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Effect of Vermi-compost on the growth of leafy vegetable *Basella alba* L

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ABSTRACT

Aim: The aim of the study was to investigate the effect of Vermi-compost on the physiological, morphological, and biochemical parameters of the leafy vegetable *Basella alba L.*

Materials and Methods: The experiment evaluates water quality and soil nutrient levels before and after the application of Vermi-compost. Additionally, the effects on photosynthetic pigments, carbohydrates, and protein contents in the leaves of *Basella alba* were assessed. The experimental study measured key growth parameters such as plant height, shoot length, shoot width, leaf dimensions, root length, midvein length, lateral veins, and number of branches over a period of 50 days. A paired samples t-test was used to evaluate the statistical differences between control and Vermi-compost-treated plants.

Results: The results demonstrated significant increases in growth and nutrient availability in Vermi-compost-treated plants compared to the control. Additionally, soil nutrient levels and photosynthetic pigments (chlorophyll a, b, and total chlorophyll), Carbohydrates and Protein contents were significantly enhanced after Vermi-compost application.

Conclusion: It was concluded that **v**ermi-compost improves the overall growth performance and photosynthetic capacity, Carbohydrates and Protein content of *Basella alba*, making it a viable organic alternative to chemical fertilizers in sustainable agriculture.

Keywords: Vermi-compost, *Basella alba*, growth enhancement, organic farming, soil fertility.

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Introduction

Achieving the green revolution can be accomplished by implementing technologies like increasing use of synthetic chemicals like pesticides and fertilizers, adoption of high-yielding, nutrient-responsive crop varieties, increased use of irrigation potential, etc. which have generally increased production output. However, ongoing careless use of these large energy inputs is currently causing a drop in agricultural productivity and production, as well as a decline in environment and soil health. India is experiencing a severe scarcity of organic manure and a daily increase in pollution as a result of buildup of organic waste. Vermi composts are defined as finely separated peat like materials that range in colour from dark brown to black. Plant and human diseases are comparatively absent from Vermi-compost, an organic fertilizer with a high nutritional content (Dominguez and Edwards, 2011; Ansari 2012; Vennila *et al*., 2012; Ansari, 2020).

According to Ramesh *et al.* (2005), organic manure has the potential to boost the land's fertility and productivity while yielding safe and nutritious food. An alternative to fulfil the growing need for organic manures is to recycle biowaste from various resources into compost, which will also help to lessen environmental degradation caused by accumulated biowastes (Kumar, 2005).Vermi-compost is a nutrient-rich organic amendment produced through the breakdown of organic matter by earthworms, which not only enhances nutrient availability but also improves soil structure, water-holding capacity, and microbial activity.Earthworms (*Eisenia fetida*; red wigglers) and microbes transform organic substrates into Vermi-compost, a rich, nutrient-rich humus material that has recently attracted attention as a soil amendment. According to research, the following plants have responded favourably to the application of Vermi-compost and its leachate (tea): parsley (*Petroselinum crispum*), tomato (*Solanum lycopersicum* L), bell pepper (*Capsicum annum*), lettuce (*Lactuca sativa*), mustard (*Brassica juncea*), strawberry (*Fragaria* spp.), ryegrass (*Lolium*

perenne L), sorghum (*Sorghum bicolour),* petunias *(Petunia spp.),* banana *(Musa sapientum),* and cassava *(Manihot esculuntum*) (Xu and Mou et al., 2016). Vermi-compost and its nutrient-rich leachate, or tea, can both improve plant development whether used alone or in conjunction with NPK fertiliser (Tekulu, 2019).

Additionally, Vermi-compost has a higher water-holding capacity due to its humus than chemical fertilisers, which require a lot of water for irrigation (Singh et al., 2010; Sundararasu and Neelanarayanan, 2012; Jaikishun et al., 2014; Kovshov and Iconnicov, 2017). Vermi-compost's ability to support plant growth is attributed to its abundance of bionutrients, such as nitrates, phosphates, soluble potassium, magnesium, exchangeable phosphorus, and calcium, all of which are necessary for plant growth (Arancon and Edwards, 2005; Kapila et al., 2021).Several investigators studied about the effect of Vermi-compost on thesoil quality and plant growth (Ansari and Ismail, 2012.,Dominguez and Edwards, 2011; Ansari, 2020; Kapila et al., 2021.,Arancon and Edwards, 2005; Kovshov and Iconnicov, 2017.,Ismail, 2005; Jaikishun et al., 2014; Kovshov and Iconnicov, 2017; Ansari, 2020Tahmineh Bahrampour (2013.,Miladi Lari, Sahel (2014Sadeghipour, 2017 Troung et al. (2018) Leafy vegetables, such as *Basella alba L.*, commonly known as Malabar spinach, are widely cultivated in tropical and subtropical regions due to their rich nutrient profile and economic importance. *Eisenia foetida*, known under various common names such as manure worm, redworm, brandling worm, panfish worm, trout worm, tiger worm, red wiggler worm, etc., is a species of earthworm adapted to decaying organic material. These worms thrive in rotting vegetation, compost, and manure. They are epigean, rarely found in soil

However, limited research has focused on the effect of Vermi-compostby using *Eisenia foetida*(*E. fetida*) on the growth parameters and photosynthetic pigments, carbohydrates and protein content of *Basella alba*. Hence the present study has been undertaken in order to evaluate the effect of Vermi-compost on the growth of *Basella alba.* Table 1 shows the details of *E. fetida* classification.

Materials and Methods

A randomized led trial was conducted at Department of Botany, Botanical garden, Vikrarama Simhapuri University College, Kavali. Kavali is located at 14.913001^0 N 79.992921^0 E. It has an average elevation of 17 meters (56 ft).The town is at a distance of 8 km from the bay of Bengal. To study the effect of Vermi-compost on *Basella alba*. Seeds of *Basella alba L.* were sown in two separate groups: a control (without Vermi-compost), treated (with Vermi-compost). Each group comprised two replicates, with plants grown in plots containing soil. Vermi-compost was applied at a rate of 200 g in treated plot, mixed with soil prior to sowing. The study was conducted over a period of 50 days. The healthy plant of *B. alba* L grown in the soil mixed with Vermi-compost has depicted (Fig. 1)

Vermi-compost preparation

Garden soil (500g), 15 earthworms (*Eisenia foetida*), cow dung (100g), cattle dung (100g), all vegetable waste (300g) in selcted proportion added to the plastic tubs. Water must be sprinkled to maintain moisture level. After 50 days it got brown, soft light granular Vermi-compost at surface. Before and after it was composted estimation of soil pH, NPK levels & physiological parameters, morphological traits, photosynthetic pigments, nutrient availability, growth enhancement, Carbohydrates and Protein content. Plant Growth Measurements, Chlorophyll content, Carbohydrates and Protein content present in the leaves of *Basella alba*. Physiological and morphological parameters were recorded at regular intervals (15, 22, 29, 36, 43, and 50 days after sowing) for both control and treated plants. The parameters measured included plant height, shoot length, shoot width, leaf length, leaf width, root length, midvein length, lateral veins, number of branches, and number of leaves, Photosynthetic Pigments, Carbohydrates and Protein content (Fig. 2).

Fig.1: Vegetative growth of *Basella alba* L in vermicopost added soil. **Fig. 2**. Enriched Vermi-compost with *Eisenia foetida*

Soil and Nutrient Analysis

Soil samples were collected before and after the experiment to assess changes in soil pH, electrical conductivity (EC), organic carbon (OC), and the levels of macronutrients (N, P, K) and micronutrients (Zn, Fe, Mn, Cu, B, S). Soil nutrient levels were analyzed using standard soil testing methods. The soil pH was determined using a digital pH meter in a 1:2.5 soil-water suspension. Macronutrients the total nitrogen content was measured using the Kjeldahl method and micronutrients content was measured using atomic absorption spectrophotometer. This dataset compares control and treatment plant growth parameters at different intervals post-sowing (15 to 50 days). The experiment highlights significant differences between the control and those treated with a particular intervention (presumably a fertilizer or growth stimulant), particularly in plant height, shoot length, leaf dimensions, root length, number of branches, and number of leaves. The consistently higher values for the treated group suggest that the treatment has a positive impact on plant growth and development across multiple parameters.

Photosynthetic Pigments

The effect of Vermi-compost on photosynthetic pigments was analyzed by quantifying chlorophyll a, chlorophyll b, and total chlorophyll using the DMSO extraction technique as described by Hiscox and Israelstam (1979). Leaf samples were collected on day 50, and pigment concentrations were expressed in mg g^{-1} fresh weight. The carbohydrate content in the leaves of *Basella alba* can be accurately estimated using the Anthrone reagent method, a widely accepted biochemical technique was developed by Roe (1955) for quantifying carbohydrates. The Protein content in the leaves of *Basella alba* can be accurately estimated using the Biuret reagent method first described by Gustav B. Rohmann in 1895. However, the reaction itself, known as the Biuret reaction, was discovered earlier by Franz Carl Leopold Gmelin in 1833. It is a widely accepted biochemical technique for quantifying Protein.

Statistical Analysis

A paired samples t-test was used to evaluate the differences in growth parameters and nutrient availability between the control and Vermi-compost treated plants. Data were analyzed using SPSS software, with a significance level of $p < 0.05$.

Results and Discussion

Plant Growth Parameters

The paired samples t-test showed significant improvements in various growth parameters of Vermi-compost-treated *Basella alba* compared to control (Table 1). For instance, plant height increased significantly at 50 days after sowing ($p = 0.017$), with treated plants showing a mean height of 18 cm, compared to 12 cm for the control .Similarly, shoot length, shoot width, leaf length, and leaf width were significantly higher in Vermi-compost-treated plants, with p-values ranging from 0.001 to 0.044. Root length was also positively influenced by Vermi-compost, showing a significant difference ($p = 0.004$) at 50 days after sowing.

On average, treated plants showed a higher increase in height compared to control, with greatest difference observed 50 days after sowing (control: 10.35 cm, Treatment: 11.45 cm). Treated plants exhibited consistently greater shoot length and width from 15 days onward. For instance, at 22 days, the shoot length was 4.1 cm in treated group vs. 3.42 cm in control, and width was 0.617 cm (treatment) compared to 0.25 cm (control). The treatment also led to larger leaf sizes across all time intervals. At 50 days, leaf length was 12.98 cm (treated) versus 6.93 cm (control), while leaf width was 5.29 cm (treated) versus 4.85 cm (control). Root length increased steadily, with treated plants having larger roots by day 50 (Treated: 6.45 cm, control: 5.85 cm). The number of branches and leaves increased significantly in treated plants, especially after 50 days (Branches: 10.67 in treated vs. 8.33 in control; Leaves: 18 in treated vs. 16 in control)

The values are Mean ± SD for three samples in each group. The statistical significances were considered at $p < 0.05$. Where DAS: Days after sowing. It was highlighted the significant improvements in plant height, shoot length and width, leaf length and width, root length, and the number of branches and leaves in Vermi-compost-treated *Basella alba* compared to the control.

The statistical analysis indicates that all measured parameters show highly significant differences ($p < 0.001$) between the control and treatment groups. The extremely low p-values suggest that the observed improvements in plant growth and development are not due to random variation but are a direct result of the treatment applied.

Table 1. Effect of Vermi-compost on growth parameters of *Basella alba*

Parameter	Control(Cm)	Experimental (Cm)	Significance
Plant Height (50 DAS)	12.00±0.294	18.00±0.163	P<0.05
Shoot Length (22 DAS)	3.42±0.061	4.10±0.041	P<0.05
Shoot Width (22 DAS)	0.25±0.008	0.617±0.012	P<0.05
Leaf Length (50 DAS)	6.93±0.082	12.98±0.102	P<0.0001
Leaf Width (50 DAS)	4.85±0.041	5.29±0.081	P<0.001
Root Length (50 DAS)	5.85±0.062	6.45±0.040	P<0.01
Number of Branches (50DAS)	8.33±0.124	10.67±0.122	-
Number of Leaves (50 DAS)	16.00±0.205	18.00±0.163	-

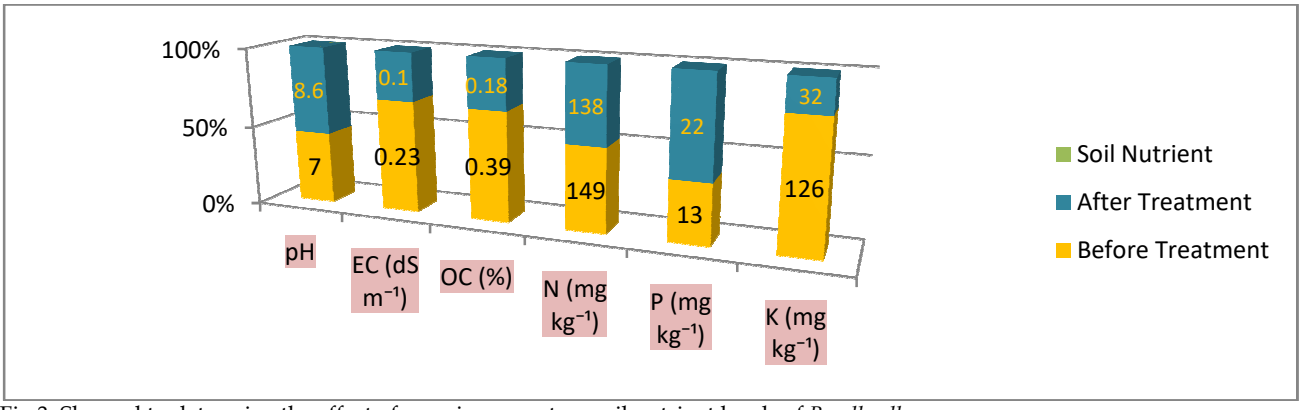

Fig 3: Showed to determine the effect of vermi-compost on soil nutrient levels of *Basella alba*

These results strongly support the conclusion that the treatment had a substantial positive impact on plant height, shoot and root growth, leaf size, and branching, ultimately enhancing overall plant vigor.

Soil Nutrient Levels

Soil analysis revealed an increase in phosphorus (P) levels and a reduction in nitrogen (N) and potassium (K) levels after Vermi-compost application (Fig. 3). Micronutrient levels such as zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), and boron (B) were considerably reduced post-treatment, indicating that Vermi-compost application resulted in enhanced nutrient uptake by the plants.

Photosynthetic Pigments

Vermi-compost-treated plants exhibited significantly higher chlorophyll content than the control plants. Chlorophyll a, chlorophyll b, and total chlorophyll concentrations increased by approximately 30% in treated plants, demonstrating the positive impact of Vermi-compost on the photosynthetic efficiency of *Basella alba* (Fig. 4).

The application of Vermi-compost to *Basella alba* has resulted in a substantial increase in carbohydrate content. The treatment group's carbohydrate level is nearly double that of the control and more than double that of the treated. This significant rise in carbohydrate content by Spectrophotometric analysis can be attributed to enhance nutrient availability and improved soil health due to application of Vermi-compost. Vermi-compost is known to provide essential nutrients and improve soil structure, which can lead to better plant growth and higher carbohydrate accumulation.

The application of Vermi-compost also positively impacts protein content in *Basella alba* leaves. The treated plants showed a considerable increase in protein content by Spectrophotometric analysis compared to control. The higher protein content in treated plants suggested that Vermi-compost application enhances nitrogen availability in soil, which was crucial for protein synthesis in plants. Improved nitrogen availability and overall soil fertility due to Vermi-compost likely contributed to increase observed in protein content (Fig. 5)

The results clearly demonstrate the beneficial effects of Vermi-compost on the growth and physiological performance, carbohydrate and protein content of *Basella alba* (Arancon *et al.*, 2004). The increase in plant height, shoot and leaf dimensions, root length, and photosynthetic pigment concentrations, carbohydrate and Protein content in the treated plants suggest that

Vermi-compost enhances nutrient availability and uptake,

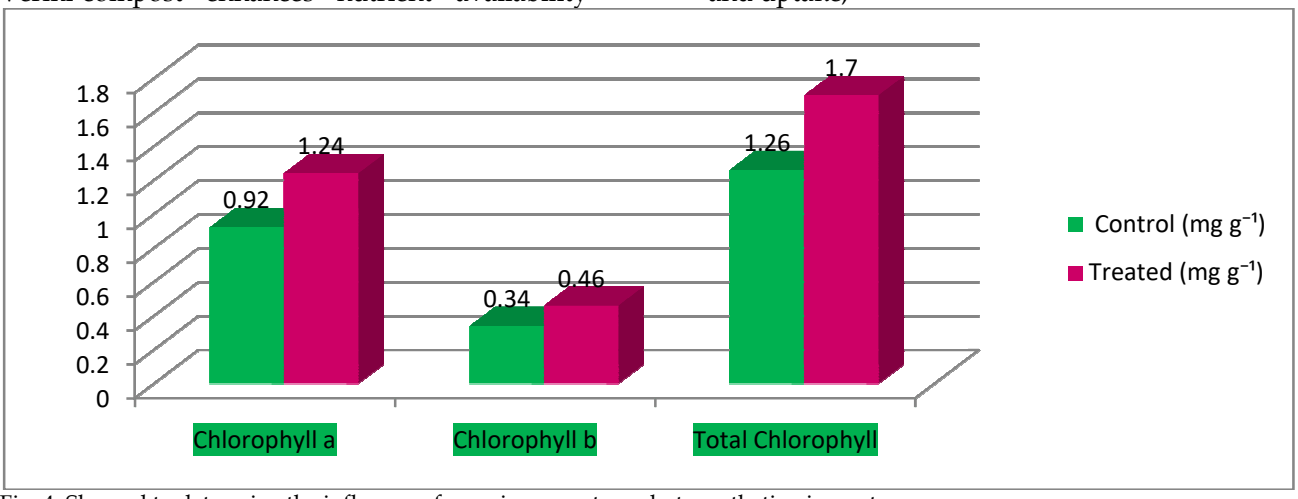

Fig. 4: Showed to determine the influence of vermi-compost on photosynthetic pigments.

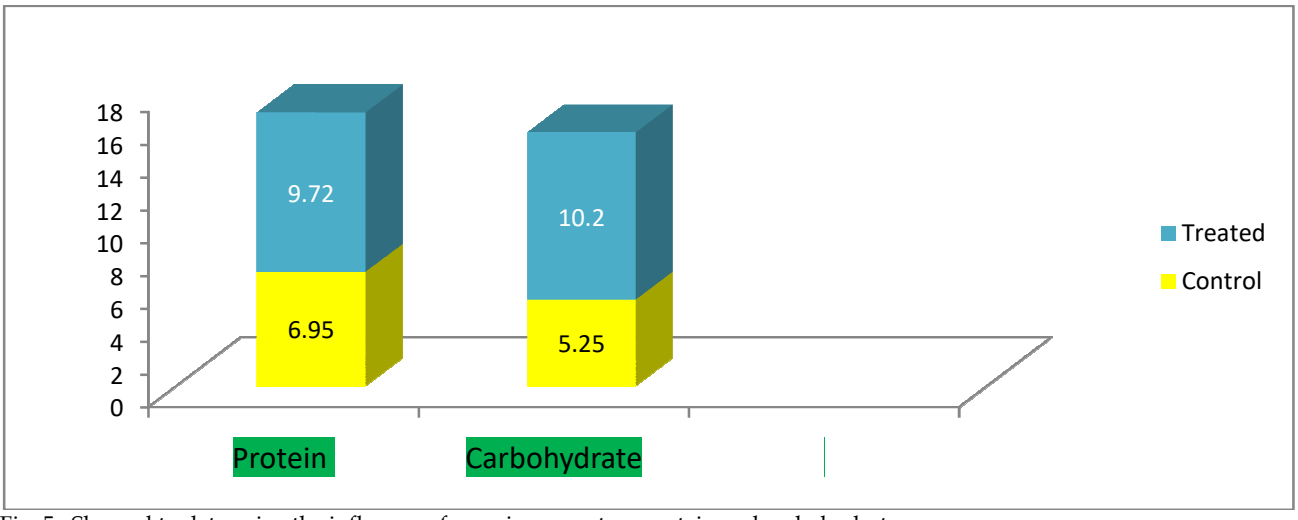

Fig. 5. Showed to determine the influence of vermi-compost on protein and carbohydrates

contributing to improved plant vigor. Dominguez and Edwards (2011) also corroborated the findings of present study. The treatment applied to the plants had a positive and significant impact on growth, as seen through increased plant height, shoot dimensions, leaf size, root length, and branch/leaf count. Similarly, it was advocated by Edwards and Arancon (2004). The treatment consistently out performed the across all measured parameters, indicating its efficacy in enhancing plant development. These findings were in agreement with Kale et al. (1992). The treatment could be a beneficial agricultural practice to improve crop yield and quality. These findings were consistent with previous studies that have highlighted the positive influence of organic amendments on crop growth (Kapila et al., 2021, Kumar, 2005, Lazcano and Domínguez, 2011 and Ramesh et al., 2005).

Conclusions

It was concluded that Vermi-compost has a good influence on the photosynthetic pigments of vegetable crops, according to the results of the experiment. The potential of Vermi-compost as a sustainable alternative to synthetic fertilizers in promoting the growth of leafy vegetables like *Basella alba* is supposed to be investigated further.

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