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Full Length Research Paper

Effect of vermicompost on manifestation of pesticide action on growth of *Zinnia elegans*

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In order to asses the implication of endosulfan in the soil amended with vermicompost, *Zinnia elegans* (Family Asteraceae) was grown, under strict laboratory conditions. Seed germination, size of internode, total length of the plant, leaf area of the plant, tufts of rootlets, which emerged, were measured and recorded. Vermicompost at a concentration of 12.5% was used as source of amendment; treatment was made with endosulfan the concentration of which ranged from 2.5, 5 and 7.5% respectively. From the data obtained after 4 days of treatment, it appeared that the addition of endosulfan in plain soil (7.5%), affects germination to negative value. Reduced germination and plant growth even during prolonged treatment (up to 9 days) was noticed during treatment with 2.5 and 5% of endosulfan. In a soil amended with vermicompost, however, germination to total length of the plant was found to increase quite considerably. This trend has continued, even during extended period of treatment. The entire texture of the plant was found to change to a healthier look in the presence of vermicompost. Better growth of the plant, larger number of rootlets, and bigger leaf area, can be suggested to be additive role of vermicompost on growth and development of *Zinnia elegans*. This also indicated possible involvement of the plant in remediation of pesticide endosulfan. On this account, *Z. elegans* like related members of this family can be considered as a candidate involved in remediation of pesticides from polluted soil

Key word: Vermicompost, endosulfan, *Zinnia elegans*.

INTRODUCTION

Vermicompost which is a product of fragmentation of organic waste of earthworm has been established to be a potential source of nutrient for growth of plants (Atiyeh et al., 2000b; Chamani et al., 2008). It has been established that vermicompost contains relatively more amount of nitrogen, carbon and mineral resources (Zinc and Allen, 1998; Azarmi et al., 2008) befitting the requirement of the recipient plant. Use of such nutrient provide resources essential for building up of molecules in plants to induce better growth, greater capacity to fight disease (Erdal et al., 2006) and to encounter obnoxious chemical substances available in the vicinity of the plants. Such action on plant has been variously mentioned (Wilson and Carlile, 1989; Sikora and Azad, 1993; Tomati and Galli, 1995; Subler et al., 1998; Atiyeh et al., 2000a). One aspect of such study is also remediation of substance of undesirable nature by plant from the soil, where the role of vermicompost in remediation of metals has been cited (Jadia and Fulekar, 2008).

Pesticides have been used variously to encounter pest infestation in plants, this has resulted into, increase in concentration of pesticides (as residual molecule) in the soil, as a result of which, the soil has gradually become sick and unfit for crop production. The affect modifies the chemistry of the soil and quite often plants uptake these pesticides (Baker and Walker, 1989; Shi-wei and Fu-zhen, 1991; Grifferty and Barrington, 2000; Kayser et al., 2001; Jauert et al., 2002; Cui et al., 2004; Peng et al., 2006) leading to entry of pesticides in the plant system

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Table 1. Chemical composition of the plain soil and soil mixed with 12.5% vermicompost.

Medium	pH	EC ds m^{-1}	OC g kg^{-1}	Available N Kg Na^{-1}	Available P Kg ha^{-1} as P_2O_5	Available K Kg ha^{-1} as K_2O_5
Plain soil	7.27	0.16	0.20	163	14.2	605
Vermicompost + Plain soil	7.27	0.16	1.01	251	58.6	1008

and subsequently in the food chain. Scarce literatures are available to evaluate the combined effect of vermin-compost and pesticides, on plants, which can open up insight on various aspect of mechanism of action of pesticides, and use of vermicompost in remediation that too with the joint effort of the target plant. Hence, this study was undertaken.

MATERIALS AND METHODS

In 1.75 kg of garden soil (Hence forth called as plain soil), 12.5% of vermicompost (obtained from commercial source) was mixed thoroughly in a manner that vermicompost was evenly and thoroughly distributed. The basis for using 12.5% of vermicompost was due to previous report (Atiyeh et al., 2000a) that this concentration is most effective in growth and development of most of the target plant. Experiment was carried out in two set viz. treatment in plain soil and treatment in vermicompost amended soil. In each set of experiment, endosulfan (Obtained from Endosulfan containing 35% of Endosulfan manufactured by Excel Crop Care Limited, Bhavnagar, Gujrat) was mixed thoroughly at a concentration of 2.5, 5 and 7.5%. Set of experiment without endosulfan served as control in each case. Soil was transferred to earthen pot to carry out further studies. Pre-soaked 10 seeds of *Zinnia* (obtained from commercial source Jardiner California variety) were sown in the earthen pot at specifically marked places, 0.2 cm below the soil. Water was sprinkled occasionally to favour germination. Various parameters for growth such as germination, plant height, internode size, number of emerging roots, leaf area was recorded. This was done using standard method described for such studies (Hameeda et al., 2007). Chemical built of the soil is described in Table 1.

RESULTS

Various parameters of morphogenesis in the vermin-compost treated and untreated plant sample is recorded and described.

Effect on germination

Germination of seeds in the treated and untreated soil was recorded and is shown in Table 2.

Table 2 shows that germination of *Zinnia* seed is affected in plain soil with the increase in concentration of endosulfan. Addition of vermicompost, however, in-creases the germination considerably and hence minimizes the effect of endosulfan.

On review of the data presented in Figure 1, it was observed that after 4 days of treatment with vermin-compost there has been 400% rise in germination (Over plain soil). This value is 50, 200 and 0% (no growth) when endosulfan was added at a concentration of 2.5, 5 and 7.5% respectively. After 5 days of treatment, this value was 700, 50 (2.5%), 150% (5%) and 0% (7.5%) respectively. The value, after 9 days of treatment, becomes 150% (control), 14% (2.5%), 34% (5%) and 80% (7.5%) respectively.

Effect on plant height

Height of the growing plant was recorded after every week and is described in Table 3. It is apparent that mixing of vermicompost in the soil minimizes the effect of endosulfan as there has been an increase in the height of the plant from the 7th day after growth. Favoured action of vermicompost seems to be observable even after 15 and 22 days of treatment. There was a constant increase in the height of the plant.

The value of increase in growth is comparatively (in plain soil and in soil mixed with vermicompost) depicted in Figure 2. The percentage rise during different period of growth is in the following order. 320, 245 and 23% [plain soil: plain soil with vermicompost], 300, 263 and 258% (2.5% of endosulfan), 500, 633 and 457% (5% of endo-sulphan) and 140, 133 and 171% (7.5 of endosulphan).

Effect on size of the internode

To determine the input of combined action of vermin-compost and different concentrations of pesticides, the length of the internode was measured and is shown in Table 4.

On comparative analysis of data presented in Figure 3, it appears that vermicompost maintains its favored action on the growth of the plant, as increase in the size of the internode continues. The trend of increase has been noticed during different duration of growth. During 7, 15 and 22 days, the increase has been 133, 135 and 43% (plain soil: plain soil + vermicompost), 44, 115 and 32% in2.5% endosulfan, 120, 141 and 64% in 5% endosulfan respectively. However, this value is 30, 130 and 18.42% in the presence of 7.5% endosulfan.

Table 2. Effect of vermicompost on germination of *Zinnia elegans* when grown in different concentration of Endosulfan.

Time of growth (day)	Endosulfan concentration (%/kg)							
	Without vermicompost				With vermicompost			
	0	2.5	5.0	7.5	0	2.5	5.0	7.5
4	1±1	2±2	1±0	-	5±1	3±0	3±4	-
5	1±1	4±1	2±0	2±1	8±3	6±2	5±5	2±0
9	4±0	7±3	6±2	5±0	10±1	8±5	8±1	9±1

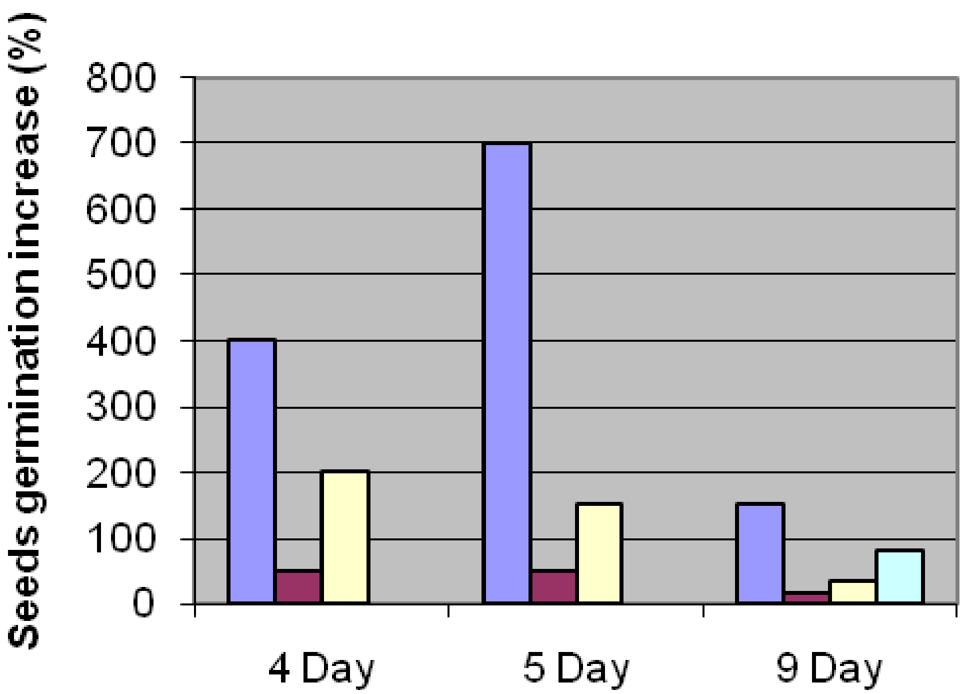

Figure 1. Effect of vermicompost on germination of *Zinnia elegans* when grown in different concentration of endosulfan, blue 0% per kg, pink 2.5% per kg, yellow 5.0% per kg, cyan 7.5% per kg

Table 3. Growth profile of *Zinnia elegans* in plain soil and soil mixed with vermicompost, when grown in presence of different concentrations of endosulfan.

Time of growth (day)	Endosulfan concentration (% kg)							
	Without vermicompost (cm)				With vermicompost (cm)			
	0	2.5	5.0	7.5	0	2.5	5.0	7.5
7	2.25±1	3±1.5	1.6±2.5	5±2.5	9±.36	9±1	8±0	7±.64
15	7.75±3	8±5	3±2	9±0	19±5.71	21±0	19±.3	21±2.7
22	17±2	12±1.2	7±2.5	19±2	39±2	31±1.6	32±0	32.5±.8

Area of leaf

Consistency of better growth during vermicompost treatment was also exhibited while calculating the area of the leaf (Table 5), it is apparent that the leaf size greatly increased from 15 to 30 cm^2 when the plant was grown in the presence of vermicompost. This trend continues even during treatment with endosulfan as leaf area is on the

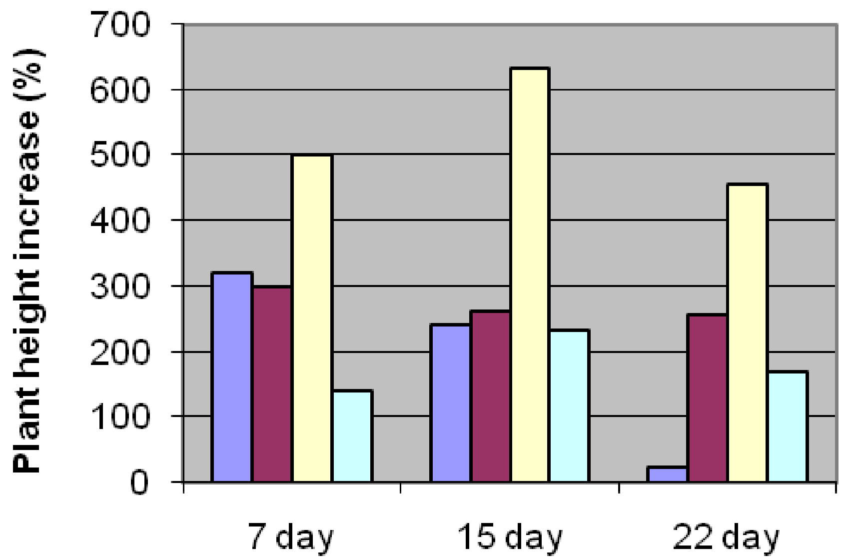

Figure 2. Growth profile of *Zinnia elegans* when grown in presence of different concentration of endosulfan, blue 0% per kg, pink 2.5% per kg, yellow 5.0% per kg, cyan 7.5% per kg.

Table 4. Length of internode of *Zinnia elegans* when grown in presence of different concentrations of endosulfan in plain soil and soil mixed with vermicompost.

Time of growth (day)	Endosulfan concentration (% kg)							
	Without vermicompost (cm)				With vermicompost (cm)			
	0	2.5	5	7.5	0	2.5	5	7.5
7	1.5±0	2.5±0	1.5±0	3±0	3.5±.1	3.6±.7	3.3±.7	3.9±.3
15	2±.7	2±.5	1.7±1	2±0	4.7±.4	4.3±.1	4.1±.4	4.6±.4
22	3.5±.5	3.4±1	2.75±1.25	3.8±1.2	5±1.3	4.5±1.3	4.5±.1	4.5±.1

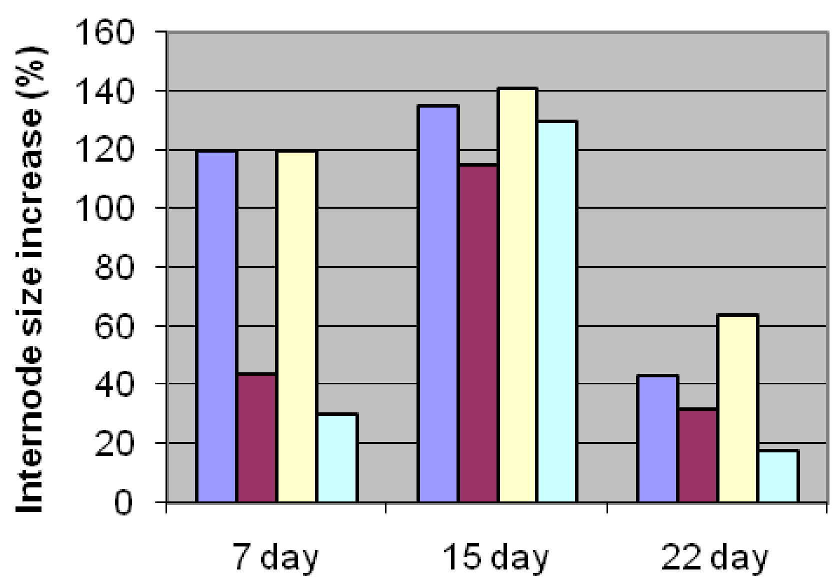

Figure 3. Length of internode of *Zinnia elegans* when grown in presence of different concentration of endosulfan, blue 0% per kg, pink 2.5% per kg, yellow 5.0% per kg, cyan 7.5% per kg.

Table 5. Area of the leaf after growth under different conditions.

Endosulfan concentration (%/kg)	Leaf area (cm^2)	
	Without vermicompost	With vermicompost (%increase)
0.0	15 ± 1	30 ± 1.2 (100)
2.5	18 ± 0	25 ± 1.4 (88.8)
5.0	3 ± 2	16 ± 2 (429)
7.5	0.9 ± 1.5	19 ± 3 (2011.1)

Table 6. Number of emerging rootlets, after different treatments.

Endosulfan concentration (%/kg)	Without vermicompost	With vermicompost (%increase)
0.0	14 ± 1	18 ± 6 (48.6)
2.5	15 ± 0	17 ± 6 (13)
5.0	15 ± 0	22 ± 1 (26.9)
7.5	16 ± 0	29 ± 7 (81)

rise to the extent of 25 to 18 cm^2 (2.5%), 03 to 16 cm^2 (5%) and 0.9 to 19 cm^2 (7.5%). It seems that vermin-compost nullifies the effect of endosulfan so far as development of leaf area is concerned.

On taking into account the value obtained in Table 5, a comparative account on the increase in leaf area was calculated. This suggests that there was 100% rise in vermi-compost included soil, 88.8% rise in the presence of 2.5% endosulfan, 429% rise in 5% endosulfan and 2011% rise in 7.5% endosulfan treated soil.

Number of rootlets

Plant was picked up neatly from the soil, washed neatly and the rootlets which emerged after each treatment were counted (Table 6). Number of rootlets was found to increase in plants treated with vermicompost. The extent of increase was 48.6% in plain soil over soil amended with vermicompost, 13% (2.5% of endosulfan), 26.9% (5% endosulfan) and 81% (7.5% endosulfan).

DISCUSSION

Vermicompost as an organic manure was identified to be a source of plant available forms such as nitrates, phosphates, exchangeable calcium and soluble potassium (Orozco et al., 1996). It was identified to play a vital role in the growth and development of variety of plants (Edwards, 1998). A wide range of plants such as cereal and legumes (Chan and Griffiths, 1998), vegetables (Atiyeh et al., 2000a), ornamental and flowering plants (Edwards and Burrows, 1988) and field crops (Arancon et al., 2006) are known to be influenced variously by the action of vermicompost. Information is gathered about its influence on germination, increase in biomass, increase in plant height and bigger leaf area. Additions of vermicompost in the soil, during this study, indicated a finding consistent with the findings described above (Atiyeh et al., 2000a; Arancon et al., 2006). It is observed that germination of seed of *Z. elegans* increases by 400% (Figure 1) in the presence of vermicompost. In a similar experiment, when endosulfan is added in the soil, the value of germination becomes 50, 200 and 0% respectively (Figure 1). An inducing effect of germination has, thus, been noticed as a result of treatment with vermicompost.

Evaluation of data related to plant height, after different periods of growth (7, 15 and 22 days) revealed the inducing effect of vermicompost, on growth, as plant height increases to the extent described (Figure 2). A rising trend of growth and development is noticed with respect to size of the internodes (Figure 3), area of leaf (Table 5) and number of rootlets (Table 6). From the data aforementioned, it can be concluded that supplementation of vermicompost in the soil favor *Z. elegans* in growth and development, as was reported in Marigold and Tomato seedling (Atiyeh et al., 2000a), Sunflower (Jadia et al., 2008), Petunia (Chamani et al., 2008), Tomato transplant (Arouiee et al., 2009; Senthil kumar et al., 2004). Enhanced germination and growth of *Z. elegans* in presence of vermicompost can be attributed as a means to reduce the inhibitory effect of this obnoxious pesticide endosulfan. It was reported that vermicompost supports remediation of zinc, cadmium, copper, nickel and lead (Jadia and Fulekar, 2008) and nitrogen (Shi- Wei and Fu-Zhen,1991). Earthworm cast produces auxin like effects on plants (Muscolo et al., 1999) such actions on *Z. elegans* cannot be denied. Further studies to confirm this aspect of remediation is under progress.

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