Journal of Kerbala for Agricultural Sciences Issue (4), Volume (12), (2025)

Effect of potassium fertilization and roselle extract foliar application on growth and yield of two turnip (*Brassica rapa* L.) cultivars

Marleen Karim Rasool* **and Khaled Abd Mutar**

Horticulture and Landscape Engineering Department, Agriculture College, University of Kerbala, Kerbala, Iraq
***Corresponding author e-mail: marleen.k@s.uokerbala.edu.iq**
https://doi.org/10.59658/jkas.v12i4.5212

Received:
June 05, 2025

Accepted:
July 17, 2025

Published:
Dec. 25, 2025

Abstract

A field experiment was conducted in the field of the Department of Horticulture and Landscape Engineering, College of Agriculture, University of Kerbala, in Al-Husseiniya District, Kerbala Governorate, during the autumn season 2024-2025, with the aim of studying the effect of adding potassium fertilizer and spraying roselle extract on the growth and yield of two turnip cultivars. The experiment was carried out according to a randomized complete block design (RCBD) with three replicates according to the factorial arrangement of three replications. The first factor included seven fertilization treatments (control potassium 100 kg K_2O ha^{-1}, potassium 200 kg K_2O ha^{-1}, potassium 100 kg K_2O ha^{-1} + spraying roselle extract at a concentration of 4 mg L^{-1}, potassium 100 kg K_2O ha^{-1} + spraying roselle extract at a concentration at 8 mg L^{-1}, potassium 200 kg K_2O ha^{-1} + spraying roselle extract at a concentration of 4 mg L^{-1}, and potassium 200 kg K_2O ha^{-1} + spraying roselle extract at a concentration at 8 mg L^{-1}), and symbolized as T1, T2, T3, T4, T5, T6 and T7 respectively. While the second factor included two cultivars of turnip plants, a local cultivar (A) and an Iranian cultivar (B). The results showed significant differences between the fertilizer treatments, as treatment T7 was outperformed in plant height (55.62 cm), number of leaves (21.60 leaf $plant^{-1}$), dry weight of the vegetative system(217.02g), total root weight (323.7 g), and marketable root weight (281.2 g). As for the cultivars, the local cultivar (A) was significantly outperformed in plant height (51.62 cm), number of leaves (18.58 leaf $plant^{-1}$), dry weight of the vegetative system (193.02 g), total root weight (303.1 g), and marketable root weight (273.5 g).

Keywords: *Brassica rapa* L.**,** Potassium fertilization, Roselle (*Hibiscus sabdariffa L.*)**)**

Introduction

Turnip (*Brassica rapa* L.) is a biennial herbaceous plant that belongs to the Brassicaceae family. Its roots complete their growth within two months, and it can be cultivated in spring, late summer, and autumn to obtain a good root yield[1,2] Numerous studies have indicated its nutritional and medicinal importance, as it is rich in

glucosinolates [3,4] phenolic compounds, organic acids, flavonoids [5], sulfur compounds, and volatile substances, which have been found to contribute to various health effects[6,7].

Potassium is an important nutrient required by large amounts of plants. It is involved in many essential biological processes, such as regulating cell pressure, improving photosynthetic efficiency and activating a large number of enzymes associated with metabolism [8]. Potassium also helps to increase the transport of photosyntant products from the leaves as root plants. It also plays a role in increasing the resistance of the facility for unfavorable environmental conditions such as drought and salinity. Therefore, potassium fertilization is an important factor that can directly affect plant growth and productivity [9].

The use of natural plant extracts as foliar fertilizers is one of the most suitable modern scientific methods that are safe for human health and the environment, including the use of the extract of the plant *Sabdariffa Hibiscus* L., which is rich in vitamins, minerals, and amino acids [10]. It stimulates vital processes in plants, such as photosynthesis, respiration, chlorophyll formation, encouraging cell division, tissue growth, and regulating and activating plant hormones[11]. Based on the above, the current study aims to evaluate the effect of different levels of potassium fertilizer and concentrations of roselle extract and their interaction on some growth traits and yield of two turnip cultivars, with the aim of determining the optimal treatment that can contribute to enhancing the growth and productivity of turnip under the prevailing environmental conditions in Kerbala governorate.

Materials and Methods

A field experiment was conducted in the field of the Department of Horticulture and Landscape Engineering - College of Agriculture - University of Kerbala in Al-Hussainiya District, Kerbala governorate, during the autumn season 2024-2025 to study the effect of adding potassium fertilizer and spraying roselle extract on the growth and yield of two turnip cultivars, with the aim of comparing the introduced cultivar (Iranian cultivar) with the local cultivar under the environmental conditions of Kerbala Governorate.

The experiment included two factors. The first factor consisted of seven fertilization treatments: control treatment, potassium at 100 kg K_2O ha^{-1} potassium at 200 kg K_2O ha^{-1} potassium at 100 kg K_2O ha^{-1}+Spraying roselle extract at a concentration of 4 mg L^{-1}, potassium at 100 kg K_2O ha^{-1}+Spraying roselle extract at a concentration of 8 mg L^{-1}potassium at 200 kg K_2O ha^{-1}+Spraying roselle extract at a concentration of 4 mg L^{-1}, and potassium at 200 kg K_2O ha^{-1}+Spraying roselle extract at a concentration of 8 mg L^{-1}. and symbolized as T1, T2, T3, T4, T5, T6, and T7 respectively. While the second factor included two cultivars of turnip plants, a local cultivar (A) and an Iranian cultivars (B).

The experiment was carried out according to a randomized complete block design (RCBD) with three replicates, each replicate included 14 experimental units, with an

area of 3 for M2 each experimental unit (3 m length x 0.8 m width). The seeds were planted on 2/10/2024 at a distance of 20 cm between plants, with 60 plants in each experimental unit. Drip irrigation was used, along with all field maintenance operations such as weeding, hoeing and pest control as needed. The potassium suifatetreatments were applied three weeks after sowing, while the roselle extract was sprayed one month after sowing at a rate of three sprays, with two weeks between each spray. At the end of the experiment season, measurements of the studied traits were taken on 1\1\2025

Table (1): Chemical components of roselle flowers (mg $100g^{-1}$)

Component	Quantity	Percentage (%)
Protein	1.145	% 1.7 – 3.2
Moisture	9.2	% 86
Fiber	12.0	% 10
Fat	2.61	% 1.1
Phosphorus	273.2	% 0.04
Calcium	12.63	% 0.18
Ash	6.90	% 1
Thiamine	0.117	-
Carotene	0.029	-
Iron	8.98	% 0.0054
Riboflavin	0.277	-
Ascorbic Acid	6.7	-
Niacin	3.765	-

Data recorded

Some vegetative traits were measured alongside yield traits, such as plant height (cm), total number of leaves (leaf $plant^{-1}$), dry weight of vegetative system (g $plant^{-1}$), total root weight (g $plant^{-1}$) and marketable root weight (g $plant^{-1}$).

Statistical analysis

After amassing and tabulating the facts associated with the have a look at, it changed into statistically analyzed according to the factorial experiment system applied by randomized complete blocks designing (R.C.B.D), and using of the GenStat15 program, the least significant difference ($L.S.D_{0.05}$) take a look at become used to compare and separate the means[12].

Results and Discussion

Plant height (cm)

The results of Table 2 showed that the effect of fertilizer treatments was significant on the height of turnip plants, as treatments T6 and T7 were superior by giving the highest means of 55.30 and 55.62 cm, respectively, while the lowest mean was found

in the control treatment T1, which recorded 38.87 cm. The results also showed a significant difference between the two cultivars in plant height, as the local cultivar recorded a mean of 51.62cm, while the Iranian cultivar recorded a mean of 45.48cm. As for the interaction between fertilizer treatments and cultivar, it was also significant, as the highest interaction was recorded in treatment T6 with the local cultivar (A), which did not differ significantly from treatment T7 of the same cultivar, with means of 58.73 cm and 58.30 cm, respectively, while the lowest interaction was in treatment T1 with the Iranian cultivar (B), with a mean of 34.33 cm.

Table (2): Effect of potassium fertilizer, foliar application of roselle extract, cultivar and their interaction on plant height (cm)

Fertilizer treatments		Cultivars		Means
		Local	Iranian	
T1	Control	43.40	34.33	38.87
T2	Potassium at 100 kg ha^{-1}	44.37	40.27	42.32
T3	Potassium at 200 kg ha^{-1}	48.70	42.60	45.65
T4	Potassium at 100 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	52.20	45.87	49.03
T5	Potassium at 100 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	55.67	50.50	53.08
T6	Potassium at 200 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	58.73	51.87	55.30
T7	Potassium at 200 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	58.30	52.93	55.62
Means		51.62	45.48	
$L.S.D_{0.05}$	Fertilizer treatments: 1.915	Cultivars: 1.023		Interaction: 2.708

Number of leaves (leaf $plant^{-1}$)

The results (Table 3) showed that the effect of fertilizer treatments significantly affected the number of leaves, as treatment T7 outperformed with an mean of 21.60 leaf $plant^{-1}$ and did not differ significantly from treatment T6, which gave an average of 20.32 leaf $plant^{-1}$, while the control treatment T1 recorded the lowest mean of 13.33 leaf $plant^{-1}$. The results also showed significant differences between the two cultivars in the number of leaves, as the local cultivar (A) recorded the highest mean of 18.58 leaf $plant^{-1}$, while the Iranian cultivar (B) recorded a mean of 16.41 leaf $plant^{-1}$. The interaction between fertilizer treatments and cultivar was also significant, as the highest interaction was in treatment T7 with the local cultivar (A) with a mean of 22.73 leaf $plant^{-1}$, while the lowest interaction was in treatment T1 with the Iranian cultivar (B) with a mean of 12.60 leaf $plant^{-1}$.

Table (3): Effect of potassium fertilizer, foliar application of roselle extract, cultivar, and their interaction on number of leaves (leaf plant^{-1})

Fertilizer treatments		Cultivars		Means
		Local	Iranian	
T1	Control	14.07	12.60	13.33
T2	Potassium at 100 kg ha^{-1}	15.40	13.87	14.63
T3	Potassium at 200 kg ha^{-1}	17.40	14.00	15.70
T4	Potassium at 100 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	19.10	16.20	17.65
T5	Potassium at 100 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	20.13	18.30	19.22
T6	Potassium at 200 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	21.20	19.43	20.32
T7	Potassium at 200 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	22.73	20.47	21.60
Means		18.58	16.41	
L.S.D$_{0.05}$	Fertilizer treatments: 1.662	Cultivars: 0.888	Interaction: 2.351	

Dry weight of the vegetative system (g plant^{-1})

The results (Table 4) showed significant differences between the fertilizer treatments in the dry weight of the vegetative system, as treatment T7 outperformed by giving the highest mean of 217.02 g plant^{-1}, while the control treatment T1 gave the lowest mean of 169.30 g plant^{-1}. The results also showed a significant difference between the two cultivars in the dry weight of the vegetative system, as the local cultivar (A) recorded a mean of 193.02 g plant^{-1}, surpassing the Iranian cultivar (B), which recorded a mean of g. It w179.11 as also noted that the interaction between the fertilizer treatments and the cultivar had a significant effect on this trait, as the highest interaction was in treatment T7 with the local cultivar (A), with a mean of 234.60 g plant^{-1}, while the lowest interaction was 165.40 g plant^{-1} in treatment T1 with the Iranian cultivar (B).

Table (4): Effect of potassium fertilizer, foliar application of roselle extract, cultivar, and their interaction on dry weight of the vegetative system (g plant)

Fertilizer treatments		Cultivars		Means
		Local	Iranian	
T1	Control	173.20	165.40	169.30
T2	Potassium at 100 kg ha^{-1}	176.30	167.93	172.12
T3	Potassium at 200 kg ha^{-1}	181.10	173.20	177.15
T4	Potassium at 100 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	185.70	178.40	182.05

T5	Potassium at 100 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	190.80	182.80	186.80
T6	Potassium at 200 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	209.43	186.60	198.02
T7	Potassium at 200 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	234.60	199.43	217.02
Means		193.02	179.11	
$L.S.D_{0.05}$	Fertilizer treatments: 2.651	Cultivars: 1.417	Interaction: 3.750	

Total root weight (g $plant^{-1}$)

The results (Table 5) showed significant differences among the means of fertilizer treatments in the total root weight of turnip plants, as treatment T7 was outperformed with a mean of 323.7 g $plant^{-1}$ compared to the control treatment which gave the lowest mean of 215.8 g $plant^{-1}$. The results in the same table also showed a significant difference between the means of the two cultivars, as the local cultivar (A) achieved a mean of 303.1 g $plant^{-1}$, surpassing the Iranian cultivar (B), which achieved a mean of 236.3 g $plant^{-1}$. As for the interaction between fertilizer treatments and cultivar, it was observed that it significantly affected the trait of total root weight, as the highest interaction was recorded in treatment T7 with the local cultivar (A) with a mean of 352.1 g $plant^{-1}$, while the lowest interaction was recorded in treatment T1 with the Iranian cultivar (B) with a mean of 185.2 g $plant^{-1}$.

Table (5): Effect of potassium fertilizer, foliar application of roselle extract, cultivar, and their interaction on total root weight (g $plant^{-1}$).

Fertilizer treatments		Cultivars		Means
		Local	Iranian	
T1	Control	246.3	185.2	215.8
T2	Potassium at 100 kg ha^{-1}	265.1	199.3	232.2
T3	Potassium at 200 kg ha^{-1}	276.1	218.3	247.2
T4	Potassium at 100 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	315.1	225.3	270.2
T5	Potassium at 100 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	323.1	251.2	287.2
T6	Potassium at 200 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	344.1	279.5	311.8
T7	Potassium at 200 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	352.1	295.2	323.7
Means		303.1	236.3	
$L.S.D_{0.05}$	Fertilizer treatments: 9.84	Cultivars: 5.26	Interaction: 13.92	

Marketable root weight (g $plant^{-1}$)

The results Table 6 indicated that there was a significant effect between the fertilizer treatments on the marketable root weight trait of turnip plants, as the T7 treatment outperformed by giving the highest a mean of 281.2 g $plant^{-1}$compared to the control

treatment T1, which gave a mean of 195.2 g plant^{-1}. The results showed a significant difference between the two cultivars in the marketable root weight, as the local cultivar (A) recorded the highest a mean of 273.5 g plant^{-1}, while the Iranian cultivar (B) recorded the lowest a mean of 203.8 g plant^{-1}. The interaction between the fertilizer treatments and the cultivar also had a significant effect on this trait, as the highest interaction was in the T7 treatment with the local cultivar (A), with a mean of 312.2 g plant^{-1}, while the T1 treatment with the Iranian cultivar (B) gave the lowest interaction, with a mean of 166.2 g plant^{-1}.

Table (6): Effect of potassium fertilizer, foliar application of roselle extract, cultivar, and their interaction on the marketable root weight (g plant^{-1}).

Fertilizer treatments		Cultivars		Means
		Local	Iranian	
T1	Control	224.2	166.2	195.2
T2	Potassium at 100 kg ha^{-1}	231.2	177.2	204.2
T3	Potassium at 200 kg ha^{-1}	249.2	191.3	220.2
T4	Potassium at 100 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	292.2	202.1	247.2
T5	Potassium at 100 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	301.1	210.2	255.7
T6	Potassium at 200 kg ha^{-1}+Roselle extract at 4 mg L^{-1}	304.2	229.2	266.7
T7	Potassium at 200 kg ha^{-1}+Roselle extract at 8 mg L^{-1}	312.2	250.1	281.2
Means		273.5	203.8	
L.S.D$_{0.05}$	Fertilizer treatments: 12.50	Cultivars: 6.68		Interaction: 17.68

The results mentioned in the vegetative growth indicators and the yield (plant height, number of leaves, dry weight of the vegetative, marketable root weight and total root weight) showed that the T7 treatment (potassium at 200 kg ha^{-1} + roselle extract at 8 mg L^{-1}) outperformed in most vegetative growth. This is due to the effective role of potassium in meristematic cell division of meristematic cells, absorption of nutrients and activation of enzymes [13], which increased the plant height and number of leaves, and also enhanced the efficiency of the photosynthesis rate, which was reflected in increasing the production of dry matter for the plant and improving plant growth (14,15). The increase in vegetative traits, plant height, number of leaves and increase in the dry weight of the vegetative (Table 2,3 and 4), led to an increase in the manufactured nutrients in the leaves and their transfer to storage areas, resulting in an increase in the marketable and total root weight. These results are consistent with what was stated in [16,17] on the cucumber plant.

The increase in vegetative indicators and yield due to spraying with the roselle extract is attributed to its content of nutrients, phenols and flavonoids (Table 1), which are important for plant growth and are added as a spray on the leaves. It also contains

nitrogen, one of the important elements that enters into the composition of proteins, enzyme cofactors and nucleic acids (RNA, DNA), which causes an increase in the production and accumulation of dry matter in the plant, leading to an increase in growth rates, which is ultimately reflected in an increase in the length of the plant and then an increase in the number of leaves and the dry weight of the vegetative. This is consistent with what was concluded by [18, 19] that spraying the roselle extract leads to an improvement in the formation of a well-developed root and shoot system, which is positively reflected in an increase in the absorption of nutrients by the plant and an increase in the efficiency of the photosynthesis process, then an increase in the production of carbohydrate materials in the leaves, their storage and transfer, which contributed to an increase in the marketable root weight and the total root weight, and thus an improvement and increase in the yield.

The findings of the study indicated that potassium fertilization at 200 kg ha^{-1} along with roselle extract at a concentration of 8 mg L^{-1} increased vegetative characteristics and yield respectively of both turnip cultivars greatly, indicating a positive interaction between potassium fertilization and plant extract. The data also revealed that the local cultivar significantly outperformed the Iranian cultivar for most of the studied characteristics indicative of its high efficiency and conformity to the environmental status of the Kerbala region. Thus, the complementary use of mineral fertilizers and plant extracts offered a means to improve growth and productivity, especially in conjunction with high levels of potassium in combination with bioactive compounds.

References

1) Hong, E., & Kim, G. H. (2008). Anticancer and antimicrobial activities of β-phenylethyl isothiocyanate in *Brassica rapa* L. *Food Science and Technology Research, 14*(4), 377.
2) Paul, S., Geng, C. A., Yang, T. H., Yang, Y. P., & Chen, J. J. (2019). Phytochemical and health-beneficial progress of turnip (*Brassica rapa* L.). *Journal of Food Science, 84*(1), 19–30.
3) Barbieri, G., Pernice, R., Maggio, A., De Pascale, S., & Fogliano, V. (2008). Glucosinolates profile of *Brassica rapa* L. subsp. *Sylvestris* L. Janch. var. *esculenta* Hort. *Food Chemistry, 107*(4), 1687–1691.
4) Baenas, N., Moreno, D. A., & García-Viguera, C. (2012). Selecting sprouts of Brassicaceae for optimum phytochemical composition. *Journal of Agricultural and Food Chemistry, 60*(45), 11409–11420.
5) Cao, Q., Wang, G., & Peng, Y. (2021). A critical review on phytochemical profile and biological effects of turnip (*Brassica rapa* L.). *Frontiers in Nutrition, 8*, 2–9.
6) Romani, A., Vignolini, P., Isolani, L., Ieri, F., & Heimler, D. (2006). HPLC-DAD/MS characterization of flavonoids and hydroxycinnamic derivatives in turnip tops (*Brassica rapa* L. subsp. *sylvestris* L.). *Journal of Agricultural and Food Chemistry, 54*(4), 1342–1346.

7) Singh, H. K., Singh, K. M., & Meraj, M. (2018). Growth and yield performance of okra (*Abelmoschus esculentus* L.) varieties on farmer's field. *International Journal of Current Microbiology and Applied Sciences, Special Issue, 7*(4), 1–13.

8) Sinha, D., & Tandon, P. K. (2020). An overview of nitrogen, phosphorus, and potassium: Key players of nutrition process in plants. In *Sustainable solutions for elemental deficiency and excess in crop plants* (pp. 85–117).

9) Mengel, K. (2016). Potassium. In *Handbook of plant nutrition* (pp. 107–136). CRC Press.

10) Al-Hashimi, A. G. (2012). Antioxidant and antibacterial activities of *Hibiscus sabdariffa* L. extracts. *African Journal of Food Science, 6*(21), 506–511.

11) Jaafar, H. S., Mutar, K. A., & Aboohanah, M. A. (2021). Effect of spraying salicylic acid on growth and yield parameters of pepper (*Capsicum annuum*). *Indian Journal of Ecology, 48*, 115–118.

12) Steel, R. G. D., & Torrie, J. H. (1980). *Principles and procedures of statistics: A biometrical approach* (2nd ed., p. 481). McGraw-Hill Book Company.

13) Al-Naimi, S. A. N. A. (1999). *Fertilizers and soil fertility* (2nd rev. ed., p. 384). Directorate of Dar Al-Kutub for Printing and Publishing, University of Mosul, Ministry of Higher Education and Scientific Research.

14) DeRosa, M. C., Monreal, C., Schnitzer, M., Walsh, R., & Sultan, Y. (2010). Nanotechnology in fertilizers. *Nature Nanotechnology, 5*(2), 91. https://doi.org/10.1038/nnano.2010.10

15) Khandelwal, A., & Joshi, R. (2018). Synthesis of nanoparticles and their application in agriculture. *Acta Scientific Agriculture, 2*(3), 10–13.

16) Al-Aidi, K. A. D. (2016). *Response of cucumber crops to inoculation with biofertilizers, salicylic acid sprays, and the nutrient Siapton, and their interaction on growth and yield* (Master's thesis). College of Agriculture, University of Baghdad, Iraq.

17) Al-Hamadi, A. A. H. (2018). *Qualitative response of cucumber plants to irrigation water and foliar spraying with potassium humate* (Master's thesis). College of Agriculture, University of Kufa, Iraq.

18) Al-Bayati, H. J. M., Al-Habar, M. T. A. S., & Al-Layla, W. B. (2012). The effect of organic fertilization on the growth and yield of female hybrid cucumber, GrassF variety, grown in unheated greenhouses. *Al-Kufa Journal of Agricultural Sciences, 4*, 327–336.

19) Yousif, A. K. H. (2012). *Effect of humic acid, biofertilizer (EM-1), and application method on growth, flowering, and yield of cucumber (Cucumis sativus L.)* (Master's thesis). University of Duhok, Iraq.

20) Müller, B. M., & Franz, G. (1992). Chemical structure and biological activity of polysaccharides from *Hibiscus sabdariffa*. *Planta Medica, 58*(01), 60–67. https://doi.org/10.1055/s-2006-962484

21) Samy, M. S. (1980). Chemical and nutritional studies on roselle seeds (*Hibiscus sabdariffa* L.). *Zeitschrift für Ernährungswissenschaft, 19*(1), 47–49.