences from the effect on toxicity or disturbance of metabolism. According to Ardiansyah, Irfan. (2021) states that decline This can hinder growth. The root cause of the decline is heavy dry roots. Weight Dry Roots that can be decreased in dose; high nutrition can be associated with allocation of energy more to plants, big for vegetative growth from the roots. According to Muhammad Fuad Syah et al. (2021), increased metabolic processes in plants will require more nutrients and increase water absorption during growth. Nutrients at high concentrations can reduce the efficiency of biomass parallel roots, with heavy dry roots declining at

200 mg/L in the table. Overall, concentrations of 50–150 mg/L appear to give optimal results for root growth, with 150 mg/L supporting heavy wet highest and 50 mg/L supporting heavy dry highest.

In plants, upset hydroponics: 60 HST available, long root; the highest, 28.52 cm, was achieved at the optimal potassium concentration. indicating that potassium at optimal doses supports root elongation through its role in increasing cell division and nutrient transport, because potassium supports cell division and regulates nutrient transport. However, the dose heights of 150 mg/L (22.31 cm) and 200 mg/L (14.65 cm) decreased the long-term root consequences of potassium toxicity, which inhibits elongation. According to Firdausy et al. (2024), increasing root length by 15–30% through turgor and stomatal mechanisms, so that the recommended K application in Indonesia should be limited to 5–10 mM to avoid root inhibition while maximizing water absorption.

#### 4. Conclusion

Studies show that potassium concentration has a significant effect on all growth parameters of the plant Kesum (*Polygonum minus*) in a hydroponic raft floating system at 60 HST. The longest root length (28.52 cm) was

observed at 100 mg/L potassium, consistent with potassium's role in increasing cell division, turgor pressure, and nutrient transport. The highest wet root weight (31.15 g) was obtained at 150 mg/L potassium, while the maximum plant height (82.77 cm) was also observed at 100 mg/L. However, the dose of high potassium levels of 150–200 mg/L cause a significant decline in root length (22.31 cm and 14.65 cm) and biomass due to potassium toxicity. This toxicity impairs calcium and magnesium absorption, inhibits cell expansion, and triggers osmotic stress. Overall, the optimal potassium range is 100–150 mg/L to support vegetative growth and a strong root system. This practical recommendation is useful for hydroponic cultivation to increase productivity and nutrient use efficiency in soils with limited nutrient availability.

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