JEE Journal of Ecological Engineering

Journal of Ecological Engineering 2024, 25(2), 215–226
https://doi.org/10.12911/22998993/176862
ISSN 2299–8993, License CC-BY 4.0

Received: 2023.12.03
Accepted: 2023.12.23
Published: 2024.01.01

Efficacy of Compost and Vermicompost on Growth, Yield and Nutrient Content of Common Beans Crop (*Phaseolus vulgaris* L.)

Batool Al-Tawarah[1], Muawya A. Alasasfa[1*], Atif Y. Mahadeen[1]

[1] Department of Plant Production, Faculty of Agriculture, Mutah University, Karak, Jordan
* Corresponding author's e-mail: muawyaasasfa@mutah.edu.jo

ABSTRACT

The experiment was conducted to study the effect of organic fertilization to the sustainability of agricultural systems by recycling nutrients and improving the physical properties of the soil; two important types of organic fertilizers, namely vermicompost and compost were tested to study their effect on soil and growth of common bean 'Sybaris'. They were mixed in different proportions of with soil by varying ratio: (100% soil, 100% compost, 100% vermicompost, 75% soil + 25% compost, 50% soil + 50% compost, 25% soil + 75% compost, 75% soil + 25% vermicompost, 50% soil + 50% vermicompost, 25% soil + 75% vermicompost, soil 33% + compost 33% + vermicompost 33%). The study findings showed ability of these two types of organic fertilizers to enrich plant growth, development and yield characteristics compared to the control treatment, with superiority of vermicompost, and there was also a clear discrepancy related to the rate of addition. Most of the results referred to superiority of the higher application rates of these two fertilizers, especially in the case of vermicompost (VC100%). The later treatment recorded the highest values in terms of vegetative, root and yield components. The study concluded that cultivation of bean and addition of vermicompost with soil replacement rates ranging from 50% to 100% has a significant impact on the development, growth, and productivity of the common bean plant.

Keywords: vermicompost, compost, green bean, organic farming, organic fertilization.

INTRODUCTION

Common bean is considered as one of most important legumes worldwide for direct human consumption. To increase bean production, its necessary to use fertilizers comprising nitrogen, phosphorus, and potassium (N,P,K) (Ramadan and Adam, 2007), because of their quick affordability for crops and ease of use, chemical fertilizers are most commonly used by vegetable producers to improve output (Thy and Buntha, 2005), but their continued use may ultimately cause harm to the chemical, biological, and physical characteristics of soil (Albiach et al., 2000) . In addition to raising production costs, their use poses a serious danger to the basic system's survival and gradually reduces productivity (Band et al., 2007), which is a crucial requirement for achieving sustainable yield (Santosa et al., 2017). Sustainable agriculture is one of the most prominent solutions to reduce the consequences of environmental pollution, which has increased as a result of wrong agricultural practices, including the extensive use of chemical fertilizers, which is considered a source of environmental pollution (Mostafa, 2011). This has significant negative effects on the physical and chemical properties, soil nutrients, groundwater and the ecosystem, which makes it a major obstacle to the ability of living organisms to survive and reproduce, in addition to having the most harmful effects on human health (Camargo and Alonso, 2006). Therefore, there was an urgent need to find an alternative, even partial to these fertilizers to be a source of nutrients needed by the plant, as it was recommended to use organic fertilizers as an alternative to chemical fertilizers (Ojo, et al. 2014; Smith, et al. 2015 and Hoque et al., 2022).

The use of organic fertilizers is an effective way to improve soil fertility, as well as increase the activities of soil microbes and crop yields (Ouédraogo, et al. 2001). It also improves soil structure, thus creating a better environment for plant rooting (Saison, et al. 2006). In recent years, the attempts to save crop cultivation have increased the value of organic fertilizers on a worldwide basis. It may be used as a substitute for chemical fertilizers (Chaterjee et al., 2005; Kumar et al., 2017) for enhancing microbial life and soil architecture (Pagliai et al., 2004). It was previously proven that using organic fertilizers can prevent ecosystem degradation and help conserve natural resources (Francis and Daniel, 2004). It enhances the physical, biological, and chemical traits of soil as well as the amount of microbes alongside to providing biological material and nutrient-rich (Albiach et al., 2000). As a consequence, organic agriculture has become a cutting-edge technique that encourages the utilization of organic materials that are naturally occurring, such as crop residue, dung, cover crop, and compost (Shannon et al., 2002). These organic, naturally occurring compounds have been shown to enhance the soil's nutrient-rich state and have an effect on additional soil attributes like air circulation, ability to hold water, and particle aggregate formation (Pagliai et al., 2004), which encourages more effective production of crops regardless of whether less or no fertilizer is applied (Islam et al., 2016).

Among fertilizers made from organic material, the compost and vermicompost are popular for supplying nutrients for plants (Shehata and El-Helaly, 2010; Manivannan et al., 2009). Vermicompost is produced from organic material through the interactions between earthworm and microorganisms that live in the top few centimeters of the soil and the waste layer, and eat recently formed biological material (Sherman, 2002; Lim et al., 2015). It acceptable from an economic and environmental standpoints, as well as for maintaining the condition of the soil (Horwth, 2005). Also, it is capable for being applied to crops as a fertilizer (Dominguez, 2023). Numerous studies have demonstrated the impact of vermicompost on bean productivity and growth (Manivannan et al., 2009; Mahmoud, & Gad, 2020). Vermicomposting is thus an intriguing way to recycle a growing quantity of organic matter while also using less fertilizer. According to Manivannan et al. (2009), the addition of vermicompost raised the development, productivity, and nutritional value of beans and enhanced the physical properties of soil, facilitating more effective nutrient absorption by plants and greater air circulation of plant root systems, drainage systems of water, promotion of macronutrients exchange, and maintained intake of nutrients. The therapy beans grow more quickly, yield more beans, and are of higher quality when 50% vermicompost and 50% NPK are applied to the soil and crops. Vermicompost, according to Zaller's research from 2007, might serve as an ecologically friendly alternative with advantages on seedling development and fruit tomato quality that are comparable to or even preferable. Vermicompost treatment increased pore volume, water retention capacity, and capacity for gas exchange considerably, according to Manivannan et al. (2009).

While compost is a byproduct of the aerobic breakdown of organic materials (Saha et al., 2022). Composts impact soil quality, crop health, and productivity (Luo et al, 2017), through providing the soil with a naturally occurring supply for minerals and organic materials (Ho et al; 2022). Given the usage of the products and their quality, this impact may be beneficial or detrimental. Composts may be able to promote plant development and safeguard crops against diseases (Leon et al., 2006; Ho et al., 2022). Additionally, using composts on an extensive basis is an effective method of raising the organic matter content of soil, which is essential for its continued fertility (Lal, 2004; Dignac et al., 2017). On the other hand, compost is a soil enhancer that improves the ability of soil to hold water, its hardness, and structure while also supplying nutrients and organic matter (Islam et al., 2016). To demonstrate the beneficial effects of compost application on soil qualities, yield improvements, and the nutritional value of crops, many investigations have been carried out. Common claims stated the benefits of compost treatment, with results in higher yields, improved soil fertility and texture (Scherer, 2004; Mahmoud et al; 2009; Shehata et al, 2011; Natsheh and Mousa, 2014; Islam et al., 2016; Rady et al; 2016; Alromian, 2020; Suminarti, 2021).

Since compost and vermicompost are inexpensive and readily available under local conditions, they can be used as integrated plant nutrient delivery sources to increase sustainable production in modern agriculture while minimizing the dependency on chemical fertilizers (Savci, 2012; Bhattacharjee and Dey, 2014). For plant crops, a variety of organic materials have been suggested as a supply of nutrients (Al-Suhaibani et al., 2021). Compost and vermicompost, according to numerous recent studies, can be used to better plant growth as well as to increase stress tolerance and resilience (Nardi et al., 2002; Siddiqui et al., 2008). Although growing crops organically is not a novel concept, little is known about growing beans organically. This makes an effort to assess how compost and vermicompost affect bean output. Thus, this study was conducted to investigate the impact of various organic fertilizers like compost and vermicompost on growth, yield and nutrient content of beans crop and determining the best organic fertilizer for green beans crop production.

MATERIALS AND METHODS

This research study was carried out during summer growing season from mid-June to mid-September, 2022 at Al Rabbah agriculture station, Jordan (920 meters above sea level, Longitude 35°45'E and Latitude 31°16'N). The location experiences a temperate environment, with an average annual temperature of 20 degrees Celsius and mean yearly precipitation of 300 mm. The layout of the treatments was applied with a randomized complete block design with ten treatments and three replications. The combinations were tested with in the following volume percent of compost and vermicompost to soil (Table 1). Three seeds of 'Sybaris' bean)the most common variety that used by local farmers) were planted per each earthen pot (20 cm diameter, 18 cm height) in 5 cm deep halls on September 30th, 2022. Thirty pots were used in this experiment. The pots received the same amount of irrigation after sowing. Irrigation was initiated when fifty percent of the water availability had been consumed. After four days of germination, the seeds were thinned, one plant was let grow, then any necessary horticultural activities were carried out.

Soil analysis

Five samples of soil were randomly selected from the top fifteen centimeters of the soil to assess the characteristics of the soil. The experimental soil was collected from the agricultural field of Mutah University, Al Rabbah, Karak, Jordan. The soil samples were analyzed in order to determine physicochemical characteristics by using the procedure described by Jackson, 1973, which showed in Table 2.

Vermicompost and compost analysis

Vermicompost was brought from a private farm located in Amman, Jordan. In turn, compost was gathered from Agriculture research station of NARC at Ghor Al-Safi. The collected vermicompost and the compost were using a 0.5 millimeter metal sieve, the standard approach was used to

Table 2. Main physico-chemical properties of the soil utilized in the experiment

Soil Item	Content
Bulk density (g/cm^3)	1.36
pH	7.8
EC (dS m^{-1})	0.41
P (mg kg^{-1})	29
K (mg kg^{-1})	447
N (%)	0.14
$CaCO_3$ (wt %)	11
Organic matter (g kg^{-1})	1.5
Texture	Clay loam

Table 1. The treatments used for compost and vermicompost

No.	Treatment	Abbreviation
T1	100% soil	(control) S 100
T2	100% compost	C 100
T3	100% vermicompost	VC 100
T4	75% soil + 25 %compost	C 25
T5	50% soil + 50% compost	C 50
T6	25% soil + 75% compost	C 75
T7	75% soil + 25% vermicompost	VC 25
T8	50% soil + 50% vermicompost	VC 50
T9	25% soil + 75% vermicompost	VC 75
T10	33% soil + 33% compost + 33% vermicompost	VC:C:S

Table 3. The chemical characteristics for compost and vermicompost

Item	Compost	Vermicompost
pH	7.43	7.21
EC (dS m^{-1})	0.21	0.94
P (g kg^{-1})	8.22	7.42
K (g kg^{-1})	17.7	23.4
N (g kg^{-1})	28.7	31.5
Ca (g kg^{-1})	22.1	21.37
Organic matter (g kg^{-})	621	232
C/N	10.8	13.22
Moisture (%)	26.9	22.7

determine various physicochemical parameters were as described by Jackson, 1973 (Table 3).

Study parameters

After 60 days, bean plants were gathered from pots and growth measurement were taken.

1. Evaluation of nutrient concentrations in leaves: at the end of the experiment, three leaf samples from every replicate were taken, dried at 75 degrees Celsius, crushed, and utilized for N, P, and K measures. The total amount of nitrogen was calculated according to the procedure developed by Kjeldahl (Chapman and Pratt, 1962). In turn, the available phosphorus was estimated by utilizing a UV spectrophotometer (UV-1601PC, Shimadzu, Japan) and the vanadate-molybdate procedure (Olsen et al., 1954). The available potassium was measured by atomic absorption spectrometer (Perkin Elmer Analyst 300, USA) (Knudsen et al., 1982).
2. Determination of germination %, lengths of the plant's roots (cm), height of the plant (cm), number of leaves, number of branching, shoot fresh weight (g), root fresh weight (g), shoot dry weight (g), and root dry weight (g) were done for each plant in the replicate.
3. Determination of pod yield and related parameters: plants' pods were counted, and the mean number of pods per plant in each pot was calculated. Each plant's seeds per pod were determined out of 10 pods at random, converted to an average value, and then documented as the total number of seeds each pod. The length of ten pods was measured using a ruler, whereas their diameter by using caliper diameter(cm) with an accuracy of -+0.1. These ten pods also were weighted in (g) using a 2 digits' sensitive balance.

Statistical analysis

Using MSTATC software and randomized complete block design; one-way analysis of variance (ANOVA) was computed on the results of the experiment. To test the level of significance differences between the means, (LSD) were applied at $p = 0.05$.

RESULTS

All organic substitutions showed a significant improvement in nitrogen concentration compared to control (S 100 = 3.89%). Furthermore, the full vermicompost treatment outperformed all treatment significantly (VC 100 = 5.15), other treatments of compost and vermicompost showed a close affinity (Table 4). The results indicated positively affected in the concentration of phosphorus in plant leaves compared with the control treatment, the higher values were observed in treatment; VC100, C50 and C75 that recorded 0.445%, 0.443% and 0.439%, respectively and lower application rates of vermicompost had the most negative effect and control; 0.293% and 0.300% respectively (Table 4), with the exception of the rates of VC25 addition (0.293%), which did not have any significant effect,

On the basis of the least significant difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at $p = 0.05$. The results showed in Table 4 that all compost treatments led to a significant increase in potassium concentration compared to the control treatment (1.15%) without a pattern associated with the rate of addition, as C75 (2.02%) and C25 (1.99%) treatments outperformed the rest of the treatments, including vermicompost treatments, which had a negative effect on the potassium concentration, especially at the rate of the upper (VC100 = 1.62%) and lower addition (VC25 = 1.47%). The combination of compost and vermicompost resulted in a significant decrease in potassium concentration (1.17%), compared to the control treatment.

All soil incorporation treatments with one component, whether compost or vermicompost, significantly improved the percentage of seed germination compared to the control treatment. In contrast, the pure treatments or the triple mixing treatment had no significant effect on this trait (Table 5). As for the vegetative growth traits, the VC100 treatment

Table 4. Effect of compost and vermicompost on (N, P and K concentrations) in bean leaves

Treatment	N (%)	P (%)	K (%)
S 100	3.89 e	0.300 f	1.15 g
C 100	4.83 b	0.383 c	1.74 c
C 75	4.09 cde	0.439 a	2.02 a
C 50	4.07 cde	0.443 a	1.67 de
C 25	4.01 de	0.426 b	1.99 a
VC 100	5.15 a	0.445 a	1.62 e
VC 75	4.36 c	0.341 d	1.72 cd
VC 50	3.95 de	0.333 d	1.85 b
VC 25	4.19 cd	0.293 f	1.47 f
S:C:V (1:1:1)	4.20 cd	0.312 e	1.17 g

Note: Based on the least significant difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

showed significant and clear superiority in all morphological traits. All treatments that contained vermicompost significantly improved plant height compared with control (75.67 cm), while compost treatments significantly reduced this characteristic, the highest value was in treatment VC100 (85.33 cm) and the lowest value was in treatment C75 (63.00 cm) as shown in Table 5.

On the basis of the Least Significant Difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05. In general, the number of leaves was improved by adding different compost and vermicompost treatments except for the VC75 treatment (34.00), with the superiority of the other vermicompost treatments (Table 5). The VC100 treatment recorded a mean of 96 leaves compared to 44 leaves in the control. Also, in the case of compost, a clear pattern was observed with an increase in the number of leaves in the plant, with an increase in the proportion of compost in the planting medium (Table 5). In view of the number of branches, it was noted that all the rates of vermicompost increased it with a significant superiority in the treatment of VC100 (63.00), as in the case of previous traits, while there was a pattern similar to what has occurred in the characteristic of the number of leaves in the case of rates of compost addition.

In contrasting with control, all treatments containing vermicompost showed a significant increase in the fresh and dry fresh weight characteristics, including the treatment of triple mixing with soil and compost compared to control; 58.51 g and 8.14 g respectively, while only the pure compost treatment was among the compost treatments that led to a significant increase compared to control. The VC100 treatment

Table 5. Effect of compost and vermicompost on vegetative growth of bean plant

Treatment	Germination (%)	Plant height (cm)	Number of leaves	Number of branches	
S 100	67 b	75.67 cde	44.00 f	21.67	g
C100	67 b	74.67 de	71.00 d	43.00	d
C 75	100 a	63.00 f	56.00 e	31.33	e
C 50	100 a	64.00 f	47.67 f	26.33	f
C 25	100 a	72.00 e	59.00 e	33.00	e
VC 100	100 a	85.33 a	96.00 a	63.00	a
VC 75	100 a	81.00 abc	34.00 g	41.33	d
VC 50	100 a	79.00 bcd	86.33 b	52.67	c
VC 25	100 a	82.00 ab	78.00 c	56.00	b
S:C:V	67 b	80.33 abcd	73.00 d	53.67	bc

Note: Based on the least significant difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

recorded the highest values in both traits; 83.91 g and 13.71 g, respectively, while C50 treatment recorded the lowest values 32.13 g and 5.35 g, respectively (Table 6). However, all vermicompost levels showed a high clear superiority over than compost. On the basis of the LSD, data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

In Table 6, it can be seen that only when using the full application rate of vermicompost (VC100) appeared a significant increase in the characteristic of root length compared with the control (15.45 cm), which was recorded (17.60 cm), while other vermicompost treatments did not record any significant differences, including the treatment of triple consolidation. With regard to the effect of compost on this characteristic, with the exception of the full compost treatment, which did not affect the length of the roots, the rest of the treatments had a negative effect, as the lowest value reached (10.30 cm) at the treatment (C50). All compost treatments had a significant negative effect on the fresh weight of the roots, and in contrast, these treatments had no significant effect on the dry weight except for the C50 addition rate, which had a negative effect and recorded the lowest value of all treatments (1.08 g). On the other hand, all treatments that contained vermicompost showed a significant increase in fresh weight, including the triple fusion treatment, and it reached its maximum in the complete vermicompost treatment VC100= 13.92 g). In terms of dry weight, all vermicompost treatments were also significantly superior, and the highest value was at VC100 (3.56 g) treatment as well, while the triple consolidation treatment did not significantly affect the dry weight of the roots.

Table 7 highlights the most important morphological and quantitative characteristics associated with the fruiting process of bean plants as well as their response to different application rates of compost and vermicompost. The complete medium of the vermicompost had the highest value of number of pods per plant (VC100 = 93.33) and there was no clear pattern associated with the rate of addition. On the basis of the LSD, data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

In terms of pod weight, all treatment showed a significant increase except in case of VC75. Treatment; C25, C100 and VC50 recorded the highest values: 17.81 g, 17.44 g and 17.44 g, respectively, compared to (8.36 g) by control (Table 7). Pods were longer significantly in the case of compost treatments than those of vermicompost and control, this is clearly observed in treatments; C25 and C75 that recorded 20.70 cm and 20.30, respectively. The lowest significant decrease value was at application rate VC75 which recorded 9.40 cm. Also, triple combination decreased this characteristic significantly to 12.60 cm (Table 7). Pod diameter improved significantly by the most additional rates of organic fertilizers compared to control (0.7 cm), these values were in range of 1.07~1.15 cm. All organic fertilizer treatments led to significant increase in seed weight compared to control (0.585g). The highest values were recorded at VC50 (1.162 g) with a relative superiority of vermicompost treatments over than those in

Table 6. Effect of compost and vermicompost on shoot fresh weight, shoot dry weight, root length, root fresh weight and root dry weight of bean

Treatment	Shoot dry weight (g)	Shoot fresh weight (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)
S100	8.14 g	58.61 ef	15.45 b	6.26 de	1.45 cd
C100	10.78 e	66.24 de	13.95 bc	5.34 ef	1.46 cd
C75	7.67 h	49.32 g	13.31 cd	4.35 fg	1.20 c
C50	5.35 i	32.13 h	10.30 e	3.18 g	1.08 d
C25	9.01 f	54.03 fg	11.59 de	5.10 ef	1.44 cd
VC100	13.71 a	83.91 a	17.60 a	13.92 a	3.56 a
VC75	12.57 b	80.57 ab	15.20 bc	10.04 b	3.32 a
VC50	12.11 c	77.64 ab	13.90 bc	7.39 cd	2.61 b
VC25	12.66 b	74.09 bc	15.40 b	10.03 b	3.28 a
S+C+VC	11.30 d	69.04 cd	14.40 bc	7.72 c	1.65 c

Note: Based on the least significant difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

Table 7. Effect of compost and vermicompost on number of pods/plant, pod weight, pod length, pod diameter, seed weight, number of seed per pod and yield per plant

Treatment	No. of pod / plant	Pod weight (g)	Pod length (cm)	Pod diameter (cm)	Seed weight (g)	No. of seed/ pod	Yield/ plant (g)
S100	30.33 g	8.36 e	16.40 c	0.7 b	0.585 d	11.00 cde	252.70 f
C100	51.67 e	17.44 a	18.21 b	1.09 a	0.969 c	16.00 a	904.92 c
C75	44.00 f	15.69 b	20.30 a	1.13 a	0.908 c	14.00 ab	855.85 c
C50	34.00 g	12.83 c	15.40 c	1.07 a	1.048 ab	10.00 de	436.81 e
C25	48.00 ef	17.81 a	20.70 a	1.07 a	1.018 b	14.00 ab	690.35 d
VC100	93.33 a	15.92 b	16.30 c	1.12 a	1.061 ab	13.00 bc	1487.9 a
VC75	61.00 d	8.14 e	9.40 e	0.70 b	0.904 c	6.00 f	1288.6 b
VC50	77.00 c	17.44 a	16.30 c	1.08 a	1.162 a	12.00 bcd	1341.9 b
VC25	85.00 b	15.15 b	18.70 b	1.15 a	1.156 ab	11.00 cde	496.96 e
S+C+VC	48.67 ef	10.38 d	12.60 d	1.05 a	0.936 c	9.00 e	506.08 e

Note: Based on the least significant difference (LSD), data in a given column that are separated by identical letter(s) are not statistically different at p = 0.05.

compost (Table 7). Conversely, the compost treatments were more superior in the characteristic of the average number of seeds per pod than the vermicompost and control treatments. The treatment of adding a complete medium of compost recorded a value of 16.00 seeds per pod while this characteristic was negatively affected by the treatments VC75 and C50 in addition to the treatment of triple consolidation: 6.00, 10.00 and 11.00 seed per pod, respectively (Table 7).

Finally, the yield per plant confirmed the superiority of vermicopost treatments over those of compost or control. The highest yield recorded by VC100, VC50 and VC75; 1487.92, 1341.90 and 1288.60 g, respectively. However, the lowest one was by control, 252.70 g (Table 7).

DISCUSSION

In this short-term research study, two important types of organic fertilizers, namely vermicompost and compost were tested, in order to study their effect on the bean 'Sybaris', where different proportions of organic fertilizers were mixed with soil by 25%, 50%, 75%, and 100%. The study findings demonstrated beyond doubt the ability of these two types of organic fertilizers to enrich plant growth, development and yield characteristics of green bean compared to the control treatment, despite the variation between the effect of each compared to the other, most of which was in favor of vermicompost fertilizer, and there was also a clear variation related to the rate of addition. Most of the results favored the higher application rates of these two fertilizers, especially in the case of vermicompost as well. In some detail, most of the rates of fertilizers positively affected the content of the leaves mineral nutrients, which in this study were limited to the macronutrients; nitrogen, phosphorus and potassium. While the compost was superior in the case of potassium, the high levels of both fertilizers were superior in the case of nitrogen and phosphorus (Table 4).

Regarding vermicompost, Kumar et al. (2017), demonstrated the addition of organic substrate through vermicompost, which promotes the maximum activity of rapid multiplication of the microbial population, which causes the available nitrogen content to increase gradually in vermicompost applied pot and reach a peak at the 40th and 50th day. According to Tayebeh et al. (2010), vermicompost has more readily available nitrogen than traditionally composted manure. This finding may support the superiority of higher vermicompost levels in study percent for nitrogen levels. Vermicompost or manure had a substantial immediate effect on the diversity of microbes in the soil, which contributed directly to a rise in P consumption by the sweet corn crop, according to the research by Lazcano et al. (2013). Application of vermicompost to soils increased the available K by increasing soluble K (Najafi-Ghiri, 2014). Lazcano et al. (2013) demonstrated that using vermicompost or manure in place of some inorganic fertilizers had a favorable effect.

The activity of the earthworm's speeds up recovering nutrients, enhancing the amount of minerals, like K, that are accessible to crops (Lim et al; 2015). In case of compost, Soheil et al. (2012) found that as compost concentration increased, so did N concentration in plants. Previously, Beraud et al. (2005) observed that since the pace of organic nitrogen mineralization of compost is slower than wheat uptake, more compost must be used in a short time to offer the inorganic nitrogen it contains. According to Fricke and Vogtmann (1993), more than 85 percent of the overall K content in compost is available for use by plants, suggesting the significance of compost as a valuable source of K for plants. Another issue may explain higher macronutrient concentrations by both organic fertilizers is related to mitigation of the leaching effect. Significant quantities of macronutrients were lost from the soil during a two-month experiment by (Abou-El-Hassan, et al., 2017). This finding proved that when nutrients are implemented as mineral fertilizers, high rates of N and K leach out of the soil. Contrarily, the latter researchers claimed that with compost and vermicompost, nutrient leaching was always minimal, as a result, from the higher content of organic matter and the action of the sorption complex. The influence of compost on nitrogen fertilization is especially restricted because of low decomposition kinetics and microbial immobility (Tayebeh et al., 2010).

This study showed an unparalleled effectiveness in the growth and development of the vegetative and root system of the green bean plant, which reflected positively and significantly on the yield components. The high replacement rates gave a great difference at all levels. All of this happened in a short period of no more than two months. Singh and Chauhan (2009) examined the response of French beans in this scenario. Vermicompost treatment was found to be superior than farmyard manure, inorganic fertilizers, and combination treatments in all observational aspects of growth, including germination, plant height, number of leaves/plant, length of leaves, and breadth of leaves. It was attributed by the researcher to the improved physicochemical characteristics of soil.

The weight of the roots had an impact on the highest and lowest values for shoot dry weight of the green bean plants that were harvested from potting mixtures that had vermicompost substituted for the control (Soobhany, et al. 2017). This clear superiority in the vegetative and root growth of vermicompost treatments was clearly reflected in the number of pods/ plant. This had a clear impact on other productive traits. The obtained results are compatible with many studies in this context, the study by Singh and Chauhan (2009), in particular, indicated that vermicompost treatment outperformed farmyard manure, inorganic fertilizers, and combination treatments in terms of French bean response, number of pods/ plant, yield/ plot, and number of seeds/ pod. The exceptional qualities of vermicompost are not new today, and many studies have indicated what we have in this study. According to several studies, utilizing organic fertilizers like vermicompost increased the amount of soil organic matter, soil microorganism's biomass, and microbial soil activity (Manivannan et al. 2009). Sharma et al. (2018) found that the grain yield of pole type French beans was similar to that obtained from the recommended application of N when vermicompost Plus 75% N was applied, resulting in a 25 percentage reduction in the use of inorganic fertilizers.

Manivannan, et al. (2009) reported that the usage of vermicompost enhanced the physical conditions of the soil, supporting better aeration to plant roots, drainage of water, enablement of cations exchange, prolonged nutrient supply, and subsequently the take up by the plants leading to improved growth, this led to an increase in bean development, yield, and quality. The author concluded that vermicompost use is advised for enhancing long-term soil fertility and crop yield, individually or in combination with inorganic fertilizers. The findings are similar to those of Mahmoud and Gad (2020), who indicated that marketing and pod weight improved when VC doses increased from 0% to 100% over the duration of two seasons. According to Domnguez et al. (2010), earthworms' digestion of manure during vermicomposting results in significant mineralization and encourages humification of the organic substrates, which lowers the quantity of quickly metabolizable chemicals in vermicompost compared to manure. According to Fernández-Luqueo et al. (2010), applying vermicompost to the beans grown in modified soil boosted plant development and increased production. For two varieties of cucumber (*Cucumis sativus* L.), application of 30 t /ha vermicompost enhanced leaf area, stem dry weight, and leaf dry weight, along with raising the overall fruit output by approximately 26%. Vermicompost acquired more green pod crops, more green grain weight / plant, more carbohydrate and protein content, and a better yield of green pods (24.8% to 91%) on garden pea (*Pisum sativum*) when in comparison with chemical fertilizers (Meena et al., 2007). By increasing microbial biomass and activity, which are essential for nutrient cycling, the synthesis of plant growth regulators, and the defense of plants against arthropod pest attacks and soil-borne disease, the use of vermicomposts in the field improves soil quality (Arancon and Edwards, 2005). According to reports, vermicompost exhibits hormone-like activity. It has been postulated that this will lead to increase root development, root biomass, development and growth of the plant, and morphological characteristics in the plants cultivated in media altered with vermicompost (Lim et al., 2015). Amylase, lipase, cellulase, and chitinase are a few of the enzymes found in vermicompost which can decompose organic material in soil to produce nutrients, thus rendering them accessible to plant roots (Chaoui et al; 2003) It was previously noted that the increased ability of plants to manufacture proteins is caused by earthworm-produced metabolites, as described by Edwards et al. (2011); the presence of vermicompost efficiently promotes plant growth.

Despite the availability of macronutrients in the leaves in the compost treatments with positive significant differences compared to the control treatment at the end of the experiment, this did not reflect positively on the growth and development characteristics of the plant, and the compost had no competitive effect compared to vermicompost. Perhaps this is due to the poor availability of nutrients, especially in the stages of early vigorous growth, which is definitely not like its vermicompost counterparts. The results of (Dinesh, et al., 2010) suggest that even brief absorption of organic manures and biofertilizers improved soil microbial and enzyme activity, and that these parameters are sensitive enough to identify the changes in soil quality brought on by brief incorporation of biological fertilizers. On the other hand, when plant nutrients are released gradually, the fertilization impact will last longer (Seran et al., 2010). Green beans grown at replacement levels between ten percent and fifty percent in compost/soil combinations. had performance comparable dry shoot weights to beans grown in the control (Soobhany, et al. 2017).

According to Arancon et al. (2008), many lower shoot dry weight responses to higher replacement levels for compost (100%), in particular, composting waste from food, could be caused due to the existence of more salt (EC) or nutrients in extremely high concentrations in the more bunched combinations. There is little difference between chemical additives and vermicompost, it has been noted that worm castings contain a larger percentage of macro and micronutrients than garden compost – nearly twice as much (Nagavallemma et al., 2004).

CONCLUSIONS

The results of the study demonstrated that these two kinds of organic fertilizers may improve plant growth, development, and yield characteristics when compared to the control treatment. In this short-term experiment, the superiority of the complete addition treatment of vermicompost in most of the characteristics remains the distinguishing mark in the study of the vegetative and root growth characteristics. There was also a noticeable difference in the rate of addition. The majority of the findings discussed how these two fertilizers performed better at greater application rates, particularly vermicompost (VC100%). Date of percent study indicated that using the use of vermicompost led to results with a faster effect than those in the case of traditional compost, and this is due to the greater effectiveness of microorganisms and consequently, the faster effect reflected on the soil properties and the subsequent availability of the nutrient mineral elements. The important point that must be accountable remains, is conducting further studies on the effect of these organic fertilizers with a broader spectrum of soil types, in addition to studying other agricultural operations that may be effective in conjunction with the use of these types of fertilizer, such as thinning branches and pods.

REFERENCES

1. Abou-El-Hassan, S., Abd Elwanis, M., El-Shinawy, M.Z. (2017). Application of compost and vermicompost as substitutes for mineral fertilizers to produce green beans. Egyptian Journal of Horticulture, 44(2), 155-163.
2. Albiach, R., Canet, R., Pomares, F., Ingelmo, F. (2000). Microbial biomass content and enzymatic activities after the application of organic amendments to a horticultural soil. Bioresource technology, 75(1), 43-48.
3. Alromian, F.M. (2020). Effect of type of compost and application rate on growth and quality of lettuce plant. Journal of plant nutrition, 43(18), 2797-2809.
4. Al-Suhaibani, N., Selim, M., Alderfasi, A.,

El-Hendawy, S. (2021). Integrated application of composted agricultural wastes, chemical fertilizers and biofertilizers as an avenue to promote growth, yield and quality of maize in an arid agro-ecosystem. Sustainability, 13(13), 7439-7450.

5. Arancon N.Q, Edwards C.A, Babenko A., Cannon J., Galvis P., Metzger J.D. (2008) Influences of vermicomposts, produced by earthworms and microorganisms from cattle manure, food waste and paper waste, on the germination, growth and flowering of petunias in the greenhouse. Appl Soil Ecol 39:91–99.
6. Arancon, N.Q., Edwards, C.A. (2005, November). Effects of vermicomposts on plant growth. In International Symposium Workshop on Vermitechnology. Philippines, 16-18.
7. Band, A.M., Mendhe, S.N., Kolte, H.S., Choudhary, R.L., Verma, R., Sharma, S.K. (2007). Nutrient management studies in French bean (*Phaseolus vulgaris* L.). Journal of Soils and Crops, 17(2), 367-372.
8. Bhattacharjee, R., Dey, U. (2014). Biofertilizer, a way towards organic agriculture: A review. African Journal of Microbiology Research, 8(24), 2332-2343.
9. Camargo, J.A., Alonso, Á. (2006). Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: a global assessment. Environment international, 32(6), 831-849.‏
10. Chaoui, H.I., Zibilske, L.M., Ohno, T. (2003) Effects of earthworms casts and compost on soil microbial activity and plant nutrient availability. Soil Biology and BioChemistry, 35, 295-302. doi:10.1016/S0038-0717(02)00279-1
11. Chapman, H.D., Pratt, P.F. (1962) Methods of Analysis for Soils, Plants and Waters. Soil Science, 93, 68.
12. Chaterjee, B., Ghanti, P., Thapa, U., Tripathy, P. (2005). Effect of organic nutrition in sprouting broccoli (*Brassica oleracea* L. var. italica Plenck). Vegetable science, 33(1), 51-54.
13. Dignac, M.F., Derrien, D., Barré, P., Barot, S., Cécillon, L., Chenu, C., Basile-Doelsch, I. (2017). Increasing soil carbon storage: mechanisms, effects of agricultural practices and proxies. A review. Agronomy for sustainable development, 37, 1-27.
14. Dinesh, R., Srinivasan, V., Hamza, S., Manjusha, A. (2010). Short-term incorporation of organic manures and biofertilizers influences biochemical and microbial characteristics of soils under an annual crop Turmeric (*Curcuma longa* L.). Bio resource technology, 101(12), 4697-4702.
15. Domínguez J., Aira M., Gomez-Brandon M. (2010) Vermicomposting: earthworms enhance the work of microbes. In: Insam H, Franke-Whittle I (eds) Microbes at work. Springer, Berlin, 93–114
16. Domínguez, J. (2023). State-of-the-Art and New Perspectives on Vermicomposting Research: 18 Years of Progress. In Vermicomposting for Sustainable Food Systems in Africa, 27-44. Singapore: Springer Nature Singapore.
17. Edwards C.A., Arancon N.Q., Sherman R.L. (2011) Vermiculture technology: earthworms, organic wastes and environmental management. CRC Press, Boca Raton.
18. Fernández-Luqueño, F., Reyes-Varela, V., Martínez-Suárez, C., Salomón-Hernández, G., Yáñez-Meneses, J., Ceballos-Ramírez, J.M., Dendooven, L. (2010). Effect of different nitrogen sources on plant characteristics and yield of common bean (*Phaseolus vulgaris* L.). Bioresource technology, 101(1), 396-403.
19. Francis, C.A., Daniel H.(2004). Organic farming. Encyclopedia of soils in the environment, 77-84. Elsevier, Oxford, UK.
20. Fricke, K., Vogtmann, H. (1993). Quality of source separated compost. BioCycle (USA).
21. Ho, T.T.K., Le, T.H., Tran, C.S., Nguyen, P.T., Thai, V.N., Bui, X.T. (2022). Compost to improve sustainable soil cultivation and crop productivity. Case Studies in Chemical and Environmental Engineering, 6, 100-211.
22. Hoque, T.S., Hasan, A.K., Hasan, M.A., Nahar, N., Dey, D.K., Mia, S., Kader, M.A. (2022). Nutrient release from vermicompost under anaerobic conditions in two contrasting soils of Bangladesh and its effect on wetland rice crop. Agriculture, 12(3), 376-389.
23. Horwath, W.R., (2005).The importance of soil organic matter in the fertility of organic production systems. Western Nutrient Management Conference, 6, 244-249.
24. Islam, M.A., Boyce, A.N., Rahman, M.M., Azirun, M.S., Ashraf, M.A. (2016). Effects of organic fertilizers on the growth and yield of bush bean, winged bean and yard long bean. Brazilian archives of biology and technology, 59.
25. Jackson, M.L.(1973). Soil chemical analysis. Englewood N. J. prentice Hall. Inc. Handbook No. (60), 4-18.
26. Knudsen, D., Peterson, G.A., Pratt, P. (1982) Lithium, Sodium and Potassium. In: Page, A.L., Ed., Methods of Soil Analysis, American Society of Agronomy, Madison, 225-246.
27. Kumar, P., Kumar, S., Meena, R.K., Kumar, R., Rawat, R. (2017). Efficacy of biofertilizers on growth, yield and quality of sprouting broccoli (*Brassica oleracea* var. italic plank)", cv. PUSA BROCCOLI KTS-1. Plant Archives, 17(2), 1647-1650.
28. Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security. science, 304(5677), 1623-1627.
29. Lazcano, C., Gómez-Brandón, M., Revilla, P., Domínguez, J. (2013). Short-term effects of organic and inorganic fertilizers on soil microbial

community structure and function: A field study with sweet corn. Biology and fertility of soils, 49, 723-733.

30. Leon, M.C.C., Stone, A., Dick, R.P. (2006). Organic soil amendments: Impacts on snap bean common root rot (*Aphanomyes euteiches*) and soil quality. Applied Soil Ecology, 31(3), 199-210.
31. Lim, S.L., Wu, T.Y., Lim, P.N., Shak, K.P.Y. (2015). The use of vermicompost in organic farming: overview, effects on soil and economics. Journal of the Science of Food and Agriculture, 95(6), 1143-1156.
32. Luo, X., Liu, G., Xia, Y., Chen, L., Jiang, Z., Zheng, H., Wang, Z. (2017). Use of biochar-compost to improve properties and productivity of the degraded coastal soil in the Yellow River Delta, China. Journal of Soils and Sediments, 17, 780-789.
33. Mahmoud, E., Abd EL-Kader, N., Robin, P., Akkal-Corfini, N., Abd El-Rahman, L. (2009). Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. World Journal of Agricultural Sciences, 5(4), 408-414.
34. Mahmoud, S.O., Gad, D.A.M. (2020). Effect of vermicompost as fertilizer on growth, yield and quality of bean plants (*Phaseolus vulgaris* L.). Middle East Journal of Agriculture Research, 9(1), 220-226.
35. Manivannan, S., Balamurugan, M., Parthasarathi, K., Gunasekaran, G., Ranganathan, L.S. (2009). Effect of vermicompost on soil fertility and crop productivity-beans (*Phaseolus vulgaris*). Journal of environmental biology, 30(2), 275-281.
36. Meena, R.N., Singh, Y., Singh, S.P., Singh, J.P., Singh, K. (2007) Effect of sources and level of organic manure on yield, quality and economics of garden pea (*Pisum sativam* L.) in eastern Uttar Pradesh. Vegetable Science, 34, 60-63.
37. Mostafa, M.R. (2011). Effects on growth, yield, and fruit quality in tomato (Lycopersicon esculentum Mill.) using a mixture of potassium humate and farmyard manure as an alternative to mineral N fertilizer. The Journal of Horticultural Science and Biotechnology, 86(3), 249-254.‌
38. Nagavallemma, K.P., Wani, S.P., Stephane, L., Padmaja, V.V., Vineela, C., Babu Rao, M., Sahrawat, K.L. (2004) Vermicomposting: Recycling wastes into valuable organic fertilizer. Global Theme on Agrecosystems Report No. 8. Patancheru, 502 324.
39. Najafi-Ghiri, M. (2014). Effects of zeolite and vermicompost applications on potassium release from calcareous soils. Soil and Water Research, 9(1), 31-37.
40. Nardi, S., Pizzeghello, D., Muscolo, A., Vianello, A. (2002). Physiological effects of humic substances on higher plants. Soil Biology and Biochemistry, 34(11), 1527-1536.
41. Natsheh, B., Mousa, S. (2014). Effect of organic and inorganic fertilizers application on soil and cucumber (*Cucumis sativa* L.) plant productivity. International Journal of Agriculture and Forestry, 4(3), 166-170.
42. Ojo, J.A., Olowoake, A.A., Obembe, A. (2014). Efficacy of organomineral fertilizer and un-amended compost on the growth and yield of watermelon (Citrullus lanatus Thumb) in Ilorin Southern Guinea Savanna zone of Nigeria. International Journal of Recycling of Organic Waste in Agriculture, 3(4), 121-125.
43. Olsen, S.R., Cole, C.V., Watanabe, F.S. (1954) Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate. USDA Circular No. 939, US Government Printing Office, Washington DC.
44. Ouédraogo, E., Mando, A., Zombré, N.P. (2001). Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa. Agriculture, ecosystems & environment, 84(3), 259-266.
45. Pagliai, M., Vignozzi, N., Pellegrini, S. (2004). Soil structure and the effect of management practices. Soil and tillage research, 79(2), 131-143.
46. Rady, M.M., Semida, W.M., Hemida, K.A., Abdelhamid, M.T. (2016). The effect of compost on growth and yield of *Phaseolus vulgaris* plants grown under saline soil. International Journal of Recycling of Organic Waste in Agriculture, 5, 311-321.
47. Ramadan, M.A., Adam, S.M. (2007). The effect of chicken manure and mineral fertilizers on distribution of heavy metals in soil and tomato organs. Australian Journal of Basic and Applied Sciences, 1(3), 226-231.
48. Saha, P., Barman, A., Bera, A. (2022). Vermicomposting: A Step towards Sustainability. Sustainable Crop Production: Recent Advances, 53.
49. Saison, C., Degrange, V., Oliver, R., Millard, P., Commeaux, C., Montange, D., Le Roux, X. (2006). Alteration and resilience of the soil microbial community following compost amendment: effects of compost level and compost-borne microbial community. Environmental Microbiology, 8(2), 247-257.
50. Santosa, M., Maghfoer, M.D., Tarno, H. (2017). The influence of organic and inorganic fertilizers on the growth and yield of green bean, *Phaseolus vulgaris* L. grown in dry and rainy season. Agrivita, Journal of Agricultural Science, 39(3), 296-302.
51. Savci, S. (2012). Investigation of effect of chemical fertilizers on environment. Apcbee Procedia, 1, 287-292.
52. Scherer, H.W. (2004). Influence of compost application on growth and phosphorus exploitation of ryegrass (*Lolium perenne* L.). Plant, Soil and Environment, 50(12), 518-524.
53. Seran, T.H., Srikrishnah, S. & Ahamed, M.M.Z. (2010). Effect of different levels of inorganic fertilizers and compost as basal application on the growth and yield of onion (*Allium cepa* L.). The Journal of

Agricultural Sciences,5(2), 64-70.

54. Shannon, D., Sen, A.M., Johnson, D.B. (2002). A comparative study of the microbiology of soils managed under organic and conventional regimes. Soil Use and Management, 18, 274-283.
55. Sharma, A., Sharma, R.P., Katoch, V., Sharma, G.D. (2018). Influence of vermicompost and split applied nitrogen on growth, yield, nutrient uptake and soil fertility in pole type french bean (*Phaseolus vulgaris* L.) in an Acid Alfisol. Legume Research-An International Journal, 41(1), 126-131.
56. Shehata, S.A., El-Helaly, M.A. (2010). Effect of compost, humic acid and amino acid on yield of snap beans. Journal of Horticultural Science & Omamental Plants, 2(2), 107-110.
57. Shehata, S.A., Gharib, A.A., El-Mogy, M.M., Gawad, A., Shalaby, E.A. (2011). Influence of compost, amino and humic acids on the growth, yield and chemical parameters of strawberries. Journal of Medicinal Plants Research, 5(11), 2304-2308.
58. Sherman, R. (2002). Vermicomposting systems overview. Biocycle, 43(12), 53-53.
59. Siddiqui, Y., Meon, S., Ismail, R., Rahmani, M., Ali, A. (2008). Bio-efficiency of compost extracts on the wet rot incidence, morphological and physiological growth of okra (*Abelmoschus esculentus* (L.) Moench). Scientia Horticulturae, 117(1), 9-14.
60. Singh, N.I., Chauhan, J.S. (2009). Response of French bean (*Phaseolus vulgaris* L.) to organic manures and inorganic fertilizer on growth and yield parameters under irrigated condition. Nature and Science, 7(5), 52-54.
61. Smith, G.H., Chaney, K., Murray, C., Le, M.S. (2015). The effect of organo-mineral fertilizer applications on the yield of winter wheat, spring barley, forage maize and grass cut for silage. Journal of Environmental Protection, 6(02), 103-111.
62. Soheil, R., Hossien, M.H., Gholamreza, S., Leila, H., Mozhdeh, J., Hassan E. (2012). Effects of composted municipal waste and its leachate on some soil chemical properties and corn plant responses. Int. Journal of Agriculture: Research and Review. 2 (6), 801-814.
63. Soobhany, N., Mohee, R., Garg, V.K. (2017). A comparative analysis of composts and vermicomposts derived from municipal solid waste for the growth and yield of green bean (*Phaseolus vulgaris*). Environmental Science and Pollution Research, 24, 11228-11239.
64. Suminarti, N.E. (2021). Effect of organic compost source and application time on growth and yield of beetroot (*Beta vulgaris* L.) in Dry Land of Jatikerto, Indonesia.
65. Tayebeh A., Abass A., Seyed A.K. (2010). Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Australian Journal of Crop Science (AJCS) 4(6), 384-389
66. Thy, S., Buntha, P. (2005). Evaluation of fertilizer of fresh solid manure, composted manure or biodigester effluent for growing Chinese cabbage (*Brassica pekinensis*). Livestock Res. Rural Dev, 17(3), 149-154.