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Comparative study of plant growth in three different sample soils and inferring the positive potentials of vermicompost on the chilli plant

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Abstract
The selection of the plant chilli for study was done on certain economical considerations. Chilli is an important cash crop of India and is essentially grown for its pungent fruits. The chilli plant was grown and observed under control, vermicompost and urea. The main aim was to sort out the difference in growth in all the three segregated amendments. The height of plant, length of the leaves and number of leaves was higher in plants grown in vermicompost than the chemical fertilizer. The utilization of vermicompost may serve to be economical and easily affordable.

Keywords: Chilli plant, height, length, vermicompost, soil

Introduction

The term "Vermicomposting" refers to the use of earthworms for composting organic matter and the latest biotechnology which helps in giving bio-fertilizers in the term of vermicompost, for agricultural uses and a high quality protein (earthworm biomass). Heavy doses of chemical fertilizers and pesticides are being used by farmers to obtain a better yield of various field crops. The chemical fertilizers and pesticides decrease soil fertility and cause health hazards to the consumers. Due to the adverse effect of chemical fertilizers, interest has been stimulated for the use of organic manures (Follet *et al*., 1981) [1].

Porosity, drainage, water holding capacity and microbial activity are comparatively high in vermicompost than in conventional fertilizers. Vermicompost is produced by biodegradation of organic material through interaction between earthworms and microorganisms (Edwards and burrows, 1988) [2, 5]. India could achieve self-sufficiency in agriculture by an increased use of chemical fertilizers. These agrochemicals deteriorate soil health and environment has turned out to be polluted. Human beings and cattle were adversely affected due to the residues of these agrochemicals in food products (Kumar and Bohra, 2006) [3]. So, organic manures like vermicomposts can serve to be a good alternative for chemical fertilizers to overcome the adverse effects.

Vermicompost contains most of the nutrients in plant available, namely nitrates, phosphates, calcium and soluble potassium. They have large particulate surface areas that harbour many micro sites for microbial activity and for the strong retention of nutrients. Vermicompost is enriched in microbial population and diversity, particularly fungi, bacteria and actinomycetes. Vermicompost increases the surface area, provides strong absorbability and retention of nutrients and retain more nutrients for a longer period of time. Vermicompost enhances the nutrient uptake by the plants by increasing the permeability of root cell membrane stimulating root growth and increasing proliferation of root hairs (Pramanik *et al*., 2007) [4]

Vermicompost includes composting earthworm's wastes, relatively decomposed organic material, the egg capsule of earthworm and other small animals. Vermicompost is organic-biologic manure obtained by passing semi-decayed organic material through the digestive tract of earthworm`s species and its diposal from their body. When the materials pass through the worm body, impregnate with gastrointestinal mucosa, vitamins and enzymes.

The result is an enriched organic fertilizer which has major applications in agricultural lands and greenhouses. The most appropriate species for producing vermicompost in *Eisenia fetida* which is reddish brown and smaller than ordinary earthworms.

Reddy and Reddy (1999) [6] reported significant increases in micronutrients in field soil after vermicompost applications compared to those in soils treated with animal manures. Atiyeh *et al*. (2002) [7] reported that use of maize plants as forage depends upon number of leaves and the wet weight of maize plants and number of leaves increased on application of vermicompost. Mohamadian and Malakouti, (2003) [8] evaluated effects of two types of compost on characteristics of soil and yield of corn and reported that consumption of chemical compost together with organic compost led to higher yield in comparison with use of chemical compost alone. Azarmi *et al*. (2009) [9] reported that leaf dry weight, chlorophyll content and number of cucumber increased on vermicompost applications.

Materials and Method

The vermicompost was prepared at Nirmala College for woman, Coimbatore. The control was carried out simultaneously along with inorganic fertilizer and vermicompost. We compared the height of the plant, number of leaves and length /width of the leaves of chilly plant with and without vermicompost amended soil.

The chilli plant was grown in a private garden in which one field inoculation with vermicompost and the other with inorganic fertilizer and the control. The seedlings were brought from the nursery and were planted at the same time in all the three fields. The soil used in the three fields was also collected from the same agricultural land. At regular intervals, the fields were watered depending upon their requirements. A random sampling technique was used to select the plants for evaluation of height, number of leaves and length/width of the leaves.

The soil samples were taken from control, inorganic fertilizer and vermicompost from each field. The pH of the soil samples was determined with the help of digital pH meter and the standards of Thorax *et al*., 2008. Phosphorous, nitrogen and potassium in the soil samples were analyzed by using a soil testing kit.

pH: Electrometric Method (Standard Method)

A sample suspension was made by taking 1.0 g of air dried sample with 5.0 ml distilled water in a flask to prepare a suspension (1:5 w/v). The suspension was kept over a shaker for 30 minutes. The shaking period was not allowed to exceed 30 minutes otherwise various biological processes may start in suspension which may change actual pH of suspension. The pH of the suspension was estimated by pH meter. The pH meter was caliberated with buffer solution.

Total Kjeldahl Nitrogen (Bremner and Mulvaney Method)

Total Nitrogen was determined by microkjeldahl method (Bremner and Mulvaney, 1982). 500 mg of dry material was taken in digestion tube. To each tube, 1g of digestion mixture and 10 ml of sulphuric acid was added. It was then digested on Kjeldahl digester till bluish green colour appeared in tube. Then 10 ml of boric acid indicator solution was taken in 100 ml Erlenmeyer flask that was marked to indicate a volume of 50 ml and flask was placed under the condenser of steam distillation apparatus. The digested mixture was taken in distillation flask and flask was attached to steam distillation colour turned black. Distillation was started by closing stop cork on steam by pass tube of distillation apparatus. When the distillate reached 50 ml mark of receiver flask, the distillation was stopped by opening stop cork on steam by pass tube and end of condenser was rinsed. The total nitrogen in distillate was determined by titration with N/50 HCL. The colour change at end point was from green to permanent faint pink. From the following formula, N (per cent) was estimated as:

$$N\% = V \times 0.00014 \times D \times 10 \div W \times A$$

Where,

V= Volume of N/50 HCL used, D = Dilution factor (Volume made in volumetric flask), W= Weight (g) of sample, A = Volume of liquid taken.

Phosphorus

This was determined by spectrophotometric method. 0.5 g sample was taken in 250 ml conical flask and to it added 100ml of 0.002N H_2SO4. Solution was shaken for half an hour and then added 2 ml of ammonium molybdate solution. 50 ml of filtered solution was taken and 5 drops of $SnCL_2$ were added into it. A blue colour appeared and reading was taken at 690 nm on a spectrophotometer using a blank with same amount of reagents. Reading was taken after 5 minutes but before 12 minutes of the addition of last reagent. The concentration was found out with help of standard curve.

The amount of TAP was estimated by using following formula:

$$\text{Available phosphorus (per cent)} = P \times V/W \times 100$$

Where,

P = Phosphate content in extract (mg/I), V = Total volume of extract (ml) prepared, W = weight of air dried sample (g).

Potassium (Flame photometric method)

This was determined by flame photometric method for this, 0.5g of sample was weighed and to it 100 ml of ammonium acetate solution was added and kept for overnight. Now, solution was filtered and during filtration first few ml of filtrate may be discarded. Potassium content in extract was determined by using potassium filters after necessary settings and calibration of the instrument. Readings for sample were noted. Potassium content in sample was determined with the help of standard curve.

The level of potassium was estimated by using following formula:

$$\text{Available potassium} = K \times V / 1000 \times S$$

Where,

K = amount of potassium (mg) per liter in sample, V = Total volume of sample extracted prepared, S = weight of sample taken.

Results and Discussion

Table 1: Macronutrient content in field samples in inorganic fertilizer and in vermicompost.

Parameters	Control	Inorganic Fertilizer Urea	Vermicompost
pH	7.6	6.5	7.8
Humus	56.55	53.85	78.61
Phosphorus	1240.16(mg/kg) medium	1230.15(mg/kg) low	1260.54(mg/kg) high
Nitrogen	0.81% medium	0.79% low	0.88% high
Potassium	437.20(mg/kg) medium	431.10(mg/kg) low	441.18(mg/kg) high

Table 2: Plant characteristics of field samples in inorganic fertilizer and in vermicompost

Plant Characteristics	Control	Inorganic Fertilizer	Vermicompost
Height of plant	1.9 (ft)	1.0 (ft)	2-2.5 (ft)
No. of leaves	10	5	15
Length/width of the leaves	1.5cm/1.2cm	1.0cm/0.5cm	2.5cm/2.0 cm

Measurement of Growth Parameters in Three Sample Soils in Control, Inorganic Fertilizer And Vermicompost

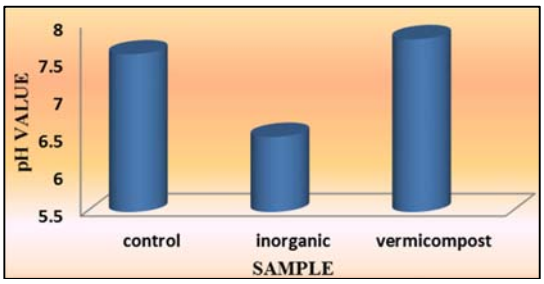

Fig 1

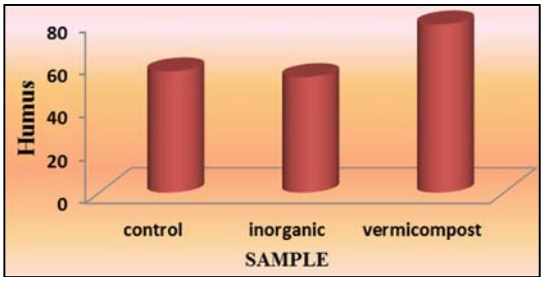

Fig 2

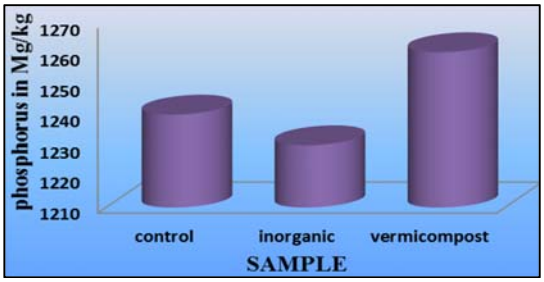

Fig 3

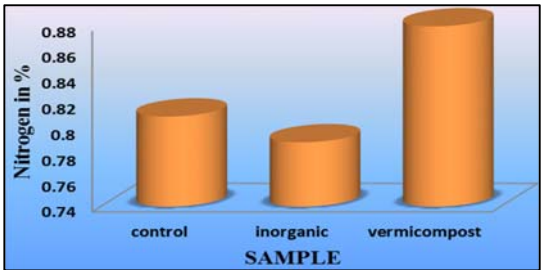

Fig 4

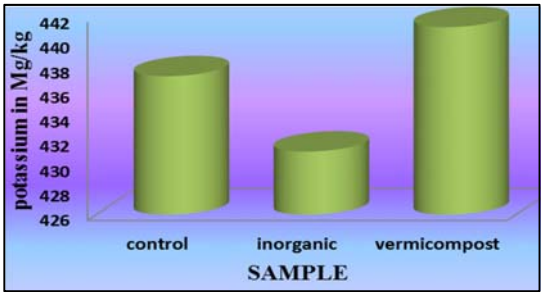

Fig 5

The pH of the soil sample using inorganic fertilizer was 6.5 and pH of the soil amended with vermicompost shows a pH of 7.8 when compared to control values of 7.6. The humus content of the soil sample with inorganic fertilizer was 53.85 and in vermicompost were 78.61. The control value was 56.55 respectively. The phosphorus content of the soil sample with inorganic fertilizer was 1230.15 (mg/kg) and the soil sample with vermicompost was having high phosphate content above 1260.54 (mg/kg) were noted in the control (Table 1)

The control value for the nitrogen content of the sample was 0.81%. In the inorganic fertilizer the soil sample are found to be 0.79% respectively and the soil sample with vermicompost was having high nitrogen content of 0.88%. The potassium content of the control value was 437.20 mg/kg and the soil sample amended with inorganic fertilizer was found to be low as 431.10 mg/kg and the soil sample amended with vermicompost was having high potassium content of 441.18 mg/kg (Table 1)

The plant characteristics like height was formed to be 1.9 (ft) in control, 1.0 (ft) in inorganic fertilizer and in vermicompost as 2-2.5ft. The number of leaves counted in control, inorganic fertilizer and vermicompost was 10, 5 and 15 leaves respectively. The length/width of the leaves was found to be 1.5cm /1.2cm in control, 1.0cm / 0.5cm in inorganic fertilizer and 2.5cm / 2.0cm in vermicompost (Table 2)

In chemical treatments most of nitrogen would be leached from the soil profile. In addition, high porosity and water holding capacity of vermicompost helps in better aeration and drainage. The increase in growth parameters may be attributed to presence of growth hormones, enzymes and other secretions of earthworms which could stimulate the growth and development of crop. The effect of the vermicompost that were used in our study, showed the influence on chilli plant growth, production of leaves and

length/width of the leaves higher than that were raised in inorganic fertilizer (without vermicompost).

Vermicompost has been reported to have 40-60% higher levels of humic compounds than conventional composts (Dominguez *et al*., 1997) [10]. The vermicompost contains many humic acids which improves morphological traits of the crop and thus increases the leaf number, leaf area index, stem diameter, plant height and reduces the period of slow growth (Atarzadeh *et al*., 2013) [11]. Bryan and Lance, (1991) found that tomatoes grown in compost –amended soils yielded more.

The phosphorus (P) and potassium (K) were found to be higher in the vermicompost soil sample than the inorganic fertilizer soil sample. Greater mineralization is a result of phosphate activity and physical breakdown of minerals. The biological grinding of matter together with the enzymatic influence after passing through the gut of earthworms is responsible for increasing the different forms of potassium (sharply and syres, 1977; mathur *et al*., 1980; Rao *et al*., 1996) [12-14].

Compost also contain plenty of beneficial soil microbes which help in soil regeneration' and fertility improvement' and protect them from degradation while also promoting growth in plants (De Brito Alvarez *et al*., 1995; Weltzien, 1989) [15, 16]

Plate 1: Comparative effects of chilli plant growth In soil amended control, inorganic Fertilizer and vermicompost

Summary and Conclusion

Thus our experiment inferred that vermicompost serves high potentials of plant growth and appears to be the most promising high value bio fertilizers. It reduces ecological risk and can be utilized at its best on all crops at any stage of growth. In the field study, the plant height, number of leaves and length/width of the leaves was significantly higher in the chilly plants that were amended with vermicompost as compared to control and inorganic fertilizer. This may be due to the increase in soil fertility level in the amended soil as vermicompost is rich in nitrogen (Plate 1).

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