Effect of Soil-Applied Vermicompost and Foliar L-Cysteine on Growth and Yield of Cauliflower (*Brassica oleracea* var. botrytis)

Haneen Mohammed Jassim

Department of Horticulture, College of Agriculture, Al-Qasim Green University, Babylon 61002, Iraq

haneen.mohammed@agre.uoqasim.edu.iq

Abstract

The Department of Horticulture and Landscape at Al-Qasim Green University conducted a field experiment during the 2025-2026 season to study how soil-based vermicompost and leaf-applied L-cysteine affected cauliflower plants. The experiment used a 3 x 3 factorial design which researchers executed through a randomized complete block design that included three experimental replicates. The researchers used three different levels of vermicompost application which included 0 and 50 and 100 g plant-1 together with three different levels of L-cysteine application which included 0 and 50 and 100 mg L-1. The application of vermicompost resulted in significant increases of leaf number and curd diameter and curd weight. The application of 100 g plant-1 vermicompost led to the production of 21.97 leaves plant-1 and a curd diameter of 21.64 cm and a curd weight of 668 g plant-1 while the application of 50 g plant-1 produced the highest plant height of 42.99 cm. L-cysteine administration at 100 mg L-1 resulted in plant height and curd diameter and curd weight increases that reached 42.55 cm and 22.63 cm and 744 g plant-1 respectively. The researchers found significant distinct effects when they studied different traits in their experiment. V2C0 produced the highest leaf number (22.80 leaves plant-1), V1C2 and V0C2 produced the greatest plant height (44.30 cm), and V1C2 gave both the largest curd diameter (23.80 cm) and the highest curd weight (880 g plant-1).

Keywords: cauliflower, vermicompost, L-cysteine, curd traits, yield

Introduction

The vegetables of cauliflower (*Brassica oleracea* var. botrytis) have cool-season cultivation value for Iraq and numerous other agricultural areas[1]. Cauliflower is also known for its anti-cancer benefits, reducing the risk of cardiovascular disease and regulating blood pressure due to its potassium content. It also improves digestive function because of its high fiber content and aids in weight loss [2]. The economic value of the product depends on three main factors which include the size of the curd and its density and the total marketable yield[3]. The practical goal of cauliflower production requires growers to find methods which enhance curd development without damaging soil health. [4].

Soil structure suffers degradation because vegetable systems rely mineral fertilizers for extended periods of time which leads to environmental damage through decreased soil health. This has created demand for organic amendments which enhance soil conditions while enabling plants to grow better. The product of earthworm activity which exists as a stabilized form of vermicompost contains microbial decomposition material that improves root zone nutrient access and water retention and aerial space within soil. [5].

The previous research about brassica crops demonstrated that vermicompost improves plant growth and nutrient absorption and marketable harvests. [6]. The product benefits plants in two ways because it supplies essential nutrients and it boosts both soil and root development which results in enhanced plant growth. The responses of cauliflower plants link directly to curd size because balanced nutrition supports continuous vegetative growth which sustains the plant. [7].

Farmers utilize foliar biostimulants as a management practice which enables them to enhance crop growth during agricultural fieldwork[8]. Plants need amino acids because they play essential roles in protein formation and food processing and they help plants deal with difficult environments while growing[9]. The amino acid L-cysteine attracts attention because it functions as a sulfur-based compound which helps regulate redox state and produces crucial sulfur compounds found in Brassicaceae plants. Previous research on cruciferous plants showed that applying cysteine through foliar spray improved both plant growth and their ability to produce yield-related traits. [10]. Cysteine is a sulfur-containing cyclic amino acid that plays an important role in plant metabolism, acting as a source of reducing sulfur necessary for the synthesis of many important bioactive compounds. These compounds include vitamins, coenzymes, and plant defense compounds such as glucosinolates and thionines. Cysteine also contributes to enhancing the plant's response to biotic and abiotic stress. It also contributes to increasing antioxidants such as glutathione. [11]. [12] A study on broccoli plants showed that spraying with cysteine (50 mg/L) and ascorbic acid (50 mg/L) led to a significant difference in the studied traits, such as the number of leaves to 65.38 leaves per plant, leaf area to 2965 cm^2 per plant, dry matter content in the leaves to 13.83%, and flower weight to 560 g, the percentage of nitrogen was 2.252%, the percentage of phosphorus was 0.597%, the percentage of potassium was 0.643%, and the total phenolic content of the heads was 0.97 A study ,mg/g dry weight. Based on the above [13] investigated the effect of foliar fertilization with cysteine and methionine on broccoli seedlings (Brassica oleracea var. italica). Cysteine and methionine were applied at three concentrations: 0, 100, and 200 mg/L,

starting 20 days after planting. The results showed that cysteine at concentrations of 100 and 200 mg/L increased leaf area by 53% and 48%, respectively. The application of L-cysteine at concentrations of 100 and 200 mg/L also increased the fresh weight of the aerial parts by 50% and 55%, respectively, and the dry weight of the roots by 26% and 60%, respectively. This research comprehensively evaluates the individual and interactive effects of worm fertilizer and cysteine on the growth characteristics and yield of cauliflower.

The existing research has documented separate advantages of both vermicompost and amino-acid sprays yet researchers have not studied their combined effect on cauliflower cultivation in central Iraq. The present study was conducted to assess how vermicompost and foliar L-cysteine interact with each other to affect cauliflower vegetative growth and curd characteristics and yield while identifying which treatment levels showed the best results throughout the evaluation period.

Materials and Methods

The Department of Horticulture and Landscape at Al-Qasim Green University conducted a 3 x 3 factorial field experiment during the autumn season of 2025-2026 in its vegetable field area. The experiment was conducted using a randomized complete block design (RCBD) which included three replicates. Each of the three experimental replicates contained nine treatment combinations which were tested on six plants that made up each experimental unit. The study applied least significant difference testing at $P <= 0.05$ to compare treatment means. The study included the following two factors:

The first factor was vermicompost (V) applied at three levels:

1. No vermicompost application (V0)
2. Vermicompost at 50 g plant-1 (V1)
3. Vermicompost at 100 g plant-1 (V2)

Vermicompost was added to the soil once at planting.

The second factor was foliar application of L-cysteine (C) at three concentrations:

1. Distilled water only (C0)
2. 50 mg L-1 L-cysteine (C1)
3. 100 mg L-1 L-cysteine (C2). Sprays were applied one month after transplanting, with three applications at two-week intervals. Seedlings of the cauliflower hybrid 'Nahar' were transplanted on October 20, 2025, in raised beds with 50 cm spacing between plants. The crop was irrigated by drip irrigation and maintained with routine field care, including hand weeding.

Table 1. Soil analysis

Characteristic	Measuring Unit	Value
Ec	Ds/m^{-1}	3.15
pH		7.5
O.M	%	1.5
N	ppm	53.2
P	ppm	10.2
K	ppm	145
sand	$g.kg^{-1}$	57
clay	$g.kg^{-1}$	13
silt	$g.kg^{-1}$	30
Soil texture	Sandy loam	

At maturity, five nearly uniform plants from each experimental unit were selected for measurement of the following traits:

Plant height (cm): measured from the soil surface to the apical meristem using a measuring tape.

Number of leaves (leaves plant-1): counted for each sampled plant and expressed as the mean per experimental unit.

Curd weight (g plant-1): recorded for sampled plants and averaged for each experimental unit.

Curd diameter (cm): measured with a measuring tape and averaged for each experimental unit.

Leaf chlorophyll content: estimated as relative chlorophyll content using a SPAD meter.

The curd dry matter percentage: established through analysis of a 100 g fresh curd sample. The sample was air-dried and then oven-dried at 70 C until constant weight. The dry matter percentage was determined through the following equation:

Dry matter (%) = (dry weight / wet weight) x 100.

Results and Discussion

Table 2. Effect of vermicompost and cysteine on plant height of cauliflower (cm plant-1).

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
40.31	41.30	43.00	36.62	C0
41.36	42.92	41.66	39.48	C1
42.55	39.05	44.30	44.30	C2
	41.09	42.99	40.13	Vermicompost average

L.S.D for(C) = 2.340	L.S.D(V*C) =4.052	L.S.D for (V) =2.340

Table 2 demonstrates that plant height showed significant changes in response to both vermicompost and L-cysteine treatment. The control treatment V0 produced the lowest plant height measurement which was 40.13 cm, while V1 showed the highest plant height measurement of 42.99 cm among the different vermicompost treatments. C2 generated the highest plant height measurement of 42.55 cm, while C0 resulted in a shorter plant height of 40.31 cm. The interaction effect was significant. The two combinations V0C2 and V1C2 produced the highest plant height of 44.30 cm, while V0C0 recorded the shortest plant height of 36.62 cm.

Table 3. Effect of vermicompost and cysteine on number of leaves in cauliflower(leaves plant^{1}).

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
20.38	22.80	20.25	18.10	C0
21.28	22.65	21.80	19.40	C1
21.44	20.45	21.80	22.07	C2
	21.97	21.28	19.86	Vermicompost average
L.S.D for(C) = 1.327		L.S.D(V*C) =2.298		L.S.D for (V) =1.327

Table 3 shows that vermicompost treatment affected leaf growth because V2 produced maximum leaf count of 21.97 leaves plant-1 while V0 showed minimum leaf count of 19.86 leaves plant-1. The main effect of cysteine on this trait was limited but the interaction between the two factors showed significant results. The highest leaf number was recorded under V2C0 (22.80 leaves plant-1), whereas the control combination V0C0 gave the lowest value (18.10 leaves plant-1)

Table 4. Effect of vermicompost and cysteine on chlorophyll content of cauliflower leaves.

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
54.80	54.37	57.00	53,03	C0
52.83	53.50	54.37	50.63	C1
51.94	49.87	52.97	53.00	C2
	52.58	54.80	52.22	Vermicompost average

L.S.D for(C) = N.S	L.S.D(V*C) =N.S	L.S.D for (V) =N.S

Table 4 indicates that neither vermicompost nor L-cysteine, whether applied alone or in combination, had a significant effect on leaf chlorophyll content.

Table 5. Effect of vermicompost and cysteine on curd diameter in cauliflower (cm).

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
18.77	21.21	18.80	16.30	C0
21.06	22.40	21.80	18.98	C1
22.63	21.30	23.80	22.80	C2
	21.64	21.47	19.36	Vermicompost average
L.S.D for (C) =1.320		L.S.D(V*C) =2.286		L.S.D for(V) = 1.320

Table 5 shows a significant increase in curd diameter with both vermicompost and L-cysteine. The highest mean diameter among vermicompost treatments was obtained with V2 (21.64 cm), whereas V0 recorded the lowest mean (19.36 cm). Likewise, C2 gave the largest mean curd diameter (22.63 cm), while C0 recorded the lowest value (18.77 cm).

The interaction between the two factors was significant. The V1C2 treatment produced the largest curd diameter (23.80 cm), whereas the control treatment V0C0 gave the smallest diameter (16.30 cm).

Table 6. Effect of vermicompost and cysteine on curd weight in cauliflower (g plant-1).

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
477	663	431	336	C0
612	770	647	420	C1
744	570	880	728	C2
	668	653	513	Vermicompost average
L.S.D for(C) = 90.6		L.S.D(V*C) =156.9		L.S.D for (V) = 90.6

Curd weight was significantly affected by both factors (Table 6). Among vermicompost treatments, V2 recorded the highest mean curd weight (668 g plant-1), whereas V0 gave the lowest mean (513 g plant-1). Foliar application of L-cysteine also improved curd weight, with

C2 producing the highest mean (744 g plant-1) and C0 the lowest (477 g plant-1). The interaction effect was significant, and V1C2 produced the heaviest curds (880 g plant-1), while V0C0 gave the lowest value (336 g plant-1).

Table 7. Effect of vermicompost and cysteine on curd dry matter percentage in cauliflower.

Cysteine(C) average	Vermicompost (v)			Cysteine(C)
	V2	V1	V0	
9.25	9.87	8.96	8.91	C0
9.79	9.62	10.17	9.56	C1
9.57	9.96	9.22	9.54	C2
	9.82	9.45	9.34	Vermicompost average
L.S.D for(C) = N.S		L.S.D(v*c) =N.S		L.S.D for (V) = N.S

Table 7 shows that vermicompost, L-cysteine, and their interaction did not significantly affect curd dry matter percentage.

The total results demonstrate that vermicompost primarily enhanced canopy growth and curd development through its effects on leaf count and curd size and curd weight properties. The physical and nutritional improvements to the root zone through vermicompost usage create this particular response [14]. The development of better soil aggregation together with improved moisture retention and gradual nutrient release allowed roots to absorb nutrients more effectively, which resulted in better growth-related results. [15] The results from chlorophyll content measurement and dry matter percentage assessment proved that vermicompost had a stronger effect on productivity than all other secondary traits under these specific conditions. [16]

L-cysteine demonstrated its strongest impact on plant height and development of curds. The growth phase and curd development stage benefits from foliar application because cysteine plays a vital role in sulfur metabolism and antioxidant protection and protein synthesis processes. [17] The significant interaction effects observed for plant height, curd diameter, and curd weight further indicate that the response to cysteine depended partly on the nutritional environment created by vermicompost. The V1C2 combination outperformed all other combinations through its ability to enhance curd diameter together with curd weight, which resulted from using moderate levels of vermicompost and higher concentrations of cysteine [18].

Conclusions

The study results which were obtained during this investigation reveal the following conclusions. The use of vermicompost resulted in better plant height and leaf count and curd diameter and curd weight results. The treatment did not produce any effects that would result in changes to leaf chlorophyll content or curd dry matter percentage. The two factors interacted to produce significant effects on several traits while V1C2 produced the best results for curd diameter and curd weight and V0C2 and V1C2 created the tallest plants and V2C0 produced the most leaves. The tested range showed that 100 mg L-1 L-cysteine and higher vermicompost level produced positive results. The combination of 50 g plant-1 vermicompost with 100 mg L-1 L-cysteine produced the most effective curd response. The researchers need to conduct more studies which will test these results across multiple environments and different management practices.

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