

Effect of vermicompost utilization as a media in different proportions on growth, yield and quality of Capsicum

Khushi Agarwal, Amod Kumar, Subhash KC, Mukul Brawed, Anita Jaswal

Department of Agronomy, School of Agriculture Lovely Professional University, Phagwara 144 411 Punjab, India.

ABSTRACT

How to increase the sustainability of the agricultural system is a major concern on a worldwide scale. This had led to an increase in the use of organic fertilizers which aids in mitigating problems associated with synthetic fertilizers. Vermicompost is one such organic fertilizer used. It is basically an enriched compost prepared with the use of earthworms. This paper reports the influence of vermicompost prepared from cow dung on the growth and flowering of capsicum. The study was conducted using a plastic pot set-up, a total of seven distinct potting media were created by combining various amounts of soil and vermicompost. The present study was carried out on the basis of a Completely Random Design (CRD) with 7 treatments and 3 replications. The obtained results from the present research indicate that overall adding vermicompost to potting media has a significant positive impact on capsicums the addition of vermicompost led to improved the yield of capsicum cultivars as compared to control. Also, different treatments containing various proportions of vermicompost, seem to have distinct differences between them in terms of their effect on plant height, stem girth, leaf area, leaf count, number of fruits, the weight of fruits, etc this had led to finding the best proportion of soil and vermicompost to be used for plant growth. Overall T4-Vermicompost + Soil (1:3 ratio), containing 75 % vermicompost showed the best results for almost all parameters under study.

Keywords- Vermicompost, capsicum, sustainability, plant growth

INTRODUCTION

Capsicum (*Capsicum* sp; 2n=24), also known as pepper, is a major vegetable and spice crop [17] that was first encountered by Christopher Columbus in Mexico and Central America region in 1493. It is believed to be originated in Tropical South America [12] but is now grown all over the world for fresh, dried, and processed goods [17]. It has been in use as food, a vegetable, a flavoring, a natural colorant, and in traditional medicines since ancient times [7]. The capsicum genus belongs to the Nightshade family Solanaceae [12]. Around the genus *Capsicum*, there is an increasing interest and fascination as it contains significant levels of pigments i.e., chlorophyll, anthocyanin, and lutein which have potential health benefits; additionally, it contains other outstanding health-promoting chemical compounds, including vitamins, minerals, flavonoids, carotenoids, and capsaicinoids [7]. There are more than 30 species that come under the genus *Capsicum*, of which five namely *C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, and *C. pubescens* are domesticated and mainly grown for consumption [17]. *Capsicum* comes in various colors viz. red, green, orange, or yellow depending on the state of ripening and ability to produce carotenoids or chlorophyll. It is acclaimed as a highly profitable vegetable and high-value low-volume crop [12]. The bell pepper production has significantly grown in recent years. According to FOASTAT, 2021 data, globally the yield and area harvested for dried Chillies and peppers were 1619924ha and 29874kg/ha respectively, and for green Chillies and peppers was 2055310 ha and 176551kg/ha respectively. However, crop losses are estimated to exceed 40% annually [3]. In India, according to the National Horticultural Board (NHB)-2020-2021 report that capsicum production was 563020 tonnes. There is a significant global concern on how to make the agricultural system more

sustainable [10] since the flora, fauna, and enzymes of the soil, which serve to maintain the natural fertility of the soil, have been negatively impacted by the excessive application of agrochemicals to crops [5]. Though inorganic fertilizers aid in increasing yield per unit area however there are many serious major disadvantages associated with their use, such as it causes water pollution, nutrient imbalance that limits the uptake of other essential nutrients and cause soil acidity, are carcinogenic etc [14]. Thus, more emphasis on the potential advantages of applying organic fertilizers are now considered. The use of organic fertilizers, which come from natural sources such as animal and bird waste, plant remains, biogas residue, and agricultural by-products, helps in reducing pollution [10]. One such basic types of natural fertilizers that is easily accessible in the market is vermicompost. Vermicompost is the result of the decomposition of organic waste like scrap papers, farmyard manure, crop residues, residues of food and leftovers, and yard trimmings etc with the help of earthworms yielding a better end product which is rich in nutrients and acts as a soil conditioner. It holds an upper hand when compared with other media because it acts as an organic fertilizer and biological control agent, it has the ability to combat numerous plant illnesses brought on by soil-borne pathogens and pests, it enhances the C/N ratio and other soil indicators such as nitrogen and it also aids in lessening the negative effect induced by heavy metals to some extent [16]. Capsicum is one of the most extensively grown crops due to its easy culture and wide adaptability and is used commonly as both a vegetable and spice crop. Nonetheless, the growth and productivity of capsicum in organic potting material have received relatively little research attention. The present investigation was undertaken to investigate the effect of the application of vermicompost on the growth and flowering of

ARTICLE HISTORY

21 November 2022: Received
11 March 2023: Revised
27 May 2023: Accepted
14 August 2023: Available Online

DOI:
<https://doi.org/10.61739/TBF.2023.12.2.465>

CORRESPONDING AUTHOR: **Anita Jaswal**

E-MAIL ID: **anita.27139@lpu.co.in**

COPYRIGHT:

© 2023 by the authors. The license of Theoretical Biology Forum. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Capsicum annuum L. var. grossum so as to come up with the best potting media for optimum growth, yield, and quality of capsicum.

MATERIAL AND METHODOLOGY

The vermicompost used for the research experiment was prepared using the pit method at Lovely Professional University, Punjab, India. To prepare vermicompost, an alternate layer of pre-digested cow dung and wheat straw were filled in the pit and well-known specie; *Eisenia fetida* was used for its formation. The optimum moisture content of around 60–80 % was maintained by regular sprinkling of water. Also, the pits were covered with rice straw to protect them from light and predators. At the end of its formation period, the worms, cocoons, and hatchlings were removed from the vermicompost by sieving, and the vermicompost was stored for 1 month for maturation for further use in potting media experiments. The soil of sandy loam nature was used in the research pots. It was procured from the fields of Lovely Professional University, Punjab, India. The nutrient status of the soil and vermicompost used is given in Table 1.

Table 1: Nutrient characteristics of soil and vermicompost used in the study.

Parameter	Vermicompost	Soil
pH	7.72	7.40
EC (dS m ⁻¹)	0.995	0.633
Nitrogen (N)	0.98%	0.98%
Phosphorous (P)	1.429%	0.777%
Potassium(K)	0.237%	0.076%

A total of 7 treatments and 1 control were prepared by mixing different proportions of soil and vermicompost. The composition of different potting media is given below: T0- Soil—control (without vermicompost), T1- Soil+ Conventional fertilizer (Urea), T2- Vermicompost + Soil (1:1 ratio), T3- Vermicompost + Soil (1:2 ratio), T4- Vermicompost + Soil (1:3 ratio), T5- Vermicompost + Soil (1:1 ratio) +2% Urea foliar spray, T6- Vermicompost + Soil (1:2 ratio) +2% Urea foliar spray, T7- Vermicompost + Soil (1:3 ratio) +2% Urea foliar spray. The capsicum seedlings of the “INDRA” variety were transplanted in the potting media containing pots on 14th February 2023. The mean relative humidity and temperature of the study site at the time of transplanting was about 39 ± 2 % and 24 ± 3°C, respectively. All the vermicompost was applied as pre-plantation manures and no other manure was added at any stage during the research period. The vermicompost used was mixed thoroughly with soil before planting the saplings. The experiment was arranged in a Completely Randomised Design (CRD) design layout with three replicates. The plants were irrigated as and when required.

Parameters of the study

Plant height (cm): Length starting from the base of the stem to the tip of the highest leaf was measured using the ruler and measuring tape. The unit used for measurement was a centimetre (cm).

Stem diameter (cm): To calculate stem diameter, the stem was encircled using a thread and the point of overlap was marked using a pen and then the length of the thread was later measured using a ruler.

Number of leaves per plant and number of branches per plant: The number of leaves and number of branches per plant was calculated through manual observations. For the calculation of the number of branches per plant, the branches emerging from the main stem of the chilli plant was counted.

Leaf area (cm²): The length and width of the selected leaf was measured and then multiplied to get leaf area. Per plant leaf area of three leaves viz. upper, middle, and lower was calculated, and then the average was done. The unit used for the leaf area was cm².

Measurement of Chlorophyll index: The SPAD chlorophyll meter was used to determine the chlorophyll content in leaves. The average of three leaves namely upper, middle, and lower was used to apprehend the chlorophyll content of the plant.

Number of flower buds per plant: Calculated through manual observation where the total number of flowers produced by the chilli plant was counted.

Number of fruits, weight of fruit, length of fruit, diameter of fruit: Chilli fruits/pods were counted manually, the weight of the individual pod was measured by using an electronic weighing balance in grams. The length of the fruit was measured by using the ruler. The unit used for fruit length measurement was centimeter (cm). The unit for the diameter of fruit was cm.

Brix reading T.S.S: Brix reading (T.S.S) at every picking was measured immediately after harvesting of fresh fruits with hand-held refractometer.

Ascorbic acid: Determination of ascorbic acid was performed through xylene extraction (Ranganna, 1986) using a spectrophotometer. Test tubes were prepared with 0.0, 0.5, 0.75, 1, 1.5, and 2 mL of standard ascorbic acid solution in 3% H₃PO₃ (0.1 mg mL⁻¹) and filled to 2 mL with 3% H₃PO₃ solution. Subsequently, 2 mL of acetate buffer (pH 4), 3 mL of 2,6 dichlorophenol indophenol solution (0.0007 M), and 15 mL of xylene were added in rapid succession. The tubes were capped and stirred for 10–5 seconds. Phase separation was provided. The xylene phase was extracted, and the absorbance was measured at 520 nm using xylene as a blank.

Statistical Analysis

The data obtained was analyzed using statistical Package for Social Science Software (version 20.0; SPSS Inc) with ANOVA test to detect the effects of the treatment on the plant growth and yield. P value less than 0.05 was considered to be statistically significant.

RESULT AND DISCUSSION

Effect of Vermicompost on growth parameters of Capsicum

Plant height (cm): The minimum height was observed in control (Soil) (20cm) and the maximum (31.1 cm) was observed in T4 (V.C. + Soil (1:3)). It was 1.5 times greater than in control. T4 -(V.C. + Soil (1:3)) is at par with T7-(V.C +Soil (1:3) +2%urea foliar spray) (29.33cm), both the treatments have the same proportion of vermicompost in their media. This value is followed by treatment with 66% vermicompost i.e., T6(V.C. + Soil (1:2) +2%urea foliar spray)(27.43cm) respectively. Vermicompost is rich in nutrients, including nitrogen, phosphorus, potassium, and micronutrients. When used in a

75% proportion, the soil mix becomes highly fertile, providing an abundant supply of essential nutrients to the plants. This abundant nutrient availability supports robust growth and encourages plants to reach their maximum potential height. Thus, with this data it can be concluded that in all the treatments, plant height increased with the percentage of the vermicompost in the soil. Therefore, making vermicompost a suitable medium for plant growth [6].

Leaf area (cm²): The leaf area of capsicum plants, grown in a mineral soil mixed with vermicompost showed greater value than those grown in control soil. Highest leaf area (28.60 cm²) recorded in T4 (V.C. + Soil (1:3)) while lowest leaf area was recorded from the control plant (T0). Values of leaf area for T4, T7, T6 were not statistically significant with each other. Second highest leaf area (23.36 cm²) recorded in T5 (V.C. + Soil (1:1 ratio) + 2% Urea foliar spray). Vermicompost improves soil structure and aeration, creating a favorable environment for root growth. With a 75% proportion of vermicompost in the soil mix, plants are more likely to develop strong and extensive root systems. Robust roots can support the uptake of water and nutrients, which in turn leads to increased photosynthesis and the production of more leaves. This positive relation of vermicompost on leaf area was also suggested by Taleshiet al. (2011), according to which availability of plant nutrients in vermicompost increases the growth and leaf area of the plant.

Stem girth (cm): Stem girth showed significant variation among the treatments. The highest stem girth (2.93 cm) was recorded in T4 (V.C. + Soil (1:3)) and that is followed by T6 (2.7 cm) (V.C. + Soil (1:2 ratio) + 2% Urea foliar spray) which is at par with T7 (2.67 cm) (V.C. + Soil (1:3 ratio) + 2% Urea foliar spray). The lowest value was observed in T0 (Control). All the variations in treatments is due to differential nutrient content, which are the primary factor for stem growth. Vermicompost is rich in essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients. When applied at a 75% proportion in the soil mix, it provides a substantial supply of readily available nutrients to plants. These nutrients are crucial for cell division, expansion, and overall plant growth, including stem thickening. The nutrients and growth-promoting hormones present in vermicompost can stimulate cell division and elongation in plants. This leads to an increase in the number and size of cells in the stem, resulting in thicker and more robust stems.

Branches per plant: Highest number of branches per plant (6.33) was recorded in (V.C. + Soil (1:3)) which was at par with (V.C. + Soil (1:3) + 2% urea foliar spray). The vermicompost contains almost all the macro and micronutrients in a sufficient amount which affects growth of the branches thus leading to higher value of branches in plants that are grown using vermicompost as media [4]. Second highest no. of branches (5.0) recorded in T6 (V.C. + Soil (1:2) + 2% urea foliar spray). Other than this all the treatments are statistically significant from each other. The lowest number of branches recorded in control T0 (3.66) in which no application of any nutrient media was added. Vermicompost contains natural plant growth hormones like auxins and cytokinins. These hormones play a crucial role in regulating growth and development, including branching. The presence of these hormones in vermicompost can stimulate lateral bud activation, leading to the formation of more branches in plants.

Chlorophyll Index (SPAD): Capsicum seedlings grown in container media containing soil mixed with conventional fertilizer, i.e., T1 (Soil + Urea), contained more chlorophyll index (68.30 SPAD) than plants grown in control or any of the vermicompost mixtures. The higher value in this case can be attributed to greater amount of Nitrogen element contributed by urea application as the availability of N can boost chlorophyll biosynthesis, leaf organ formation and assimilation [13]. The second highest SPAD (62.3) recorded in T4 (V.C. + Soil (1:3)), the cause of lower value of SPAD in pots containing vermicompost may be due to the fact that inorganic fertilizer component of the mixture provided early nutrient to the growing crops during the early vegetative growth stage, while the organic component provided nutrient at the later stage of the crop development [2]. All the other treatments are statistically significant from each other and the lowest SPAD recorded in T0 - control (55.36) with no additional nutrient media.

Root length (cm): The root length exhibited a maximum value of 24.51 cm in T4 (V.C. + Soil (1:3)) and least value of 15.6 cm in the control. The reason for higher value of root length for treatments other than control, is due to use of vermicompost that leads to a decrease in soil bulk density and an increase in soil pH and soil organic carbon, together these changes in soil properties improve available air and water thus encouraging root growth [9]. Second highest value recorded for T7 (22.86 cm) (V.C. + Soil (1:3) + 2% urea foliar spray) which is at par with T6, T7 (22.16 cm) (V.C. + Soil (1:2) + 2% urea foliar spray). Vermicompost enhances soil structure and aeration, promoting healthier root systems. Strong and extensive root networks facilitate better nutrient and water uptake, providing the necessary resources for growth.

Leaf count (no.): The effects on the leaf count of the capsicum plant vary depending on the amount of vermicompost added. A significant rise in the leaf count was observed upon the increasing doses of vermicompost application. Highest leaf count (42.3) recorded in T4 (V.C. + Soil (1:3)) which is at par with T7 (40.3) (V.C. + Soil (1:3) + 2% urea foliar spray). Both T4 - (V.C. + Soil (1:3)) and T7 - (V.C. + Soil (1:3) + 2% urea foliar spray) are treatments containing maximum proportion vermicompost (75%) thus showing a synergistic effect between the amount of vermicompost and leaf number. The lowest leaf count was recorded in T0 (22.6). Vermicompost is rich in essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients. When added in a 75% proportion to the soil mix, it provides a plentiful supply of nutrients to plants. These nutrients are essential for leaf formation and expansion, resulting in an increase in leaf count. Vermicompost contains natural plant growth hormones like auxins, cytokinins, and gibberellins. These hormones play a crucial role in regulating plant growth and development, including leaf initiation and formation. The presence of these hormones in vermicompost can stimulate the growth of more leaves.

Dry weight (g): Dry weight per plant was significantly recorded highest (9.08 g) in T4 - (V.C. + Soil (1:3)) which was at par with T7 - (V.C. + Soil (1:3) + 2% urea foliar spray) (8.89 g) and minimum dry weight (5.62 g) recorded in T0 - Control. The remaining all treatments were statistically different from each other. The increase in dry matter of plants with vermicompost 75% proportion might be due to vermicompost contributing to the build-up of organic matter and humus in the soil. Organic matter improves soil structure, water-holding capacity, and nutrient

retention. The presence of humus further supports nutrient availability and uptake, leading to increased dry weight in plants [13].

Effect of Vermicompost on yield parameters of Capsicum:

Fruits per plant: Fruit per plant was significantly higher in vermicompost treatments than in control. The highest number of fruits was observed in T4(VC +Soil (1:3)) (10), while the lowest fruit count was in control (1.33). Higher fruit yields because of a significant increase in soil microbial biomass following the application of vermicompost, which resulted in a higher hormone or humate content in the vermicompost treatment[18].With a higher proportion of vermicompost, plants are likely to have higher chlorophyll content and increased leaf area. This enhances photosynthetic efficiency, allowing plants to produce and allocate more energy toward fruit development and yield.

Flower Buds (no): Level of nutrition, level of carbohydrate, light, leaf growth and hormones are some of factors which affects the process of bud initiation in plants (Jackson,1969). Maximum number of flower buds(22) was produced in (VC +Soil (1:3)) treatment followed by (Vermicompost + Soil (1:2)) and the least number of flower buds(6.6) was observed in case of T0 (control) in which no additional soil amendment added. Vermicompost contains natural plant growth hormones like auxins, cytokinins, and gibberellins. These hormones play a crucial role in regulating plant growth and flowering. The presence of these hormones in vermicompost can stimulate the development of more flower buds. Vermicompost has excellent water-holding capacity, ensuring that the soil remains consistently moist. Adequate moisture availability is critical for flower development, and sufficient water supply can promote the formation of more flower buds

Fruit weight (g): The individual fruit weight was significantly higher in treatments containing vermicompost. The highest fruit weight(152.23g)was recorded in T4(VC +Soil (1:3))while the lowest fruit weight in the control plant (T0)that is 20.40g. The synthesis of additional assimilate resulting from the application of vermicompost treatment contributed to a notable enhancement in the fruit yield response, ultimately leading to the production of larger and more economically valuable capsicum fruits. Vermicompost is rich in essential nutrients, including nitrogen, phosphorus, potassium, and micronutrients. When applied at a 75% proportion in the soil mix, it provides a significant supply of readily available nutrients to plants. These nutrients are vital for fruit development, and an ample nutrient supply supports larger fruit size and increased girth.

Fruit girth:T4-(VC +Soil (1:3)) showed maximum fruit girth (17.06cm) which is at par with T7-(V.C.+ Soil (1:3) +2%urea foliar spray)(15.76cm). The observed rise in fruit girth with the increasing vermicompost level can be attributed to the abundant availability of essential nutrients necessary for optimal plant growth, supplied by vermicompost. This nutrient-rich environment contributed to increased photosynthate formation, enabling the plant to enhance its vegetative growth, and consequently leading to an expansion in fruit girth. The minimum value was recorded in control (14.43cm) plants. The nutrients and growth-promoting substances in vermicompost support robust vegetative growth, leading to an abundance of flowers. More flowers increase the chances of successful

pollination, which is crucial for fruit set and subsequent fruit development with a larger size and girth.

A number of seeds per fruit: Vermicompost application significantly changed the number of seeds per fruit. Capsicum plants grown in the higher level of vermicompost (75%) had the higher seed number(171.67) followed by T6 and T7, while the least value (51.7) was observed in the control.The increase in number of seeds per fruit when used in a 75% proportion might be due to it providing a plentiful supply of nutrients to the capsicum plants. Nutrient-rich conditions support robust reproductive growth and can result in increased flower production and subsequent seed development within the fruits[11].

Effect of Vermicompost on fruit quality of Capsicum

Ascorbic acid :Ascorbic acid is an essential nutrient and antioxidant that plays a crucial role in various physiological processes in plants and is beneficial for human health. The application of vermicompost significantly influenced ascorbic acid contents (Vitamin C) in capsicum fruits. The maximum vitamin C content was observed in the highest level of vermicompost application i.e., T4(VC +Soil (1:3)) with 194.93 mg/ 100 g followed by T7(V.C.+ Soil (1:3) +2%urea foliar spray), while the minimum value was recorded at control with 154.83 mg/ 100 g. Though ascorbic acid content is influenced by a number of variables, including cultivar, plant nutrition, production methods, and maturity [11], the vermicompost can also be a reason for the increase in the levels of vitamin C in plants. As vermicompost contains surplus Zinc and Manganese ions which have key roles in enabling ascorbic acid oxidase enzyme, thus resulting in higher levels of Vitamin C in soil treated with vermicompost [1].

Total soluble solids (TSS): TSS refers to the total concentration of soluble sugars, organic acids, and other compounds in fruit juice, and it is an important indicator of fruit sweetness and flavor.The highest TSS was observed in the highest level of vermicompost treatment (75% vermicompost) i.e., T4(VC +Soil (1:3)) with 4.56°Brix followed by T7 (4.10°Brix) (V.C.+ Soil (1:3) +2%urea foliar spray), while the lowest value was observed in the control (2°Brix). A similar relationship of vermicompost application and TSS was indicated in the study conducted by Aminifard and Bayat.,2017 on bell pepper. The higher chlorophyll content and increased leaf area resulting from the use of vermicompost promote better photosynthetic efficiency in capsicum plants. Increased photosynthesis means more production of carbohydrates (sugars) through the process of photosynthesis, contributing to higher TSS levels in the fruit.

Conclusion: In conclusion, plant growth as well as yield characteristics were affected by the application of different levels of vermicompost. Out of all treatments used T4 with 75% vermicompost showed greater potential to increase the performance, growth of capsicum, and improvement of fruiting characteristics. These experiments, along with others described in the literature, show that using vermicomposts as components of horticulture soil or container media can greatly improve plant development. Vermicompost application is therefore recommended as a simple bio-treatment for enhancing the growth and flowering of capsicum plants.

Table 1: Effect of vermicompost on growth parameters of Capsicum

Treatments	Plant height(cm)	Root length (cm)	Leaf area (cm ²)	Stem girth (cm)	Number of leaves	Branches per plant	Chlorophyll index (SPAD)	Dry weight(g)
T0 - Control	20 ^e ±1.00	15.66 ^f ±0.41	14.27 ^e ±0.65	1.88 ^e ±0.04	22.66 ^d ±1.2	3.67 ^{de} ±0.58	55.3 ^d ±4.2	5.62 ^e ±0.34
T1- Conventional fertilizer urea	23.67 ^d ±2.89	19.20 ^e ±0.49	17.11 ^d ±0.75	2.00 ^e ±0.10	33.00 ^c ±1.0	4.33 ^{cd} ±0.49	68.3 ^a ±2.7	7.76 ^c ±0.41
T2- Vermicompost+Soil (1:1)	22.33 ^{de} ±0.58	20.16 ^{de} ±0.49	19.08 ^{cd} ±2.41	2.28 ^d ±0.13	40.33 ^a ±1.5	4.67 ^c ±0.49	57.6 ^{cd} ±1.4	7.62 ^c ±0.43
T3- Vermicompost+Soil (1:2)	27.27 ^{bc} ±0.87	21.46 ^{cd} ±0.62	19.56 ^c ±0.94	2.47 ^c ±0.10	36.00 ^b ±1.0	4.33 ^{cd} ±0.62	58.7 ^{bcd} ±0.9	7.58 ^c ±0.34
T4- Vermicompost +Soil (1:3)	31.10 ^a ±1.28	24.51 ^a ±0.79	28.60 ^a ±1.16	2.93 ^a ±0.08	42.33 ^a ±0.6	6.33 ^a ±0.79	62.3 ^b ±0.9	9.08 ^a ±0.23
T5- Vermicompost+Soil (1:1)+2%urea foliar spray	26.13 ^c ±0.81	21.26 ^{cd} ±0.82	23.36 ^b ±1.01	2.23 ^e ±0.15	36.66 ^b ±1.2	3.00 ^e ±0.82	57.4 ^{cd} ±0.8	8.56 ^b ±0.22
T6- Vermicompost+Soil (1:2)+2%urea foliar spray	27.43 ^{bc} ±1.15	22.16 ^{bc} ±0.66	27.29 ^a ±0.91	2.70 ^b ±0.10	37.66 ^b ±1.5	5.00 ^{bc} ±0.66	59.2 ^{bc} ±1.0	6.14 ^d ±0.21
T7- Vermicompost+Soil (1:3)+2%urea foliar spray	29.33 ^{ab} ±1.03	22.86 ^b ±0.49	27.36 ^a ±1.37	2.67 ^b ±0.07	40.33 ^a ±1.5	5.67 ^{ab} ±0.49	62.2 ^b ±1.0	8.89 ^{ab} ±0.12

*Data is in the form of mean ± SDM at p ≤ 0.05. the mean followed by different letters was significantly different at p ≤ 0.05, according to DMRT for separation of means.

Table 2. Effect of vermicompost on yield Parameters of Capsicum

Treatments	Fruit weight (g)	Number of fruits	Flower buds	Fruit girth (cm)	Number of seeds per fruit
T0 - Control	20.40 ^d ±7.26	1.33 ^d ±0.58	6.66 ^d ±0.58	12.43 ^c ±0.63	57.8 ^f ±0.16
T1- Conventional fertilizer urea	21.83 ^d ±6.32	1.66 ^d ±0.58	11.66 ^c ±0.58	12.66 ^c ±0.39	123.4 ^e ±0.09
T2-Vermicompost+Soil (1:1)	65.63 ^c ±12.01	4.33 ^c ±1.15	18.00 ^b ±1.00	14.55 ^b ±0.76	125.6 ^e ±0.09
T3-Vermicompost+Soil (1:2)	131.93 ^{ab} ±8.48	8.66 ^{ab} ±1.15	21.00 ^a ±1.00	14.38 ^b ±0.94	134.50 ^d ±0.21
T4- Vermicompost +Soil (1:3)	152.23 ^a ±4.35	10.00 ^a ±1.00	22.00 ^a ±2.00	17.06 ^a ±0.54	171.67 ^a ±0.19
T5-Vermicompost+Soil (1:1) +2% urea foliar spray	122.73 ^b ±17.21	8.00 ^b ±1.00	20.00 ^{ab} ±1.00	12.62 ^c ±1.07	145.00 ^c ±0.15
T6-Vermicompost+Soil (1:2) +2% urea foliar spray	112.20 ^b ±9.20	7.33 ^b ±0.58	18.00 ^b ±1.00	14.96 ^b ±0.21	158.67 ^b ±0.28
T7-Vermicompost+Soil (1:3) +2% urea foliar spray	111.53 ^b ±10.25	7.33 ^b ±1.15	20.00 ^{ab} ±1.00	15.76 ^{ab} ±0.54	155.60 ^b ±0.07

*Data is in the form of mean ± SDM at p ≤ 0.05. the mean followed by different letters was significantly different at p ≤ 0.05, according to DMRT for separation of means.

Table 3. Effect of vermicompost on fruit quality of Capsicum.

Treatments	Ascorbic acid	Total soluble solids (TSS)
T0 - Control	154.83 ^f ±1.88	2.33 ^f ±0.13
T1- Conventional fertilizer urea	166.70 ^e ±1.23	2.82 ^{ef} ±0.05
T2-Vermicompost+Soil (1:1)	178.80 ^d ±1.78	3.06 ^e ±0.04
T3-Vermicompost+Soil (1:2)	185.80 ^c ±1.07	3.22 ^d ±0.07
T4- Vermicompost +Soil (1:3)	194.93 ^a ±1.29	3.69 ^a ±0.12
T5-Vermicompost+Soil (1:1) +2%urea foliar spray	178.97 ^d ±0.98	3.14 ^{bc} ±0.01
T6-Vermicompost+Soil (1:2) +2%urea foliar spray	185.17 ^c ±2.19	3.20 ^c ±0.04
T7-Vermicompost+Soil (1:3) +2%urea foliar spray	190.73 ^b ±1.14	3.33 ^b ±0.04

*Data is in the form of mean ± SDM at p ≤ 0.05. the mean followed by different letters was significantly different at p ≤ 0.05, according to DMRT for separation of means.

REFERENCES

1. Aminifard, M., & Bayat, H. (2016). Effect of vermicompost on fruit yield and quality of bell pepper. *International Journal of Horticultural Science and Technology*, 3(2), 221-229.
2. Amujoyegbe, B. J., Opabode, J. T., & Olayinka, A. (2007). Effect of organic and inorganic fertilizer on yield and chlorophyll content of maize (*Zea mays L.*) and sorghum *Sorghum bicolor* (L.) Moench. *African Journal of Biotechnology*, 6(16).
3. Anaya-Esparza, L. M., Mora, Z. V. D. L., Vázquez-Paulino, O., Ascencio, F., & Villarruel-López, A. (2021). Bell peppers (losses and wastes: Source for food and pharmaceutical applications. *Molecules*, 26(17), 5341.
4. Aslam, M., Hussain, N., Zubair, M., Hussain, S. B., & Baloch, M. S. (2010). Integration of organic and inorganic sources of phosphorus for increased productivity of mungbean (*Vigna radiata L.*). *Pak. J. Agri. Sci*, 47(2), 111-114.
5. Gupta, R., Yadav, A., & Garg, V. K. (2014). Influence of vermicompost application in potting media on growth and flowering of marigold crop. *International Journal of Recycling of Organic Waste in Agriculture*, 3, 1-7.
6. Hassan, S. A. M., Taha, R. A., Zaied, N. S., & Essa, E. M. (2022). Effect of vermicompost on vegetative growth and nutrient status of acclimatized Grand Naine banana plants. *Heliyon*, 8(10), e10914.
7. Hernández-Pérez, T., Gómez-García, M. D. R., Valverde, M. E., & Paredes-López, O. (2020). Capsicum annum (hot pepper): An ancient Latin-American crop with outstanding bioactive compounds and nutraceutical potential. A review. *Comprehensive Reviews in Food Science and Food Safety*, 19(6), 2972-2993.
8. Jackson, D. I. (1969). Effects of water, light, and nutrition on flower-bud initiation in apricots. *Australian Journal of Biological Sciences*, 22(1), 69-76.
9. Lazcano, C., & Domínguez, J. (2011). The use of vermicompost in sustainable agriculture: impact on plant growth and soil fertility. *Soil nutrients*, 10(1-23), 187.
10. Lin, W., Lin, M., Zhou, H., Wu, H., Li, Z., & Lin, W. (2019). The effects of chemical and organic fertilizer usage on rhizosphere soil in tea orchards. *PLoS one*, 14(5), e0217018.
11. Meléndez-Martínez, A. J., Vicario, I. M., & Heredia, F. J. (2007). Carotenoids, color, and ascorbic acid content of a novel frozen-marketed orange juice. *Journal of Agricultural and Food Chemistry*, 55(4), 1347-1355.
12. Pramanik, K., Mohapatra, P. P., Pradhan, J., Acharya, L. K., & Jena, C. (2020). Factors Influencing Performance of Capsicum under Protected Cultivation: A Review. *International Journal of Environment and Climate*, 10, 572-588.
13. Purbajanti, E. D., Slamet, W., & Fuskhah, E. (2019, March). Effects of organic and inorganic fertilizers on growth, activity of nitrate reductase and chlorophyll contents of peanuts (*Arachis hypogaea L.*). In IOP conference series: earth and environmental science (Vol. 250, No. 1, p. 012048). IOP Publishing.
14. Sharma, A., & Chetani, R. (2017). A review on the effect of organic and chemical fertilizers on plants. *Int. J. Res. Appl. Sci. Eng. Technol*, 5, 677-680.
15. Taleshi, K., Shokoh-Far, A., Rafiee, M., Noormahamadi, G., & Sakinejhad, T. (2011). Effect of vermicompost and nitrogen levels on yield and yield component of safflower (*Carthamus tinctorius L.*) under late season drought stress. *International Journal of Agronomy and Plant Production*, 2(1), 15-22.
16. Thakur, A., Kumar, A., Kumar, C. V., Kiran, B. S., Kumar, S., & Athokpam, V. (2021). A review on vermicomposting: By-products and its importance. *Plant. Cell Biotechnol. Mol. Biol*, 22, 156-164.
17. Tripodi, P., & Kumar, S. (2019). The Capsicum crop: an introduction. *The capsicum genome*, 1-8.
18. Wang, X. X., Zhao, F., Zhang, G., Zhang, Y., & Yang, L. (2017). Vermicompost improves tomato yield and quality and the biochemical properties of soils with different tomato planting history in a greenhouse study. *Frontiers in plant science*, 8, 1978.