Int.J.Curr.Microbiol.App.Sci (2025) *14*(06): 68-80

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 14 Number 6 (2025)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2025.1406.006

The Effect Different Types of vermicompost fertilizers in productivity the Cumin Crop in Al – Hasaka Governorate

Kasem Alfaraj[1], Sami Sheikhmous Othman[2] and Mohammad Naif Al-Khalaf[1]

[1]*Department of Soil Sciences, University of Al-Furat, Syria*
[2]*Field Crops Department, Scientific Agricultural Research Center in Qamishli, Syria*

**Corresponding author*

Keywords

Cumin, Hassakeh, Vermicompost,, Productivity, Economic Returns

Article Info

Received:
08 April 2025
Accepted:
25 May 2025
Available Online:
10 June 2025

A B S T R A C T

This study aims to evaluate The Effect Different Types of Virmicompest fertilizers in productivity the Cumin Crop in Al – Hasaka Governorate The experiment was conducted by applying varying rates of vermicompost (300, 600, 900, and 1200 kg/donum) to the soil, with an assessment of plant morphological growth indicators. The results showed that vermicompost derived from sheep manure was the most effective in promoting plant growth, followed by cow manure vermicompost, and then horse manure vermicompost. Economically, the application of 300 kg/donum of sheep manure vermicompost yielded the highest returns compared to other application rates, with a significant increase in cumin yield. Although cow and horse manure vermicompost also contributed to improved soil productivity, their economic impact was relatively lower. This study highlights the importance of selecting the appropriate type and optimal quantity of vermicompost to sustainably enhance crop productivity, thereby supporting sustainable agriculture and improving the agricultural economy in the region.

Introduction

Cumin (*Cuminum cyminum* L.) is one of the important medicinal and aromatic crops in Syria and worldwide, due to its high economic, nutritional, and medicinal value.

Cumin is widely cultivated in dry and semi-dry environments, including Al-Hasakah Governorate, which is one of the main agricultural regions in northeastern Syria. However, productivity in these areas is negatively affected by many factors, foremost among them soil degradation caused by the intensive use of chemical fertilizers and the decline in soil organic matter content.

Amid these challenges, there has been a growing global interest in the use of organic fertilizers, particularly vermicompost, as a sustainable and safe alternative to chemical fertilizers. Vermicompost is the product of organic matter decomposition by earthworms in cooperation with microorganisms, characterized by its rich composition of macro- and micronutrients, including nitrogen, phosphorus, potassium, and trace elements, which contribute to enhancing plant growth and agricultural production (Gandhi *et al.,* 2012; Atiyeh *et al.,* 2001).

Many studies have shown that the use of vermicompost improves vegetative growth, increases the number of flowers and seeds, and enhances product quality in several medicinal and aromatic plants such as basil (Anwar *et al.,* 2008), turmeric (Vadiraj *et al.,* 1998), fennel (Darzi *et al.,* 2007), and chamomile (Azizi *et al.,* 2008). This improvement is attributed to vermicompost's ability to enhance nutrient availability, stimulate microbial activity in the rhizosphere, and improve soil structure, thereby creating an optimal growth environment for the plant (Arancon *et al.,* 2008; Edwards *et al.,* 2010).

Research results have also shown that vermicompost use leads to significant increases in yield components for several crops, such as fruit number, seed weight, and total yield. For example, Aktas *et al.,* (2013) indicated that fertilization with vermicompost significantly increased fennel seed production. In another study, the application of vermicompost increased the yield of black cumin, bull's tongue, and basil beyond that of conventional fertilization Joshi *et al.,* (2013).

Despite these positive outcomes, most of these studies were conducted on crops and agricultural systems outside the Syrian local context, in environments with soil and climatic characteristics different from those in Al-Hasakah. Moreover, most of them did not focus on cumin as a main crop nor included a detailed evaluation of the performance of different types of vermicompost produced from various animal sources, such as cow, sheep, and horse manure, which differ in nutrient content, decomposition, and agricultural effectiveness. Additionally, alkaline soils rich in calcium carbonate, as found in Al-Hasakah, represent soils in which vermicompost effectiveness has not yet been sufficiently studied, especially regarding its impact on medicinal plant productivity. Stevenson (1994) noted that such soils may limit the effectiveness of certain nutrients, making it necessary to study cumin's response to vermicompost application in this type of environment.

The primary objective of this study is to investigate the effects of various types of vermicompost—specifically those derived from sheep, cow, and horse manure—on the growth performance and yield of cumin (*Cuminum cyminum* L.). The study seeks to compare these organic amendments in terms of their agronomic impact on key growth parameters (such as plant height, number of umbels, seed yield, etc.) and overall crop productivity. In addition, a comprehensive economic evaluation will be conducted to assess the cost-effectiveness of each treatment. This dual approach aims to identify practical and economically viable vermicompost options for cumin cultivation, contributing to sustainable and organic agricultural practices.

Materials and Methods

Site and Time of the Study

The research was conducted over two agricultural seasons (2023–2024 and 2024–2025) on lands belonging to the Agricultural Extension Unit in Bezzara, affiliated with the Directorate of Agriculture in Hassakeh Governorate. The study site is located in the second stability zone at a longitude of 40.83° E and a latitude of 36.58° N. The experimental field is positioned at coordinates 36°23'08.2608"N and 42°11'78.011"E, at an elevation of 452 meters above sea level. The area receives an average annual rainfall of approximately 350 mm and is considered an important agricultural region for the production of crops such as cumin.

Prior to applying any treatments, soil samples were collected from various locations within the experimental field at a depth of 0–30 cm to determine the initial physical and chemical properties of the soil during the study period. These samples were combined and homogenized to form a composite sample representative of the site. This composite sample was then analyzed to determine its physical and chemical characteristics, the results of which are presented in Table (1).

Geological Setting

The region is covered by basaltic shields dating back to the Neogene–Quaternary period, in addition to ophiolitic rock masses and associated volcanic-sedimentary rocks belonging to the Ordovician and Silurian periods. These consist primarily of claystone with some interbedded sandstone layers. Paleozoic formations are exposed in only one area of the region—the core of Mount Abdulaziz—and date back to the Lower Carboniferous. Deeper rock layers, penetrated by drilling operations, mainly belong to the Miocene epoch.

Marine Neogene deposits are widely distributed across the area and primarily date back to the Miocene, while continental Neogene sediments appear in the basins of the Palmyrene mountain range. Quaternary deposits are found in the form of fluvial terraces (such as in the Euphrates Basin), and in the Syrian Desert, they form a crust of carbonate and gypsum rocks (Techno export, 1964).

Fertilizer and Plant Material

Preparation of Vermicompost

Vermicompost was prepared in small plastic containers designated for experimental purposes, aiming to provide a suitable environment for the reproduction and activity of the red earthworm species *Eisenia fetida*. Initially, the bottom of each container was lined with a layer of dry organic materials, including fallen tree leaves, paper scraps, newspapers, shredded straw, dry plant residues, torn pieces of paper bags, and small pieces of dried palm fronds, filling about half of the container's volume.

A small amount of pre-matured compost was also added to activate microorganisms and accelerate the decomposition process. Subsequently, two handfuls of a mixture of sand and soil were added to the organic layer to improve the physical structure and enhance aeration, then the mixture was moistened with water until the moisture level reached that of a wrung-out sponge, which is optimal for worm activity.

Through careful proportioning of the components used, the carbon-to-nitrogen (C/N 25:1 -30:1) ratio of the organic material was adjusted to an ideal range for worm activity, which helped speed up decomposition and improve the quality of the resulting vermicompost. Approximately 2000 worms (equivalent to about 5 kg) of *Eisenia fetida* were introduced, capable of consuming about 2.5 kg of food waste daily, based on data from the University of New Mexico.

Afterward, plant-based food residues were evenly distributed over the surface of the container, while avoiding the addition of undesirable materials such as citrus peels, onions, garlic, and meat scraps, since these negatively affect the worm environment and may attract flies. It is preferable that the added residues are slightly warm to promote biological decomposition and reduce unpleasant odors.

During the preparation period, moisture and aeration conditions were regularly monitored to ensure a stable and suitable environment, which contributed to producing mature, homogeneous vermicompost rich in beneficial organic matter. The vermicompost produced for use in the experiment was analyzed, and its results are presented in Table (2).

Preparation of Cumin Seeds

Local Syrian cumin seeds were used at a quantity of 4 kg, selected from newly harvested, high-germination fruits that were free from diseases. The seeds were treated with fungicidal disinfectants at a rate of 4 g/kg using the dusting method, in preparation for their use in the experiment.

Field Experiment Methodology

Land preparation began in late November of each year, with two successive plowing operations carried out to a depth of 25–30 cm, followed by two soil pulverization operations to break up soil clods and improve surface leveling. Afterwards, an additional two plowing passes were conducted, and the soil surface was carefully leveled. The 450-square-meter field was then divided into experimental plots according to the experimental design.

In early January, vermicompost was applied approximately one week before sowing. The designated quantity for each treatment (300, 600, 900, or 1200 kg/dunum) was evenly distributed over the surface of the plots and incorporated into the topsoil to a depth of 10–15 cm, ensuring interaction between the organic matter and the soil. Surface broadcasting without incorporation was not adopted, as mixing enhances compost-soil integration and stimulates microbial activity.

On January 15th, sowing was performed mechanically using a seed drill, placing cumin seeds (*Cuminum cyminum* L.) at a depth of 2–3 cm along the planting rows. Surface irrigation (furrow irrigation) was used when rainfall amounts were insufficient to meet the crop's water requirements. Manual weeding was carried out two or three times during the growing season, depending on weed density.

Approximately two weeks before harvest, soil samples were collected from a depth of 0–20 cm within the root zone. Ten random holes were dug in each experimental plot, and the samples were combined into a composite sample was sent for the necessary physical and chemical analyses according to the objectives of the study. Cumin was harvested 120 days after sowing, once signs of maturity appeared on the plants. Three plants were randomly selected from each experimental plot to measure the morphological indicators of the plants. Plant height (cm) was measured at mid-growth when the plants were fully developed but before full maturity. The seed yield per plant (g) was measured immediately after harvest, once the seeds were collected and dried. Total yield (kg/dunum) was calculated from the weight of seeds harvested from the entire experimental plot after the harvest was completed.

Experimental Design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. It included 13 treatments consisting of different application rates (300, 600, 900, and 1200 kg/dunum) of three types of vermicompost (sheep manure, cow manure, and horse manure), in addition to a control treatment.

This resulted in a total of 39 experimental units. Each plot covered an area of 10 m², with appropriate spacing maintained between treatments and between replications. The following is the layout of the experiment.

Analyses and Measurements:2-6

The component analyses were conducted at the laboratories of the Agricultural Scientific Research Center in Damascus, within the Soil Research Department.

Soil Analyses

Physical Analyses

Mechanical Composition: Determined using the hydrometer method, and the soil texture will be identified based on the USDA soil texture triangle, following the procedures outlined in the manual (Gavlak, *et al,* 2005).

Bulk Density: Measured using the paraffin wax method.

Particle Density: Determined by the pycnometer method (Black and Hartge, 1986).

Total Porosity: Calculated based on the relationship between bulk density and particle density:

$$\text{Porosity (\%)} = \left(1 - \frac{P_B}{P_S}\right) \times 100$$

Air Porosity: Calculated as the difference between total porosity and field capacity moisture content on a volumetric basis.

$$\text{Solid Space (\%)} = \left(\frac{\rho_B}{\rho_S}\right) \times 100$$

Field Capacity = $(W_W - W_d)/W_d \times 100$**%**

Chemical Analyses

Soil Reaction (pH): Measured using a pH meter on the saturated paste extract.

Electrical Conductivity (EC): Determined using a conductivity meter on the saturated paste extract.

% Organic Carbon: It was determined using the wet oxidation method with potassium dichromate.

Calcium Carbonate: Determined using a **calcimeter**.

Total nitrogen (N): Using the Kjeldahl method (Bremner and Mulvaney, 1982).

Available phosphorus: Using the Olsen method (Olsen *et al.,* 1954).

Exchangeable sodium and potassium: Using the flame photometer.

Exchangeable calcium and magnesium: Determined by titration with versenate solution using murexide indicator for calcium determination, and Eriochrome Black T indicator for the combined determination of calcium and magnesium.

Total Sulfur: Total sulfur was determined by the wet digestion method using a mixture of nitric and perchloric acids, followed by the turbidimetric measurement of the barium sulfate ($BaSO_4$) precipitate formed after adding barium chloride ($BaCl_2$), according to standard procedures. The turbidity of the $BaSO_4$ precipitate was measured using a spectrophotometer at a wavelength of 420 nm to estimate the sulfur content in the samples.

The micronutrients (iron (Fe), zinc (Zn), manganese (Mn), and copper (Cu)): are extracted from the soil using DTPA (Diethylene Tri amine Penta acetic Acid) solution, and their concentrations are determined using an Atomic Absorption Spectrophotometer (AAS).

Studied Morphological Indicators of the Plant:2

Three plants were randomly selected from each experimental unit, and the following morphological indicators were measured:

-Plant height (cm).
-Seed yield per plant (g)
-Total yield (kg/dunum).

Statistical Analysis

The experimental data were analyzed using the GenStat statistical software. Analysis of variance (ANOVA) was performed to test the significance of differences among treatments. Mean comparisons were carried out using the Least Significant Difference (LSD) test at a significance level of 0.05.

Results and Discussion

Effect of adding different types of vermicompost on some growth and yield-related traits

Effect of different types of vermicompost on plant height (cm).

Plant height is a fundamental indicator reflecting the plant's response to environmental and nutritional conditions, and it is directly associated with the efficiency of nutrient uptake and vegetative growth activity. Organic matter, particularly vermicompost, contributes to improving soil fertility and providing nutrients in a balanced manner, thereby enhancing plant growth and increasing height. The response varies depending on the type and quantity of vermicompost applied, due to differences in its nutrient content and its ability to improve the soil's physical and chemical properties.

Table (8) illustrates the effect of adding different types of vermicompost (sheep, cow, horse) at various rates (300, 600, 900, 1200 kg/donum) on cumin plant height over two consecutive growing seasons. The results showed significant differences between treatments, both in terms of the type of fertilizer used and the applied quantity, as well as their interaction, at a significance level of $P \leq 0.05$. During the first season, the treatment with sheep vermicompost at 1200 kg/donum recorded the highest plant height (37.55 cm), which was not significantly different from the 900 and 600 kg/donum treatments of the same type, while the lowest value was observed in the control treatment (24.3 cm). It was noted that increasing the amount of vermicompost generally led to a significant increase in plant growth, especially with sheep vermicompost, reflecting its high effectiveness in improving the nutritional and physical conditions around the roots.

In the second season, the results showed a similar pattern, where the highest plant height (61 cm) was observed in the treatment with sheep vermicompost at 1200 kg/donum, followed by the 900 kg/donum treatment of the same type (57.997 cm), then the 600 kg/donum treatment (56.003 cm). Conversely, the control treatment recorded the lowest height (47 cm). The positive effect of vermicompost continued more clearly during the second season, indicating the cumulative biological and nutritional impact of the organic materials in the soil over time.

Comparison among the three types of vermicompost showed that sheep vermicompost significantly outperformed the cow and horse types at all application rates. The average plant height with sheep vermicompost was 34.52 cm in the first season and 55.20 cm in the second, compared to 33.72 cm and 52.47 cm for cow vermicompost, and 30.94 cm and 49.74 cm for horse vermicompost, respectively.

The LSD values indicate that the differences between types, quantities, and their interaction are statistically significant, supporting the conclusions drawn from the data. The low CV% values reflect the accuracy of the results and the homogeneity of the data within treatments.

These results can be explained by the fact that vermicompost derived from sheep manure contains a high proportion of nutrients available to plants and decomposes faster, in addition to containing effective organic matter that improves soil structure and aeration, facilitating nutrient uptake and enhancing microbial activity in the soil.

The overall positive effect of vermicompost is attributed to its high water retention capacity and balanced supply of macro- and micronutrients, which stimulate microbial activity and biological processes in the soil, resulting in increased biomass production and plant height (Edwards and Burrows, 1988; Atiyeh *et al.,* 2001; Ansari *et al.,* 2010). Previous studies confirmed significant improvements in growth, development, and height of various crops when optimal rates of vermicompost were applied (Vadiraj *et al.,* 1998; Arguello *et al.,* 2006; Darzi *et al.,* 2007; Azizi *et al.,* 2008), in addition to enhanced flowering and number of flower umbels (Ratti *et al.,* 2001) and increased productive tillers in barley due to microbial stimulation and gradual mineral nutrient release (Roy and Singh, 2001; Pandey *et al.,* 2015).

Effect of different types of vermicompost on seed yield per plant (g)

Seed yield is a key indicator for evaluating the efficiency of agricultural treatments and their impact on improving crop productivity. The application of vermicompost, as an organic fertilizer rich in nutrients and beneficial microorganisms, contributes to enhancing the physiological processes of the plant and improving soil properties, which are fundamental for achieving high yield and quality. The amount of seed produced varies according to the type and quantity of vermicompost applied, due to differences in its composition and its direct and indirect effects on nutrient uptake and growth stimulation.

Table (9) illustrates the clear effect of adding different types of vermicompost (sheep, cow, horse) at varying rates (300, 600, 900, 1200 kg/donum) on the seed yield per cumin plant over two consecutive growing seasons. Significant differences were recorded at the level of ($P \leq 0.05$) for the factors of type, quantity, and their interaction.

In the first season, the treatment with sheep vermicompost at 1200 kg/donum produced the highest yield (2.46 g/plant), followed by the 900 kg/donum treatment (2.26 g/plant), then 600 kg/donum (2.08 g/plant), all of which were significantly superior to the other treatments. In contrast, the control treatment recorded the lowest yield (1.32 g/plant). It was observed that increasing the quantity of sheep vermicompost was positively correlated with increased seed yield, indicating its high efficacy in supplying nutrients to the plant and improving the physical and biological properties of the soil.

In the second season, the results confirmed the same trend, with the highest seed yield (2.69 g/plant) observed in the treatment with sheep vermicompost at 1200 kg/donum, followed by the 900 kg/donum treatment (2.47 g), while the control treatment had the lowest yield (1.42 g). Generally, seed yield values increased in the second season compared to the first, which can be attributed to the gradual improvement in soil fertility resulting from the accumulation of decomposed organic matter and increased microbial activity in the soil.

Furthermore, comparison among the three types of vermicompost showed a clear superiority of the sheep vermicompost across all application rates, with average seed yields per plant of 1.99 g in the first season and 2.11 g in the second, compared to 1.70 g and 1.78 g for cow vermicompost, and 1.39 g and 1.61 g for horse vermicompost, respectively. This superiority is attributed to the higher content of readily available nutrients in sheep vermicompost and its physical characteristics that stimulate root growth and efficient nutrient uptake.

Statistical analysis results (LSD) indicate that the differences between treatments concerning type, quantity, and their interaction were significant, supporting the reliability of the observed data differences. The low values of CV% indicate consistency and homogeneity of results among replicates, reflecting the accuracy of the experiment. These findings are consistent with the results of.

Effect of different types of vermicompost on yield per dunum (kg)

Total seed production per unit area is a critical indicator for evaluating the feasibility of agricultural practices and the efficiency of organic fertilization in achieving sustainable economic yields. The importance of using vermicompost lies in its ability to improve the physical, chemical, and biological properties of the soil, which positively impacts crop productivity by providing a suitable growth environment and enhancing nutrient uptake efficiency.

The cumin crop's response in terms of yield varies according to the type of vermicompost used and the application rate, as differences in nutrient content and organic matter among sheep, cattle, and horse manure result in variability in their effects on the final yield.

Table (10) results show a significant effect of using vermicompost, differing by type (sheep, cow, horse) and application rates (300, 600, 900, 1200 kg/donum), on the total productivity of cumin plants per donum across two consecutive seasons. Significant differences were observed at ($P \leq 0.05$) for the studied factors (type, quantity, and their interaction).

In the first season, the treatment with sheep vermicompost at 1200 kg/donum recorded the highest productivity (81 kg/donum), followed by 900 kg/donum (76 kg/donum), then 600 kg/donum (70 kg/donum). The control treatment showed the lowest productivity (40 kg/donum).

It is noted that the gradual increase in vermicompost quantity, especially from the sheep type, contributed significantly to improving productivity, confirming its effectiveness in preparing fertile soil conditions and enhancing the soil's physical and chemical properties, thereby supporting plant growth and yield.

In the second season, similar trends continued, where the sheep vermicompost treatment at 1200 kg/donum again produced the highest yield (75 kg/donum), followed by 900 kg/donum (70 kg/donum), while the control treatment dropped to the lowest yield (34 kg/donum). This improvement in the second season can be attributed to the cumulative positive effect of organic matter and increased microbial activity that promotes nutrient availability.

Comparing the averages of the different vermicompost types reveals the superiority of sheep vermicompost across all quantities, with average total productivity of 66 kg/donum in the first season and 60 kg/donum in the second, compared to 62.60 and 56.60 kg/donum for cow vermicompost, and 61.20 and 55.40 kg/donum for horse vermicompost, respectively. This superiority is attributed to the richness of sheep vermicompost in macro- and micronutrients, its high organic matter content, and its capacity to improve soil structure and moisture retention.

Statistically, significant differences among treatments were confirmed by LSD values, whether between quantities, types, or their interaction. Moreover, the low coefficient of variation (CV%) in both seasons reflects the stability and homogeneity of the results among replicates. These results indicate that increasing vermicompost quantity, especially from sheep sources up to 1200 kg/donum, leads to a significant increase in yield per unit area. This is a vital indicator for adopting this type of organic fertilizer in sustainable cumin cultivation, given its dual role in improving soil properties and enhancing farmers' economic returns. This effect is attributed to organic compounds, amino acids, humic and fulvic acids produced from organic matter decomposition, which improve soil properties and increase nutrient availability.

Additionally, these compounds reduce nutrient leaching below the root zone due to their ion-adsorbing capacity. They also act as a buffer against pH fluctuations, making nutrients more available and enabling better plant nutrition, resulting in vigorous vegetative growth and increased photosynthetic output.

This increase aligns with findings by Safi *et al.,* (2017) and Saadea *et al.,* (2023), who reported significant improvements in agricultural productivity through vermicompost's enhancement of soil physical and chemical characteristics. Similar results have been reported for okra by Shelar *et al.,* (2011) and tomato by Azarmi *et al.,* (2008).

Economic Feasibility of Fertilizer Application

Economic analysis is a fundamental step in evaluating the effectiveness of any fertilization treatment and determining its feasibility for farmers. This evaluation goes beyond merely increasing production to achieving the highest net profit.

In this study, the gross income from cumin production per donum was calculated based on the average cumin yield (kg/donum) and the selling price per kilogram. The cost of adding vermicompost was then calculated according to the quantities used and the price per kilogram of vermicompost.

Net profit is defined as the difference between the revenue generated from selling cumin (USD/donum) and the cost of the added vermicompost (USD/donum), according to the following equations:

Cumin revenue (\$/donum) = Cumin yield (kg/donum) × Price per kilogram (6USD),

Vermicompost cost (\$/donum) = Quantity of vermicompost applied (kg/donum) × Price per kilogram of vermicompost (0.25 USD),

Net profit (\$/donum) = Cumin revenue − Vermicompost cost.

Table.1 Physical and Chemical Properties of the Soil at the Study Site (0–30 cm Depth) During the Two Growing Seasons

2025-2024			**2024-2023**			**The physical and chemical properties**
Clay **%**	Silt **%**	Sand **%**	Clay**%**	Silt **%**	Sand**%**	**Mechanical composition**
37.55	**33.25**	**29.2**	**41.6**	**29.25**	**29.15**	
Silty Clay Loam			**Silty Clay**			
1.29			**1.32**			**Bulk density (g/cm³)**
2.62			**2.67**			**Particle density (g/cm³)**
50.76			**50.56**			**Total porosity (%)**
7.7			**7.8**			**pH**
0.84			**1.06**			**EC (m mhos/cm)**
460			**425**			**Total nitrogen (N) ppm**
18.4			**17.85**			**Available phosphorus (P) ppm**
221			**205**			**Available potassium (K) ppm**
0.551			**0.437**			**Organic carbon (C)%**
21			**23.5**			**Calcium carbonate %**
11.97			**10.28**			**C/N**
2.64			**2.46**			**Zn ppm**
6.2			**5.91**			**Fe ppm**
2.96			**2.32**			**Mn ppm**

Table.2 Chemical Properties of Vermicompost Derived from Sheep, Cow, and Horse Manure

Substrate used	PH	EC (ds/m)	C (%)	N (%)	C/N	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
Sheep manure vermicompost	7, 2	6.4	16.89	1.49	11.3	1.36	1.26	2.77	0.63	0.1	595	265	185	46
Cow manure vermicompost	7.5	1.29	32.25	2.98	11.77	1.42	1.48	5.91	1.02	0.15	502	253	381	178
Horse manure vermicompost	7,97	1.07	39.51	1.62	22.16	0,54	0.83	1.6	0.47	0.08	209	98	174	127

Table.3 Effect of vermicompost treatments on plant height (cm)

Average	2025-2024			Average	2024-2023			Type quantity kg/dunum
	Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost		Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost	
47.00e	**47j**	**47j**	**47j**	**24.30d**	**24.3i**	**24.3i**	**24.3i**	**Control**
51.75d	**48.5i**	**52fg**	**54de**	**34.24c**	**31.2h**	**35.527e**	**36cde**	**300**
53.00c	**50h**	**53ef**	**56.003c**	**35.05b**	**32.057g**	**35.77de**	**37.333ab**	**600**
54.50b	**51gh**	**54.497d**	**57.997b**	**35.71a**	**33.297f**	**36.397cd**	**37.427a**	**900**
56.10a	**52.2 f**	**56.1c**	**a61**	**36.00a**	**33.85f**	**36.6bc**	**37.55a**	**1200**
	49.74c	**52.47b**	**55.20a**		**30.94c**	**33.72b**	**34.52a**	**Average**
Quantity= 0.686 type=0.531 1.188 =type*Quantity				**Quantity= 0.4707 type= 0.3646 0.8153 =type*Quantity**				**LSD 0.05**
R 1.2 R*Units 1.4				**R 0.7 R*Units 1.5**				**CV%**

Note: In each column or row, values sharing the same letters are not significantly different at ($P \leq 0.05$).

Table.4 Effect of vermicompost treatments on seed yield per plant (g)

Average	2025-2024			Average	2024-2023			Type quantity kg/dunum
	Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost		Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost	
1.42^{e}	**^{i}1.42h**	**^{i}1.42h**	**^{i}1.42h**	**1.32^{e}**	**1.32^{j}**	**1.32^{j}**	**1.32^{j}**	**Control**
1.73^{d}	**^{h}1.63**	**^{g}1.74**	**^{f}1.83**	**1.62^{d}**	**1.38^{i}**	**1.66^{g}**	**^{e}1.82**	**300**
1.87^{c}	**^{h}1.64**	**^{f}1.83**	**^{c}2.13**	**1.74^{c}**	**1.4^{hi}**	**1.74^{f}**	**2.08^{c}**	**600**
2.00^{b}	**^{h}1.65**	**^{e}1.87**	**^{b}2.47**	**1.85^{b}**	**1.42^{hi}**	**1.86^{e}**	**2.26^{b}**	**900**
2.15^{a}	**^{g}1.72**	**^{d}2.04**	**^{a}2.69**	**1.94^{a}**	**1.44^{h}**	**1.92^{d}**	**2.46^{a}**	**1200**
	1.61^{c}	**1.78^{b}**	**2.11^{a}**		**1.39^{c}**	**1.70^{b}**	**1.99^{a}**	**Average**
Quantity= 0.02094 type=0.01622 0.03627 =type*Quantity				**Quantity= 0.01059 type= 0.0082 0.01834 =type*Quantity**				**LSD 0.05**
R 1.3 R*Units 1.2				**R 2.1 R*Units 1.9**				**CV%**

Note: In each column or row, values sharing the same letters are not significantly different at ($P \leq 0.05$).

Table.5 Effect of vermicompost treatments on yield per dunum (kg)

Average	2025-2024			Average	2024-2023			Type quantity kg/dunum
	Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost		Horse manure vermicompost	Cow manure vermicompost	Sheep manure vermicompost	
34.00^{e}	$^{j}34$	$^{j}34$	$^{j}34$	40.00^{e}	$^{i}40$	$^{i}40$	$^{i}40$	Control
54.33^{d}	$^{i}52$	$^{h}54$	$^{g}57$	60.33^{d}	$^{h}58$	$^{h}60$	$^{g}63$	300
61.33^{c}	$^{f}59$	$^{e}61$	$^{d}64$	67.33^{c}	$^{fg}65$	$^{f}67$	$^{e}70$	600
66.33^{b}	$^{d}64$	$^{d}65$	$^{b}70$	72.33^{b}	$^{e}70$	$^{de}71$	$^{b}76$	900
70.33^{a}	$^{c}68$	$^{bc}69$	$^{a}75$	76.33^{a}	$^{cd}73$	$^{bc}75$	$^{a}81$	1200
	55.40^{c}	56.60^{b}	60.00^{a}		61.20^{c}	62.60^{b}	66^{a}	Average
Quantity= 1.117 type=0.865 1.935 =type*Quantity				Quantity= 1.581 type= 1.225 2.739 =type*Quantity				LSD 0.05
R 1.4 R*Units 2				R 2.9 R*Units 2.6				CV%

Note: In each column or row, values sharing the same letters are not significantly different at ($P \leq 0.05$).

Table.6 Effect of Vermicompost Type and Quantity on Cumin Yield and Economic Return in Al-Hasakah Governorate

Profit ($/dunum)		Cost of Vermicompost ($/dunum)		Revenue from Fertilizer		Cumin Yield (kg/dunum)		Applied Quantity (kg/dunum)	Type of Vermicompost
2025-2024	-2023 2024	-2024 2025	-2023 2024	-2024 2025	-2023 2024	-2024 2025	-2023 2024		
0	0	0	0	0	0	34	40	0	Control
63	63	75	75	138	138	57	63	300	Sheep manure vermicompost
30	30	150	150	180	180	64	70	600	
-9	-9	225	225	216	216	70	76	900	
-54	-54	300	300	246	246	75	81	1200	
45	45	75	75	120	120	54	60	300	Cow manure vermicompost
12	12	150	150	162	162	61	67	600	
-39	-33	225	225	186	186	65	71	900	
-90	-90	300	300	210	210	69	75	1200	
33	33	75	75	108	108	52	58	300	Horse manure vermicompost
0	0	150	150	150	150	59	65	600	
-45	-45	225	225	180	180	64	70	900	
-96	-102	300	300	204	198	68	73	1200	

Figure.1 Layout of the Field Experiment

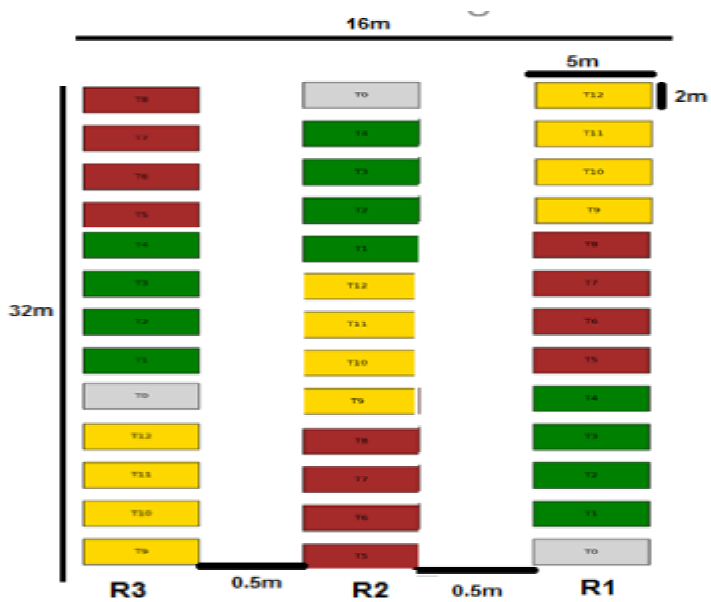

Table (11) results showed the economic feasibility of using different types and quantities of vermicompost in cumin cultivation. The treatment with 300 kg/donum of sheep vermicompost achieved the highest net profit of 63 USD/donum in both seasons, making it the best economic option as it combined improved productivity with lower costs.

Increasing the quantity to 600 kg/donum reduced the profit to 30 USD, while higher quantities (900 and 1200 kg/donum) resulted in net financial losses due to exceeding the optimal economic quantity.

For cow vermicompost, the results were less favorable, with a profit of only 45 USD at 300 kg/donum, decreasing to 12 USD at 600 kg/donum, and clear losses at higher quantities.

Horse vermicompost showed the lowest performance compared to the other types, with a profit of 33 USD at 300 kg/donum, breakeven at 600 kg/donum, and significant losses at higher quantities.

These results indicate that increasing the quantity of vermicompost does not necessarily lead to increased economic returns; excessive use may cause losses. This highlights the importance of determining the optimal economic quantity and favoring the most efficient vermicompost type in terms of production performance and financial feasibility, which in this case is sheep vermicompost at the lowest application rate.

The findings of this study clearly demonstrate the positive impact of vermicompost application on cumin crop productivity under the environmental and soil conditions of Al-Hasakah Governorate. The key conclusions are as follows:

Stimulation of Vegetative Growth

All vermicompost treatments significantly increased plant height compared to the control. The highest growth was observed with sheep manure vermicompost, particularly at application rates of 900–1200 kg/donum,

Enhancement of Yield Performance

Sheep manure vermicompost also produced the highest seed yield per plant and total yield per donum across both growing seasons, followed by cow and horse vermicompost. This highlights the importance of selecting the appropriate organic fertilizer type for maximizing cumin productivity.

Economic Feasibility and Optimal Dosage

The most profitable treatment was the application of 300 kg/donum of sheep vermicompost, achieving the highest net return per unit area. Higher application rates, while improving yield, resulted in reduced or negative economic returns due to increased input costs. This underscores the need to optimize application rates for commercial use.

Long-Term Soil Benefits

The cumulative effects observed in the second season suggest that vermicompost contributes to sustained improvements in soil fertility, organic matter content, and microbial activity, supporting long-term agricultural sustainability.

Recommendations

Use of Vermicompost as a Sustainable Alternative

Farmers should adopt vermicompost, particularly sheep manure-derived, as a sustainable substitute for chemical fertilizers to improve both soil quality and crop productivity.

Limit Application to Economically Feasible Levels

For commercial farming, the recommended application rate is 300 kg/donum to maximize profitability and avoid unnecessary costs.

Promote Utilization of Local Animal Waste

Encouraging the use of locally available livestock residues, especially sheep manure, for vermicomposting offers both environmental and economic advantages.

Farmer Training and Awareness

Extension programs should be implemented to train farmers on the optimal use of vermicompost—its type, application timing, and dosage—for effective adoption.

Encourage Further Long-Term Studies

Future research should focus on the long-term impact of vermicompost on soil health, and its application under different irrigation regimes.

Author Contributions

Kasem Alfaraj: Investigation, formal analysis, writing—original draft. Sami Sheikhmous Othman: Validation, methodology, writing—reviewing. Mohammad Naif Al-Khalaf:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

Aktas, H., S. Daler, O. Ozen, K. Gencer, D. Bay, and I. Erdal. 2013. The effect of some growing substrate media on yield and fruit quality of eggplant (*Solanum melongena* L.) grown and irrigated. 1:5–12.

Ansari, A.A., and K. Sukhraj. 2010. Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. Afr. J. Agric. Res. 5(14):1794–1798.

Anwar, F., Hussain, A. I., Sherazi, S. T. H., & Przybylski, R. (2008). Title: Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimum basilicum*) essential oils depends on seasonal variations. Journal: Food Chemistry, 108(3), 986–995.

Arancon, N. Q., Edwards, C. A., Babenko, A., Cannon, J., Galvis, P. & Metzger, J. D. (2008). Title: Influences of vermicomposts… on the germination, growth and flowering of petunias in the greenhouse. Applied Soil Ecology, 39 (2008), pp. 91–99

Argüello, J.A., A. Ledesma, S.B. Núñez, C.H. Rodríguez & M.C. Díaz Goldfarb (2006). Vermicompost efects on bulbing dynamics, nonstructural carbohydrate content, yield, and quality of "Rosado Paraguayo" garlic bulbs. HortScience 41: 589-592.

Atiyeh RM, Lee Edward CA, Sulbar S, Metzger T (2001). Pig manure vermicompost as a component of a horticultural bedding plant medium. Effects on physiochemical properties and plant growth. Bioresour. Technol., 78: 11-20. http://dx.doi.org/10.1016/S0960-8524(00)00172-3

Azarmi R, Sharifi P, Satari MR (2008). Effect of vermicompost on growth, yield and nutrition status of tomato (*Lycopersicum esculentum*) In Press.

Azizi M, Rezwanee F, Khayat MH, Lackzian A, Neamati H (2008). The effect of different levels of vermicompost and irrigation on morphological properties and essential oil content of German chamomile (*Matricaria recutita*) C.V. Goral. Iran. J. Med. Aroma.Plants, 24(1): 82-93.

Blake GF, Hartge KH (1986). Bluk density. In: klute, A. (Ed), Methods of soil analysis. Part 1, 2 nd ed., Am. Soc. Agron., Madison, WI, pp. 363-382.

Bremner, J.M. and Mulvaney, C.S., 1982. Nitrogen-total. In: Page, A.L., Miller, R.H., Keeney, D.R. (Eds.), Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. American Society of Agronomy Madison, WI, USA, pp. 595–624 https://doi.org/10.2134/agronmonogr9.2.2ed.c31

Darzi MT, Ghalavand A, Rejali F, Sephidkon F (2007). Effects of Biofertilizers Application on yield and yield components in fennel (*Foeniculum vulgare* Mill.). Iran. J. Med. Aroma. Plants, 22(4): 276-292.

Edwards CA, Arancon NQ, Vasko-Bennett M, Askar A, Keene G (2010). Effect of aqueous extracts from vermicomposts on attacks by cucumber beetles (*Acalymna vittatum*) (Fabr.)on cucumbers and tobacco hornworm (*Manduca sexta*) (L.) on tomatoes. Pedobiologia, 53(2): 141-148.

Edwards, C. A., & Burrows, I. (1988). The potential of earthworm composts as plant growth media. In C. A. Edwards & E. Neuhauser (Eds.), Earthworms in waste and environmental management (pp. 21–32). SPB Academic Publishing.

Gandhi, M., Sangwan, V., Kapoor, K. K., & Dilbaghi, N. (2012). Title: Microbial diversity of vermicompost bacteria that exhibit useful agricultural traits and waste management potential. Springer Plus, 1:26 (October 4, 2012)

Gavlak, R., D. Horneck & R. Miller. 2005. “Hydrometer Method for Soil Particle-Size Analysis.”

Joshi, R., A.P. Vig, and J. Singh. 2013. Vermicompost as soil supplement to enhance growth, yield and quality of *Triticum aestivum* L.: A field study. *Int. J. Recycl. Org. Waste Agric.* **2**(16).

Olsen S R, Cole C V, Watanabe F S and Dean L A. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. USDA. Circle 939: 19–33.

Pandey, I.B., R.K. Pandey, and R. Kumar. 2015. Integrated nutrient management for enhancing productivity and profitability of long-duration pigeonpea (*Cajanus cajan*) under rainfed condition. Indian J. Agron. 60(3): 436–442. https://doi.org/10.59797/ija.v60i3.4476.

Ratti, N., S. Kumar, H. Verma, and K. Gautam. 2001. Effect of mycorrhizal fungi and plant growth promoting bacteria on biomass and phosphorus content of *Hypericum perforatum*. Bioresource Technology 76: 201–206.

Roy, D.K., and B.P. Singh. 2001. Effect of level and time of nitrogen application with and without vermicompost on yield, yield attributes, and quality of malt barley (*Hordeum vulgare*). Indian J. Agron. 51(1):40–42. http://dx.doi.org/10.59797/ija.v51i1.4963

Saade, S., F. Abbas, H. Al-Shbatt, and D. Al-Seed. 2023. Effect of vermicompost and mineral fertilizers on growth and productivity of faba bean (*Vicia faba* L.) under Homs-Syria conditions. Majallat al-Mukhtar lil-‘Ulum (مجلة المختار للعلوم) 38(2): 209–219. https://doi.org/10.54172/mjsc.v38i2.1291

Safi, A., Cole, M., Kelly, A.L., and Walker, N.C. 2017. Effect of vermicompost application on soil physical and chemical properties. Advances in Physical Education 11(2):158–171. https://doi.org/10.4236/ape.2021.112012

Shelar, R. B., Kadam, A. S., Patil, V. K., & Narsude, P. B. (2011). Studies on effect of different sources of nitrogen on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. International Journal of Agricultural Sciences, 7(1), 70-73.

Stevenson FJ (1994). Humus Chemistry: Genesis, Composition, Reactions, Second edition John Wiley & Sons Inc. New York.

Techno Export. 1964. Geological map of Syria, scale 1/1000000. Ministry of industry, Syria.

Vadiraj, B. A., Mahantshetti, N. S., Basavaraj, N., and Rajashekarappa, K. 1998. Effect of vermicompost on growth and yield of sunflower (*Helianthus annuus* L.). Journal of the Indian Society of Soil Science 46(4): 916–919.

How to cite this article:

Kasem Alfaraj, Sami Sheikhmous Othman and Mohammad Naif Al-Khalaf. 2025. The Effect Different Types of vermicompost fertilizers in productivity the Cumin Crop in Al – Hasaka Governorate. *Int.J.Curr.Microbiol.App.Sci.* 14(06): 68-80. **doi:** https://doi.org/10.20546/ijcmas.2025.1406.006