# EFFECT OF VERMICOMPOSTING BY DETERMINING THE PLANT GROWTH IN THE MIXTURE OF POLLUTED- VERMICOMPOST SOIL

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## ABSTRACT

The tremendous increase in population, urbanization, industrialization and agricultural production results in accumulation quantities of solid wastes. This has created serious problem in the environment. In order to dispose this waste safely it should be converted effectively. This is achieved by bio-composting and vermicomposting of farm, urban and agro-industrial waste. It is being increasing realized that composting is an environment friendly process, convert wide variety of wastes into valuable agricultural inputs. Compost is excellent source of humus and plant nutrients, on application of which improve soil biophysical properties and organic matter status of the soil. This present study focused on to promote soil health and to obtain plant growth in the mixture of polluted-vermicompost soil with the use of organic amendments instead offertilizes .Collection of polluted soil from the place where the waste of industries gets deposited, vengadamangalam, chennai,Tamilnadu. The experimental plant material *Trigonella foenum-graecum* called Fenugreek selected for the study, seed samples were procured from

karunya nursery, panaiyur, chennai to raise plants for the experiments. This is to show how plant growth occurs in vermicompost-polluted soil with the elimination of heavy metals in the polluted soil by earthworms**.**

**Key words:** Vermicomposting, *Eisenia fetida*, polluted soil, Earthworm, *Trigonella foenum-graecum*,

## Introduction

Intensive uses of agrochemicals in conventional cropping systems have caused irreversible effects on soil and water ecosystems i.e., pollution of surface and fresh water resources, and endangered food safety ( AwasthiaK et al.,2020). Inefficient organic waste management practices, i.e., burning and land filling, have also contributed adverse environmental problems. Since 1960s, increased social consciousness has urged humanity to develop viable and eco-friendly sustainable management methods for both agronomic production and management of biodegradable organic wastes (ChoW. et al.,2017). In thisrespect,vermicultureandculturing/utilizationofearthwormshaveintroduceda widevarietyofefficaciousenvironmentallysafelow-inputprocessesmanageableat differentscalesforavarietyofproductaims (SharmaK et al., 2019).Vermicompostingprovidesbiological conversion of biodegradable organic wastes into economically high-valuable pro- ducts (MupambwaH.A et al., 2019).

Vermicomposting has been extensivelyutilizedbothinindustrializedandinlessindustrializedcountriesduring thelast40years(Tondoh, K et al., 2019).*Eisenia fetida*, is a species of earthworm adapted to decaying organic material. These worms thrive in rotting vegetation, compost, and manure. *E. fetida* worms are used for vermicomposting of both domestic and industrial organic waste. Organic fertilizers are used to improve soil quality and tilts, and to provide nutrients for plant growth (Yadav Y et al.,2019). They provide nitrogen, phosphorus, and potassium, as well as other elements essential for plant development and overall good health. NPK is short for Nitrogen (N), Phosphorus (P) and Potassium (K), which are the three major elements in this kind of fertilizer (AbakumorE.V et al., 2018). They are essential for plant growth and increase the fertility of the soil lacking these macronutrients. Therefore, the objective of this research to identify the effect of vermicomposting by determining the plant growth in the mixture of polluted- vermicompost soil

## Materials and Methods:

Three types of soil samples were collected namely polluted soil, Normal soil, vermicompost soil. Fenugreek (*Trigonella foenum graecum*) is an annual plant in the family Fabaceae. Fenugreek is used as a herbfresh spice, and vegetable, sprouts andmicrogreens. The plant growth parameters of this plant have been studied using vermicompost in comparison with thedifferent types of soil.Vermicompost was prepared in pits with suitabledimensions. The pit was 2 m in length and 1 m in width and depth. Base of the pit was filled with layer ofbrokenbricks,followedbyalayerofsandtorestricttheearthworm'smovementtowardsthe soil.15cmofthepitwasthenfilledwithloamysoilorgardensoilandsmalllumpsoffreshcattle dung were sprinkled atrandom. This acts as an active growing medium for earthworms. About 100–500 earthworms were introduced in the vermibed. 10 cm thick layer of straw, leaf litter and various farm residues were placed aboveit. SlurryofCowdungwassprinkled.(Fig 1).Thesamesetoflayerswascontinuedtillaheightof1m and sprinkled with water to retain in the moisturecontent. Harvesting was done on45th day, and the worms were separated from the vermicast. The young worms and cocoons were separated from the soil using 3 mm sieves. The vermicompost contains macro and micronutrients.(Fig 2)

## Measurements of plant growth parameters

Length of shoot and inter node (cm) was measured with a measuring tape and the data were recorded. The number of leaves and branches was counted manually.

## Statistical analysis

Data on morphological parameters were subjected to statistical analyses. All data were given as mean and standard error. The differences between the treatment groups and controls were statistically analyzed. The level of significance was set at $P < 0.05$.

**Fig 1:** BEFORE SOWING SEEDS– SOILSETUP

**Fig 2:** FENUGREEK SEEDS WERE SOWED IN ALL THE FOUR TYPES OF SOIL AT THE SAME TIME.


## RESULTS

The morphological parameters like shoot length, inter- modal length, number of leaves and number of branches was recorded at an interval of 1 week (7 days) for 5 weeks in control and experimental groups.

### Length of shoot

Table 1 shows there is a significant difference in shoot length between control and treated plants. Length of the shoot at the beginning of first week, i.e., at the time of treatment was 8.5 cm. A considerable increase in shoot length was recorded in treated plants; when compared to control plants length of the shoot of plants treated with vermicompost mixed with polluted soil (23.15 cm), vermicompost soil (21.14 cm), polluted soil (18.12 cm) was significantly higher than in control (10.67) plants.

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**Length of internode**

Table 2 explain average intermodal length at the time of treatment was 0.1 cm. After the treatment, significant increase in theintermodal length of the treated groups was observed compared to control plants. Maximum intermodal length was observed in vermicompost mixed with polluted soil treatments (2.97 cm) followed by vermicompost soil (2.27 cm), polluted soil (1.87 cm) treated plants than in control plants (1.66 cm) at the end of fifth week.

**Number of leaves**

Table 3 explain at the zero hours average number of leaves was 2.0 vermicompost mixed with polluted soil treated plants, showed maximum number of leaves (27.0) and polluted soil, vermicompost soil treated plant the numbers were 15.8 and 15.5 respectively at the end of fifth week of treatment. The minimum number of leaves was recorded in control (13.3) plants.

**Number of branches**

Table 4 demonstrate duringtheexperimentalperiod;thenumberofbrancheswas increasedinallthetreatedplantswhencomparedtothecon- trolplantsattheendoffifthweek.Themaximumnumberof branches was recorded in vermicompost mixed with polluted soil (25.30), vermicompost soil(19.8) and polluted soil (19.0). The number of branches was less significant in the control plants.

Table 1. Effect of soil samples on the shoot length (cm) of *Trigonella foenum-graecum*

| Treatment | Iweek | IIweek | IIIweek | IVweek | Vweek |
|---|---|---|---|---|---|
| Normalsoil (Control) | 8.09[ab] ± 0.38(+80.9) | 8.86[ab] ± 0.53(+88.5) | 9.13[ab] ± 0.34 (+ 91.3) | 10.32[ab] ± 0.20 (+ 103.2) | 210.67[ab] ±0.24(+ 106.7) |
| Polluted + vermicompost soil | 10.45[ab] ± 0.39 (+ 104.5) | 13.83[ab] ± 0.54 (+ 138.2) | 15.87[ab] ± 0.50 (+ 158.7) | ) 17.14[ab] ± 0.79 (+ 171.4) | 23.15[ab] ±0.79(+ 221.4) |
| Vermicompostsoil | 10.05[ab] ± 0.29 (+ 100.5) | 12.32[ab] ± 0.34 (+ 123.2) | 15.27[ab] ± 0.50 (+ 154.7) | 16.74[ab] ± 0.79 (+ 167.4) | 21.14[ab] ±0.56 (+ 191.4) |
| Polluted soil | 10.00[ab] ± 0.36 (+ 100.0) | ) 12.02[ab] ± 0.44 (+ 120.2) | 14.68[ab] ± 0.50 (+ 146.7) | ) 16.14[ab] ± 0.79 (+ 161.4) | 19.12[ab] ±0.63 (+ 181.4) |

Values are mean ± S.E of 10 individual observations. Values in parentheses are percent change over control. Degrees of freedom $F \leq 0.05$

[a]Represents significance of variance between periods

[b]Represents significance of variance between treatments

Table 2 Effect of soil samples on internodal length (cm) of *Trigonella foenum-graecum*

| Treatment | Iweek | IIweek | IIIweek | IVweek | Vweek |
|---|---|---|---|---|---|
| Normalsoil (Control) | 1.30$^{ab}$ ± 0.13 (+ 13.0) | 1.37ab ± 0.1 (+ 13.7) | 1.49ab ± 0.19 (+ 14.9) | 1.55$^{ab}$ ± 0.13 (+ 15.5) | 1.66$^{ab}$ ± 0.06 (+16.6) |
| Polluted + vermicompost soil | 1.28$^{ab}$ ± 0.13 (+ 12.7) | 1.47$^{ab}$ ± 0.09(+ 14.7)) | 1.6$^{ab}$ ± 0.06 (+ 17.0) | 1.85$^{ab}$ ± 0.05 (+ 18.5) | 2.97$^{ab}$ ± 0.15 (+29.7) |
| Vermicompostsoil | 1.30$^{ab}$ ± 0.13 (+ 13.0) | 1.39$^{ab}$ ± 0.1(+ 13.9) | 1.49$^{ab}$ ± 0.19 (+ 14.9) | 1.55$^{ab}$ ± 0.13 (+ 15.5) | 2.27$^{ab}$ ± 0.05 (+21.7) |
| Polluted soil | 1.27$^{ab}$ ± 0.13(+ 12.7) | 1.5$^{ab}$ ± 0.07(+14.0) | 1.5$^{ab}$ ± 0.06 (+ 15.0) ) | 1.64$^{ab}$ ± 0.05 (+ 16.5 | 1.87$^{ab}$ ± 0.11 (+17.7) |

Values are mean ± S.E of 10 individual observations. Values in parentheses are percent change over control. Degrees of freedom $F \leq 0.05$

[a]Represents significance of variance between periods

[b]Represents significance of variance between treatments

Table 3 Effect of soil samples on the number of leaves (*n*) of *Trigonella foenum-graecum*

| Treatment | Iweek | IIweek | IIIweek | IVweek | Vweek |
|---|---|---|---|---|---|
| Normalsoil (Control) | 7.9$^{ab}$ ± 0.7(+79.0) | 10.0$^{ab}$ ± 0.71 (+ 100.0) | 10.7$^{ab}$ ± 0.61 (+ 107.0) | 12.1$^{ab}$ ± 0.78 (+ 121.0) | 13.3$^{ab}$ ± 0.59 (+133.0) |
| Polluted + vermicompost soil | 8.3$^{ab}$ ± 0.6(+83.0) | 13.0$^{ab}$ ± 0.89 (+ 130.0) | 16.7$^{ab}$ ± 0.96 (+ 167.0) | 17.9$^{ab}$ ± 0.97 (+ 179.0) ) | 27.0$^{ab}$ ± 0.98 (+250.0 |
| Vermicompostsoil | 6.8$^{ab}$ ± 0.0(+68.0) | 7.2$^{ab}$ ± 0.39(+73.0) | 9.3$^{ab}$ ± 0.42(+ 94.0) | 12.8$^{ab}$ ± 0.44 (+ 128.0) | 15.8$^{ab}$ ± 0.34 (+148.0) |
| Polluted soil | 7.2$^{ab}$ ± 0.71 (+ 72.0) | 11.1$^{ab}$ ± 0.47 (+ 111.0) | 12.2$^{ab}$ ± 0.41 (+ 122.0) | 14.6$^{ab}$ ± 0.76 (+ 136.0) | 15.5$^{ab}$ ± 0.80 (+145.0) |

Values are mean ± S.E of 10 individual observations. Values in parentheses are percent change over control. Degrees of freedom $F \leq 0.05$

[a]Represents significance of variance between periods

[b]Represents significance of variance between treatments

Table 4 Effect of soil samples on the number of branches (*n*) of *Trigonella foenum-graecum*

| Treatment | Iweek | IIweek | IIIweek | IVweek | Vweek |
|---|---|---|---|---|---|
| Normalsoil (Control) | $6.9^{ab}$ ± 0.27(+69.0) | $7.7^{ab}$ ± 0.35(+77.0) | $9.6^{ab}$ ± 0.30(+ 96.0) | $11.3^{ab}$ ± 0.63 (+ 113.0) | $12.3^{ab}$ ± 0.55 (+123.0) |
| Polluted + vermicompost soil | $8.2^{ab}$ ± 0.61 (+ 82.0) | $12.8^{ab}$ ± 0.99 (+ 128.0) | $15.8^{ab}$ ± 0.99 (+ 158.0) | $18.5^{ab}$ ± 0.46 (+ 185.0) | $25.0^{ab}$ ± 0.81 (+250.0) |
| Vermicompostsoil | $6.8^{ab}$ ± 0.24 (+ 68.0) | $11.2^{ab}$ ± 0.35 (+ 112.0) | $13.5^{ab}$ ± 0.52 (+ 145.0) | $16.5^{ab}$ ± 0.54 (+ 165.0) | $19.8^{ab}$ ± 0.46 (+188.0) |
| Polluted soil | $8.0^{ab}$ ± 0.51 (+ 80.0) | $11.5^{ab}$ ± 0.67 (+ 114.0) | $15.7^{ab}$ ± 0.73 (+ 157.0) | $17.6^{ab}$ ± 0.90 (+ 176.0) | $19.2^{ab}$ ± 0.61 (+192.0) |

Values are mean ± S.E of 10 individual observations. Values in parentheses are percent change over control. Degrees of freedom $F \leq 0.05$

[a]Represents significance of variance between periods

[b]Represents significance of variance between treatments

## DISCUSSION

In this study, the growth of plants was found to be significantlyincreasedinplantstreatedwithvermicompost.Plants treated with vermicompost mixed with polluted soil showed increased shoot length than vermicompost soil and polluted soil treated plants. Studies by LukasheN.Set al., (2019) reported the benefits of vermicompost as bed- ding media to promote seed germination, seedling growth and productivity ofplants.

Organic amended in the form of vermicompost and vermiwash,whenaddedtosoilincreasetheyieldandgrowthof plants (SallP.M. et al.,2019)Lengthoftheinternodeanddiameterwereincreased significantly and maximum in vermicompost-treated plants than in vermicompost soil and polluted soil treated plants (Sali. 2018). The increase in the diameterofinternodecanberelatedtoincreasedgirthofthe plants. The observations in present study are in accordance with previous reports Taheri S et al.,. (2018). An increase in the yield of certain vegetable crops such as brinjal, okra and tomato have been reported by Liu, W.J(2017), Sujatha K et al., (2020), Vimala bangarusamy. (2020), James S.W et al., (2019), respectively.

In plants treated with earthworm cast, the growthparam- eters of *Triticum aesticum* such as plant height, number of leavesandtillers,earlyearheading,earheadlengthanddry matter per plant was found to be enhanced than the control plants(Ogunwole, G et al.„ 2018) Emergenceoftomato, cabbage and radish seedling was significant in vermicom- postedsoilthaninthermophilicallycompostedanimalwaste (Yadav Y and Shukla, V. 2020).

Biofertilizerscontainaconsortiumofnutrientswhichare neededforplantgrowth (SrivastavaV et al., 2020) .TheNPKcontentofvermicompost- amended soil was found to be enhanced when compared to the other amended soil. The soil amended with vermicom postprovidestherequirednutrients,whicharenotavailable in chemically treated soil (PiyaS et al., 2018,). This increased nutrient uptake by plants may have contributed to maximum growth in vermicompost treated when compared to othertreatments.

Vermicompost and vermiwash treatments improve the micronutrient levels in the soil (HussainN., D et al., 2018). The carbon content in vermicomposted soil is found to release the nutrients slowly into the soil and thereby aiding the plants to absorb the available nutrients (FronaD et al., 2019).

Remarkable growth obtained in vermicompost-treated plants may be due to favorable and optimum temperature; moisture and a balance between organic and inorganic nutrients in the vermicompost have significantly aided in increased growth of plants (Esmaeili, M.R et al., 2020). The enhanced growth in these plants may be due to improved soil health and the physiochemical properties of soil were enhanced leading to an increase in both microbial activity and macro and micro nutrients.Vermicomposttreatmentenhancedtheavailability of nutrients in the soil (GuptaC. et al.,2018).

Studies by RavindranBet al., *(*2019) reported a considerable increase of nitrogen in vermicomposted soil. The improvement of $N_2$content in the soil may be due to the nitrogeninthevermicast,whichresultsinnitrogenmineralizationaidedbymicrobesinthesoil,throughthedegra dation of the earthworm tissues (MupambwaH.A. 2018). Elimination of pathogens as of wastes like cow manure and sludgeofwastewatertreatmentplantmaybeappliedforsoil improvementwhichisveryessentialinpreventingthespread andtransmissionofdisease(VermaB.C et al., 2020).Theluxuriant growth, flowering and yield of the vegetable cropswere promoted by the worms and vermicompost. The incidence of ‘yellow vein mosaic; ‘color rot’ and ‘powdery mildew’ diseaseswaslessinwormandvermicompost-treatedplants.

## CONCLUSION

The results of this study showed that vermicompost mixed with polluted soil treatment showed great potential to increase the performance, growth of *Trigonella foenum-graecum* plant and improvement of soil quality. Thestudypositively highlights the importance of organic farming; therefore,vermicompostmaybeputtogooduseasanaturalfertilizerforcerealsandvegetablecropsforincreased production and for sustainable agriculturalsystems.

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