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Effect of Vermiwash and Vermicompost on an Ornamental Flower, Zinnia sp.

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Abstract

Vermiwash and vermicompost were used in different doses to study their effect on the growth and flowering of an ornamental flower, Zinnia sp. The combination of vermicompost and vermiwash showed maximum positive effects on the growth and flowering of *Zinnia sp.* compared to either vermicompost alone or vermiwash alone. This study also indicated that vermiwash and vermicompost could be utilized effectively for sustainable plant production at low input-basis green farming.

Keywords: Vermiwash, Vermicompost, Flowering, *Zinnia sps*

Introduction

Zinnias are popular garden flowers, usually grown from seed, and preferably in fertile, humus-rich, and well-drained soil, in an area with full sun. A number of species of zinnia are popular flowering plants. Their varied habits allow for uses in several parts of a garden, and their tendency to attract butterflies and hummingbirds is seen as desirable. Senthilkumar et al. [1] found that vermicompost ± NPK fertilizers significantly enhanced rose growth, yield and quality over the untreated control, especially when used in combination. Kumari and Usha kumari [2] reported that enriched vermicompost was a superior treatment for enhancing uptake of N, P, K, Ca and Mg by cowpea.

In vermicompost, compared to conventional compost, accelerated bio-oxidation of organic matter is achieved mostly by high density earthworm populations [3]. Vermicomposts are typically finely divided peat-like materials with high porosity, aeration, drainage and water holding capacity [4].

Nutrients in vermicompost are present in readily available forms for plant uptake; e.g. nitrates, exchangeable P, K, Ca and Mg [4]. There is increasing interest in the potential use of vermicomposts as plant growth media and soil amendments. These are products of a non-thermophilic bio-degradation of organic materials through interactions between earthworms and microorganisms [5] Vermicomposts are comprised of large amounts of humic substances, some of the effects of which on plant growth are similar to those of soil-applied plant growth regulators [6] For peppers, an improvement of the physical structure of the potting medium, increases in populations of beneficial microorganisms and enhanced availability of plant growth influencing substances produced by microorganisms in vermicomposts were factors considered to have contributed to increased fruit yields [7].

While vermicompost effects on growth and productivity of plants have been investigated, there have been relatively few investigations on ornamental flowering plants and none on zinnia, a widely grown and economically important color flower [1,8]. The aim of this study was to determine the effects of different combinations of vermicompost and vermiwash of an animal manure origin on the flowering of *Zinnia.*

Materials and Methods

One pot experiment was conducted using 27 pots. Seven days old seedlings of Zinnia sp. were incorporated into each pot. One plant per pot was maintained. The experiment was continued up to 90 days. The pot soil was clay loam in texture. In addition to control, eight treatments were made. Three replications were made for each treatments including control. The treatments were as follows: Control (water only), T1 (Vermicompost), T2 (vermiwash: water in the ratio 1: 5), T3 (vermiwash: water in the ratio 1:10), T4 (vermiwash: water in the ratio 1:15), T5 (Vermiwash, 1:5 + vermicompost), T6 (Vermiwash, 1:10 + vermicompost), T7 (vermiwash, 1:15 + vermicompost), T8 (Garden fertilizer). The control pot received neither vermicompost nor vermiwash, it received only pond water. The doses of the treatments are given in Table 2. The first dose of vermiwash / vermicompost was given on the 4th day after sowing the plant in the pot. The every fifteen days interval the doses were given to the plants.

Time to flowering was recorded as time from plantation to first open flowers. Flower numbers per pot were counted till the termination of the experiment.

The physico-chemical properties of vermicompost and vermiwash are presented in Table 1 and were determined prior to plantation in the pot and both the vermiwash and vermicompost were produced in the farm of the Central Institute of Freshwater Aquaculture. Vermicompost pH was measured in distilled water (solids/solution ratio of 1:2.5) using a pH meter while the same was measured for vermiwash directly using the pH meter. Electrical conductivity (EC) was measured in the extract of vermicompost (solids/solution ratio of 1:5) using a digital conductivity meter. The EC was measured directly for vermiwash. The organic carbon was determined by the Walkley-Black method [9]. The organic carbon of vermiwash was determined using potassium di-chromate and concentrated sulphuric acid as extractants using hot water bath, and then followed the method of Walkley-Black. Total N was determined in vermicompost samples of 1.0 g d.w. by the Kjeldhal method using concentrated H_2SO_4, K_2SO_4 and selenium to digest sample and was estimated according to Bremner and Mulvaney [10]. Total N was determined in vermiwash by the Kjeldhal method also. For other nutrients, ground sample (2 g) was ashed in a muffle furnace at 550°C. The ash was dissolved in 2N HCl and made up to 100 ml with distilled water. P was determined by the

colourimetric method of Olsen et al. [11]. A flame photometer was used for determination of K, Ca and Mg was measured according to Houba et al. [12]. Zn, Fe, Cu and Mn were determined by atomic absorption spectrophotometer [13,14]. The vermiwash was digested with tri-acid and the nutrients viz., P,Ca, Mg, K, Fe, Cu, Mn and Zn were determined as per the methods described above for the vermicompost.

Parameters	Vermicompost	Vermiwash (field)
pH	7.98	7.52
EC (ds m^{-1})	0.56	1.10
Organic carbon (%)	0.04	0.01
Total nitrogen (mg L^{-1})	55.0	61.02
Total phosphorus (mg L^{-1})	19.15	18.20
Total potassium (mg L^{-1})	46.24	55.20
Sodium (mg L^{-1})	119.40	120.10
Calcium (mg L^{-1})	181.08	178.60
Magnesium (mg L^{-1})	196.34	198.00
IAA (mg L^{-1})	16.08	15.02

Table 1: Chemical composition of vermiwash and vermicompost.

The experiment was a completely randomized design with 3 replicates of each treatment. Data were analyzed by one way ANOVA using SPSS software (version 14.0).

Results and Discussion

General observations

Among all the treatments, 20% vermiwash plus vermicompost and 10% vermiwash plus vermicompost showed the earliest bud initiation, more number of leaves and maximum increase in plant height. The 5% vermiwash and vermicompost showed comparatively less growth of plants. However, the only vermiwash at all the experimental dilutions and also the only vermicompost treatment showed the intermediate results. The control treatment showed the minimum number of leaves and lower plant height. The first flower bud initiation occurred on 45 days of sowing at the 20% vermiwash plus vermicompost treatment.

Flower numbers

Treatments with 20% vermiwash plus vermicompost and 10% vermiwash plus vermicompost produced significantly ($P<0.05$) higher number of flowers compared to the control (Figure 1). No significant ($P>0.05$) difference was found between 10% vermiwash plus vermicompost and 20% vermiwash plus vermicompost. Treatments with 5% vermiwash plus vermicompost and garden fertilizers gave significantly ($P<0.05$) increased flower production compared to control. Treatments with only vermicompost, 20% vermiwash and 10% vermiwash also produced significantly ($P<0.05$) increased flower production compared to control.

Treatment	Treatment quantity/ plant/dose [ml or mg]	Observations	Total number of flowers
Control	70	Minimum growth	8 ± 2
T1 (Vermicompost)	70 gm	Less growth compared to T3	15 ± 3
T2	70	Less growth compared to T3	16 ± 2
T3	70 ml	Almost similar observations like treatment 7 and 8	21 ± 3
T4)	70 ml	Less growth compared to treatment 3	17 ± 3
T5	70 ml + 70 gm	Earliest bud initiation; bigger number of leaves; maximum increase in plant height	34 ± 3
T6	70 ml + 70 gm	Earliest bud initiation; more number of leaves; maximum increase in plant height	35 ± 2
T7)	70 ml + 70 gm	Earlier bud initiation; medium number of leaves; medium increase in plant height	28 ± 2
T8	70 gm	Earlier bud initiation; medium number of leaves; medium increase in plant height	27 ± 3

Table 2: Effect of water, vermiwash and vermicompost on the growth and flowering of *Zinnia sp.*

However, there was no significant difference in flower production among these three different treatments.

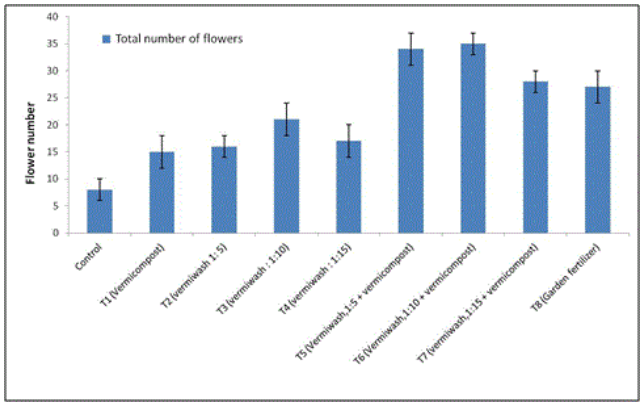

Figure 1: Effect of vermiwash and vermicompost on flower numbers for Zinnia

Time to flowering

Plants treated with 5% vermiwash plus vermicompost, 10% vermiwash plus vermicompost, 20% vermiwash plus vermicompost and garden fertilizer produced flowers significantly ($P<0.05$) sooner than other treatments (Figure 2). Significant differences ($P<0.05$) were found between the vermiwash at different dilution rates plus vermicompost and the the diluted vermiwash only or vermicompost only treatment. No significant ($P>0.05$) differences were observed among the different diluted vermiwash treatments and vermicompost treatment.

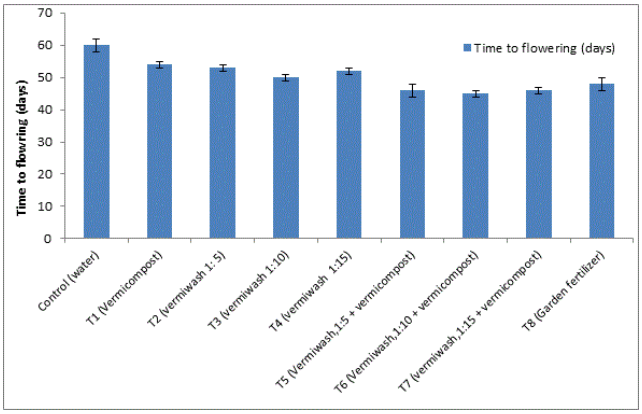

Figure 2: Time to flowering of Zinnia plant produced by vermiwash and vermicompost

Incorporation of vermicompost and vermiwash had significant ($P<0.05$) positive effects on flower numbers compared to both the control and only vermicompost or only vermiwash at different dilution treatments. Increasing of flower numbers by vermicompost amendments is also corroborated with the findings of Gajalakshmi and Abbasi [15], where use of vermicompost led to significant improvements in both growth and flowering of crossandra compared to untreated control plants. Chappmani et al. [14] also reported about the positive effects of vermicompost on flower numbers of Petunia hybrid 'Dream neon rose' compared to control. Application of vermicompost obtained from water hyacinth, Eichhornia crassipes significantly enhanced growth and flowering of Crossandra udulaefolia compared to untreated control plants [15]. The effect of vermiwash was reported on the growth and productivity of Marigold [16].

In the present study, the combination of vermicompost and vermiwash showed maximum positive effects on the growth and flowering of Zennia sp. compared to either vermicompost alone or vermiwash alone. The vermicompost contains appreciable amount of organic carbon, nitrogen, phosphorus and potassium. In addition to that it also contained good amount of secondary nutrients of calcium and magnesium. The vermicompost also contained available micronutrients viz., iron, copper, zinc and manganese. Similarly, the vermiwash also contained all these macronutrients, secondary nutrients and micronutrients.

Vermicomposting contains mainly earthworm excreta and decomposed matter. As the main substrates presented in the waste is of rich source of macromolecules which can easily broke by secretory enzymes of earthworms. Soil with simpler substances is the best suitable media to growth of nitrogen fixing and phosphate solubilizing microbes. Vermiwash is a collection of excretory products and excess secretions of earthworms along with micronutrients from soil organic molecules. The vermiwash could also contained enzymes which could be helpful for the plant growth. Zambare et al. [17] reported that vermiwash contained enzymes of protease, amylase, urease and phosphatase. They also reported that vermiwash also contained nitrogen fixing bacteria like Azotobactrer sp., Agrobacterium sp. and Rhizobium sp. and some phosphate solubilizing bacteria. Thus, combination of 20% vermiwash and vermicompost was the best combination to produce more number of Zinnia flowers.

In conclusion, the results of this study indicate that incorporation of vermicompost and vermiwash enhanced the flowering of potted Zinnia plants. This study also indicates that vermiwash and vermicompost could be utilized effectively for sustainable plant production at low input-basis green farming. However, further study is essential to identify the plant growth promoting substances in vermiwash in order to determine its feasibility in crop production.

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