



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(5): 427-430
Received: 17-02-2026
Accepted: 21-03-2026

Baneen Ahmed Abdul hassen
Faculty of Agriculture, University
of Kufa, Republic of Iraq

Zainab Hasan Thajeel Al-Khuzae
Faculty of Agriculture, University
of Kufa, Republic of Iraq

Response of table beeta *Bet vulgaris* to organic fertilizer and nano-calcium spraying in growth indicators and root yield

Baneen Ahmed Abdul hassen and Zainab Hasan Thajeel Al-Khuzae

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5f.5539>

Abstract

Due to the importance of cultivating table beet The experiment was conducted at the research station of the Faculty of Agriculture - University of Kufa during the agricultural season 2025-2026 to demonstrate the role of organic fertilizer and Nano calcium in in growth indicators and root yield., by studying two factors: organic fertilizer at three concentrations (0, 1800 and 3600g)40kg.ha⁻¹ and the second factor was nano calcium calcium, at three concentrations (0, 20 and 40) mg/L⁻¹. As recommended by the manufacturer, the second factor consists of three concentrations of nano-calcium: (0, 20, and 40) mg/L, which is sprayed in two stages. The first application is before the formation of the reservoir roots, i.e., after the development of 4-5 true leaves, and the second application is 20 days after the first spraying. The field soil is prepared by thoroughly tilling it and divided into three replicates. Each replicate is divided into nine plots, each plot representing an experimental unit measuring 3 m² by 1 m² (length x width), resulting in an area of 3 m². Each plot is then divided into eight rows, each containing five plants. The distance between plants is 20 cm, and between rows, 30 cm, for a total of 40 plants per experimental unit. A 50 cm distance is left between experimental units for maintenance and isolation purposes. The distance between replicates is 1 m². implemented using a complete randomized block design (R.C.B.D) 3×3×3 = 27. were analyzed using analysis of variance (ANOVA) and comparisons were made. According to the Least Significant Difference test (L.S.D) at a probability level (0.05). The results showed that organic fertilizer at a concentration of 3600 hectare⁻¹ with nano calcium at concentrations of 40 mg.L⁻¹. The best results that recorded a significant increase in root circumference, root length, root diameter, plant height, number ofv leaves, and total soluble carbohydrates. The interaction was 3600 hectare⁻¹ organic fertilizer and 40 mg.L⁻¹ nano calcium, which did not differ from the interaction of organic fertilizer at the same concentration with 20 mg.L⁻¹ nano calcium. The mentioned interaction treatments differed significantly from the individual treatments and was also significantly different from the control treatment in all the studied parameters.

Keywords: *Beta vulgaris*, organic fertilizer, nano calcium

Introduction

An important winter crop. It is cultivated for its roots, which are rich in carbohydrates, minerals, and vitamins. Its leaves are also edible due to their beneficial nutrients. Thus, all parts of the plant are useful and have high nutritional value [10]. Cultivated beetroot, including sugar beet, is an economically important edible crop [19]. Medically, several studies have demonstrated the therapeutic efficacy of table beetroot through its highly active compounds that enhance blood properties and components in humans. This suggests that the general public, and pregnant women in particular, can use beetroot as a comprehensive, non-pharmaceutical treatment for anemia prevention [17]. Ceclu and Nistor reported that beetroot is an important source of health-promoting phytochemicals, including polyphenols, carotenoids, and vitamins. It also possesses antioxidant, anti-inflammatory, anticancer, and hepatoprotective properties. Beetroot has benefits against diabetes, cardiovascular disease, hypertension, and promotes wound healing. It is also used to treat anemia, cancer, constipation, dandruff, and stomach ulcers. Beetroot fiber helps lower cholesterol [8]. and may mitigate the effects of dementia and memory loss by increasing blood flow to the brain. It also strengthens bones, and beetroot juice is used as a natural remedy for erectile dysfunction [16]. Organic fertilizers: Organic farming is one of the

Corresponding Author:
Baneen Ahmed Abdul hassen
Faculty of Agriculture, University
of Kufa, Republic of Iraq

most important modern practices in vegetable production, and it is difficult to deny that organic fertilization is one of the important methods for supplying plants with their required nutrients without any negative impact or side effects on the environment. Furthermore, excessive organic fertilization does not lead to the plant damage that occurs when fertilizing with large quantities of mineral fertilizers. Those working in the agricultural sector are also well aware of the role of organic matter in plant growth and yield, whether added to the soil or sprayed on the foliage [13]. Organic fertilizers improve the physical properties of the soil by increasing its stability and the formation of soil aggregates, and its chemical properties by increasing the soil's cation exchange capacity [12] reported results when adding 5, 10, 15, and 20 tons. In one hectare of poultry waste, the leaf area of potato plants increased linearly with the addition of organic fertilizer, which positively impacted the availability of most nutrients. This led to an increase in chlorophyll content and the rate of photosynthesis, resulting in an increase in the number of leaves and, consequently, an increase in leaf area. Table beet plants are affected by several factors, the most important of which is foliar fertilization. Most plants readily absorb nutrients when sprayed on their foliage

using Symeplast and Apoplast. Therefore, foliar feeding has become a good method for supplying plants with nutrients, as well as being an effective way to transport nutrients more efficiently and quickly within the plant [1]. Consequently, attention has turned in recent years to the use of modern technologies in plant nutrition, one of the latest being nanotechnology. Studies indicate that the use of nano-fertilizers leads to increased nutrient utilization efficiency and reduces the potential negative effects of traditional application [11].

Materials and Methods

The experiment was carried out at the agricultural research station of the College of Agriculture - University of Kufa during the agricultural season, this was done to study the response of table beet plants to organic fertilizer and spraying with nano-calcium in terms of growth indicators and root yield random soil samples were taken before planting in a field at a depth of (0-30) cm. The samples were mixed and air-dried for (72) hours, then ground and sieved through a sieve with [6] mm openings. Chemical analysis was then performed on them, as shown in the table. Table (1)

Table 1: Some of the physical and chemical properties of the soil used in the study

Unit of measurement	Analysis result	Type of analysis	
	Physical properties		
gm. kg ⁻¹	88	Clay	
	61	Silkenage	
	708	Sand	
	Sandy mixture		tissue
	Chemical and fertility properties		
	7.21		Degree of reactivity
Decimins. M ⁻¹	2.4		Electrical conductivity
%	1.9		Organic matter
mg. kg ⁻¹ soil	0.668		Nitrogen
mg. kg ⁻¹ soil	0.670		Phosphorus
mg. kg ⁻¹ soil	5.2		Potassium
Millimol charge ⁻¹ liter	24.1	Calcium	Dissolved ions Positive ions
	8.5	Magnesium	
	1.2	Sodium	
Millimol charge ⁻¹ liter	5.1	sulfates	ions melted
	2	bicarbonate	
	17.6	chloride	

Table 2: Chemical Analysis of Irrigation Water Used in Irrigating the Study Field

unit of measurement	Analysis result		Type of analysis
	Chemical properties		
	8.40		Degree of reactivity
Decimens.L ⁻¹	1.29		Electrical conductivity
%	1.3		Organic substance
mg. L ⁻¹	12.2	Potassium	Ions Positive Soluble
Millimol charge. Liter	7.3		
	8.1	Sodium	
	9.3	Calcium	Ions
Millimol charge. Liter ⁻¹	3.2	Magnesium	Negative
	Nil	Bicarbonate	
	29	Carbonate	
	3.3	Chloride	
	4.51	Phosphorus	
	1.13	Iron	

The field soil was prepared by plowing it thoroughly and divided into three replicates. Each replicate was further divided

into nine (9) raised beds, each representing an experimental unit measuring 3 m² by 1 m² (length x width), thus making the area

of an experimental unit 3 m². The raised beds were then divided into eight (8) rows, each row containing five (5) plants. The distance between plants was 20 cm, and between rows, 30 cm, resulting in each experimental unit containing 40 plants. A 50 cm distance was left between experimental units for maintenance and isolation purposes. The distance between replicates was 1 m², where maintenance, irrigation, weeding and pest control operations were carried out.

Indicators under study

Vegetative growth indicators

1. Plant height (cm) was measured with a measuring tape from the soil surface of the pot up to the highest end of the vegetative part.
2. Number of leaves (leaf.plant⁻¹) by calculating the total number of leaves for each experimental unit and then taking the average for each treatment.

Indicators of radical growth

1. Root circumference per root circumference

The root circumference was measured by wrapping a string around the widest point of the root, then measuring the length of the string with a ruler for each experimental unit, and finally calculating the average for five roots.

Root diameter

Root diameter was measured using a vernia instrument for each experimental unit, and then the average was calculated for five roots.

Chemical Indicators

Estimation of the leaves' content of total soluble carbohydrates

(mg.g⁻¹).

The carbohydrate content of the leaves was estimated according to the method [6].

Results

The results shown in Table (3) addition with organic fertilizer at a concentration of 3600 g.40kg.ha⁻¹ led to a significant increase in, root length, root diameter, number ofv leaves, and total soluble carbohydrates, reaching. 11.433 cm, 53.02cm, 43.29 leaf.planT₁⁻ and 14.24 mg.g⁻¹ compared with the control treatment, which amounted to. 10.200 cm, 52.84mm, 25.43 leaf.planT₁⁻ and 12.88 mg.g⁻¹, respectively. We conclude from the results of Table (3).

The results shown in Table (3)) show that spraying with calcium at a concentration of 60 mg.L⁻¹ g led to a significant increase in root circumference, root length, root diameter, plant height, number ofv leaves, and total soluble carbohydrates, reaching 84.39mm. 12.800 cm, 72.30 mm, 32.60 cm, 47.62 leaf.planT₁⁻ and 16.59 mg.g⁻¹ compared with the control treatment, which amounted to 64.26 mm. 10.200 cm, 52.84mm, 29.01 cm, 25.43 leaf.planT₁⁻ and 12.88 mg.g⁻¹, respectively.

The results of Table (3) show that addition with organic fertilizer at a concentration of 3600 g 40kg.ha⁻¹ and spraying nano calcium at a concentration of 60.mg.L⁻¹ led to a significant increase in root length, root diameter, plant height, number ofv leaves, and total soluble carbohydrates, reaching 91.21mm. 14.067 cm, 72.17 mm, 35.76 cm, 59.74 leaf.planT₁⁻ and 16.33 mg.g⁻¹ compared with the control treatment, which amounted to 64.26 mm. 10.200 cm, 52.84mm, 29.01 cm, 25.43 leaf.planT₁⁻ and 12.88 mg.g⁻¹, respectively.

Table 3: Response of table beet to organic fertilizer and nano-calcium spraying in growth indicators and root yield

Organic fertilizer kg.	Nano-calcium mg.L ⁻¹	CHO	Root circumference	Root length	Root diameter	Plant height(cm)	Number of papers leaf.planT ₁ ⁻
0	0	12.88	64.26	10.200	52.84	29.01	25.43
	20	13.95	69.58	11.400	64.41	30.69	37.58
	40	16.59	84.39	12.800	72.30	32.60	47.72
1800	0	15.84	64.70	11.113	52.54	26.60	42.01
	20	14.18	71.01	13.633	64.31	28.52	54.41
	40	13.47	90.59	14.467	71.91	32.54	52.99
3600	0	14.24	63.72	11.433	53.02	27.49	43.29
	20	15.93	70.65	13.033	64.10	30.44	50.50
	40	16.33	91.21	14.067	72.17	35.76	59.74
L.S.D. (P≤0.05)	Organic fertilizer	1.612	5.114	0.4713	1.149	1.499	4.723
	Nano-calcium	1.612	5.114	0.4713	1.149	1.499	4.723
	Interaction	3.224	8.858	0.8164	2.258	2.597	8.180

Discussion

Organic fertilizers are a cornerstone of sustainable agricultural systems, playing a vital role in improving soil fertility and increasing crop productivity, including that of sugar beets [15]. Their main sources include manure, poultry waste, and compost, which are characterized by their balanced nutrient content and organic matter, contributing to improved soil properties. Adding organic fertilizers enhances the physical characteristics of the soil by increasing particle cohesion and granular structure, thus improving aeration and increasing water retention capacity. This is crucial for root growth and development This results in an increase in root circumference, height, and diameter, especially in root crops like sugar beets. Organic fertilizers also reduce soil bulk density and improve water permeability, enhancing nutrient absorption. From a biological perspective, organic fertilizers activate soil microorganisms, which play a significant role in

decomposing organic matter and releasing nutrients. They also secrete growth-promoting substances such as auxins and gibberellins, promoting both root and shoot growth This has a positive effect on plant height and the number of leaves. [9]. Calcium, a key nutrient, is involved in the formation and strengthening of cell walls. It is incorporated into the calcium pectates required by plant cells and contributes to regulating cell permeability and reducing water loss, thus enhancing plant tolerance to minor stresses [18]. Studies have shown that foliar calcium application improves plant quality by reducing physiological issues such as fruit cracking and blossom rot [3]. Chemically, chemical fertilizers increase cation exchange capacity (CEC), helping retain nutrients and preventing leaching [7]. They also regulate soil pH, thereby improving nutrient availability to plants. Furthermore, they provide a slow-release source of nutrients, ensuring continuous

and balanced plant nutrition throughout the growing season. This leads to improved root and plant leaves characteristics, resulting in good productivity^[4].

Conclusion

Results showed that addition with Organic fertilizer at a concentration of 3600.ha⁻¹ led to a significant increase in root circumference, root length, root diameter, plant height, number of leaves, and total soluble carbohydrates follows that was spraying with Organic fertilizer at a concentration of 3600 g.ha⁻¹ with nano-calcium at a concentration of 60mg.l⁻¹ had a significant effect on the mentioned qualities.

References

1. Al-Jawari AKS. The effect of spraying with different nutrients on the growth and yield of sweet pepper *Capsicum annum* L [master's thesis]. Baghdad (IQ): College of Agriculture, University of Baghdad; 2002.
2. Al-Khafaji AMH, Al-Amri NJ, Al-Dulaimi NHA. Growth, yield, and antioxidant traits of different parts of beetroot as affected by vermicompost and glutathione. *Iraqi J Agric Sci.* 2022;53(5):1107-1114.
3. Al-Rubeae FMS, Al-Douri EF. Effect of foliar spraying with benzyl adenine and nano-calcium on some vegetative growth and fruiting traits of Al-Ubaid fig trees. *Tikrit J Agric Sci.* 2025;25(4):92-100.
4. Bhatt MK, Labanya R, Joshi HC. Influence of long-term chemical fertilizers and organic manures on soil fertility: A review. *Univ J Agric Res.* 2019;7(5):177-188.
5. Ceclu L, Nistor OV. Red beetroot: Composition and health effects - A review. *J Nutr Med Diet Care.* 2020;6(1):1-9.
6. Dubois M, Gilles KA, Hamilton JK, Robers PA, Smith F. Colorimetric method for determination of sugars and related substance. *Anal Chem.* 1956;28:350-356.
7. El-Motaium RA, Shaban AE, Badawy EH, Ibrahim AS. The potential role of nano-calcium and boron in increasing mango fruits productivity, quality and antioxidant content. *J Plant Nutr.* 2025;48(9):1529-1546.
8. Kumar Y. Beetroot: A superfood. Assistant Professor, Department of FPT, Bilaspur University, Bilaspur, Chhattisgarh, India. 2015;1(3).
9. Mahmoud E, *et al.* Role of organic fertilization in improving soil properties and crop productivity. 2021.
10. Matloub AN, Mohammed EES, Abdul KS. Vegetable Production. Part One. Baghdad (IQ): Dar Al-Kutub Printing and Publishing Foundation, Ministry of Higher Education and Scientific Research; 1989.
11. Morales CM, DeRosa M, Mallubhotla SC, Bindraban PS, Dimkpa C. Nanotechnologies for increasing the crop use efficiency of fertilizer-micronutrients. *Biol Fertil Soils.* 2016;52(3):423-437.
12. Najm AA, Haj SeyedHadi MR, Fazeil F, Darzi MT, Shamorady RR. Effect of utilization of organic and inorganic nitrogen source on the potato shoots dry matter, leaf area index.
13. Nardi S, Pizzeghello D, Schiavon M, Ertani A. Plant biostimulants: Physiological responses induced by protein hydrolyzed-based products and humic substances in plant metabolism. *Scientia Agricola.* 2016;73(1):18-23.
14. Pylak M, Oszust K, Frac M. Review report on the role of bioproducts, biopreparations, biostimulants and microbial inoculants in organic production of fruit. *Rev Environ Sci Biotechnol.* 2019;18:597-616.
15. Sas Paszt L, Gluszek S. Organic fertilizers and biofertilizers. In: *Instant Insights: Organic Soil Amendments.* Cambridge (UK): Burleigh Dodds Science Publishing; 2025. p. 1-45.
16. Szot M, Karpecka-Galka E, Drózd R, Frączek B. Can nutrients and dietary supplements potentially improve cognitive performance also in esports? *Healthcare.* 2022;10(2):186.
17. Triana H, Hadisaputro S, Djamil M. Effect of beet powder (*Beta vulgaris* L.) with Fe supplementation on increasing hemoglobin, hematocrit, and erythrocyte levels in pregnant women with anemia. *Strada J Ilm Kesehat.* 2020;9(2):893-899.
18. White PJ, Broadley MR. Calcium in plants. *Ann Bot.* 2003;92(4):487-511.
19. Yolcu S, Alavilli H, Ganesh P, Panigrahy M, Song K. Salt and drought stress responses in cultivated beets (*Beta vulgaris* L.) and wild beet (*Beta maritima* L.). *Plants.* 2021;10(9):1843.