Nutrient Analysis Of Compost And Vermicompost And Their Impact On Growth Of *Cicer arietinum*

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Abstract: The study was aimed to evaluating the nutrient availability and effect of compost and vermicompost on the growth of *Cicer arietinum.* Nutrient analysis showed that pH of compost was higher than that of vermicompost and water holding capacity is lower than vermicompost. While all other nutrients like nitrogen, phosphorus, organic carbon, exchangeable calcium, exchangeable magnesium and organic matter were higher in vermicompost. Thus it is more nutrient rich and cheap organic manure. The experiment was set up with two concentrations (20% and 40%) of compost and vermicompost and in triplicates of each. Soil treatment was taken as control. The obtained results from present research indicated that application of vermicompost at 40% concentration had significant improving effects on healthier growth of plants. The seeds sown in vermicompost (20 and 40% concentration) showed higher germination percentage. Root shoot length, fresh shoot and root biomass, dry weight of root and shoot, total chlorophyll and carotenoids were higher in 40% vermicompost treatment. Thus vermicompost is an effective amendment to soils for improving soil characteristics, biological properties and the growth of crop plants by increased microbial biomass and activity and sustained supply of macro nutrients.
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Key words: compost; carotenoids; nutrients; total chlorophyll; vermicompost

1. Introduction

Soil is a natural dynamic body on the surface of earth in which plants grow and is composed of minerals, organic matter, air, water, soil micro flora and fauna (Sharma, 2011). In India, during the period of 1960s to 1980s, there was a remarkable increase in the agricultural production due to ''Green revolution'' (Gupta, 1996). After green revolution, use of chemical fertilizers increased and India achieved self-sufficiency in agriculture. Use of chemical fertilizers resulted in pollution of soil, water and air. There have been adverse effects on the health of human beings and cattle due to the residues of these agrochemicals in food products (Kumar and Bohra, 2006). Environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contributes largely to the deterioration of the environment, loss of soil fertility, less agricultural productivity and soil degradation (Inbar et al. 1993).

Recently there is being a global shift from chemical fertilizer to organic fertilizer (Omueti et al. 2000). Organic fertilizers are naturally occurring fertilizers like compost and manure. It reduces the amount of toxic compounds (such as nitrates) produced by conventional fertilizer in vegetables (Adesina and Sanni, 2013). The material gaining interest is agricultural manure waste composted through the action of earthworms (Handreck, 1986). This material called as vermicompost, is being used as organic fertilizer, soil amendment, and potting substrate components. Vermicompost is a product of non-thermophilic biodegradation of organic material by combined action of earthworms and associated microbes (Pathma and Sakthivel, 2013). It is highly fertile, finely divided peat-like material with high porosity, aeration, water-holding capacity and low C: N ratios (Dominguez and Edwards, 2004). Vermicomposts also have characteristics of conventional composts. Vermicompost is easily handled and supply nutrients during crop growth. Depending on the origin, vermicompost differ in chemical composition (Handreck, 1986).

The increases in plant growth have mostly been related to improvements in physical and chemical structure of the growth media. However, the use of vermicompost appears to affect plant growth in many ways that cannot be directly linked to physical or chemical properties (Dash and Petra, 1979). It seems like that growth promotion is due to some plant hormones like activity related to micro flora associated with vermicomposting and to metabolites produced as a consequence of secondary metabolism (Parle, 1963; Tomati et al. 1987; Atiyeh et al. 2002).

The enhancement of plant growth by vermicompost may not only be nutritional, but due to its content of biologically active plant growth-influencing substances (Warman and AngLopez, 2010). The presence of plant growth regulators such as auxins, gibberellins, cytokinins of microbial origin (Tomati et al.1988) and humic acids (Atiyeh et al. 2002) has been reported in vermicompost.

Stimulation of root growth (initiation and proliferation of root hair), increased root biomass, enhanced plant growth and development have been reported with the application of vermicompost, because of the presence of humic acids (Tomati et al. 1988; Mylonas and Mccants 1980; Chen and Aviad, 1990). Moreover, the positive influences of humic acids on plant growth and productivity, which seem to be concentration specific, could be mainly due to hormone like activities of humic acids through their involvement in cell respiration, photosynthesis, oxidative phosphorylation, protein synthesis and various enzymatic reactions (Chen and Aviad, 1990). Further, humic acids are molecules that regulate other processes of plant development such as macro and micronutrient adsorption (Gutierrez-Miceli et al. 2008a) and metabolism, which influence protein synthesis.

The present study was undertaken to assess the nutrient analysis of compost and vermicompost and their impact on growth of *Cicer arietinum.*

2. Materials and methods

2.1 Collection of samples

In present study soil sample was collected from garden area of Kanya Gurukul Campus Haridwar from the depth of 20 cm. Compost and vermicompost were procured from Dev Sanskriti Vishwavidyalaya, Haridwar. Samples were collected in polythene bags and brought to laboratory. Soil samples were air dried and processed (hammered and sieved) for the analysis.

2.2 Experimental setup

To evaluate growth enhancement properties compost and vermicompost on chick pea growth, a pot experiment was conducted from January to March of 2015 in plastic pots. The experiment was laid out with 2 treatments along with control. Each pot contains 3 kg of sample. Two different concentrations of (CWC) compost (20% and 40%) and (VC) vermicompost (20% and 40%) were prepared. Two different concentrations of compost were prepared TC_1 (20%=600g CWC + 2400g soil) and TC_2 (40%=1200g CWC + 1800 soil). Similar concentrations of vermicompost were also prepared TV_1 (20%=600g VC + 2400g soil) and TV_2 (40%=1200g VC + 1800g soil). T_1 was maintained as control (3kg of soil was used). Ten seeds were sown in each pot and irrigated on alternate days. All the concentrations were maintained in triplicate.

2.3 Estimation of physico chemical, morphological and biochemical parameters

Various physical and chemical parameters were analysed for each sample. Moisture content, Water holding capacity, pH, Organic matter, Organic carbon Total Kjeldahl Nitrogen, Inorganic phosphate, Exchangeable Calcium, Exchangeable Magnesium (Trivedi and Goel, 1997) were analysed. Some plant growth parameters of *Cicer arietinum* viz. Germination percentage (Mayer and Mayer, 1982) and Shoot length, Root length (Odedina et al. 2011), Vigour index (Abdul-Baki, 1980) Fresh biomass, Dry biomass and Total Chlorophyll and carotenoids were analysed in each concentration of potted plants (Trivedi and Goel, 1997).

3. Result Analysis

Result obtained from nutrient analysis showed that there is significant difference in nutrient availability of each sample. Moisture content and water holding capacity were reported to be high in vermicompost. pH (6.83) of vermicompost was lesser than compost and control. The pH reduction in vermicompost may be attributed to mineralization of nitrogen and phosphorus into nitrites/nitrates and orthophosphates (Ndegwa et al. 2000). Release of CO_2 and organic acids from microbial metabolism and the production of humic and fulvic acids, may be a possible causes of the decrease in pH of vermicompost (Ndegwa and Thompson, 2001; Kaushik and Garg, 2004). Organic matter, Organic carbon, total kjheldahl nitrogen, inorganic phosphorous, exchangeable calcium, exchangeable magnesium show significant increase in vermicompost (Table. 1). Vermicompost were found to be increase in nitrogen content which may be due to the decomposition of organic materials by earthworm which accelerated the N mineralization process and subsequently changes the N profile of the substrate (Benitez et al. 1999). Another reason for increase in nitrogen content might be due to the enzymes, hormones, nitrogenous excretory substances of organisms (John and Prabha, 2013; Lazcano et al. 2009). Vermicompost were found to be increase in phosphorous which may be due to the reason that some amount of phosphorus was converted to more available forms partly by earthworm gut enzymes, i.e. acid phosphatases and alkaline phosphatases and further release of phosphorous might be attributed to phosphate solubilizing microorganisms present in vermicompost.

Maximum calcium and magnesium was found in vermicompost which may be due to the presence of nutrients in free forms so they can be readily taken up by the plants (Edwards and Burrows, 1998; Orozco et al. 1996 and Atiyeh, 2001).

Morphological parameters such as germination percentage and Shoot length, Root length, Vigour index, Fresh biomass, Dry biomass and Total Chlorophyll and carotenoids were observed (Table.2.). Maximum percentage germination of seeds (93.33%) was reported in 20% and 40% concentration of vermicompost and minimum (70%) was in control.

Germination in VC was highest which may be due to hormone-like activity of vermicompost and has been assumed to enhance root initiation of seeds. Maximum shoot length (33.43) was reported in 40% concentration of vermicompost and minimum (26.27) was in control. Prolified growth in VC treated plants may be due to the presence of certain phyto hormones produced by microorganisms in worm worked material. Maximum root length (12.04) was reported in 40% VC treatment

The maximum root length was in vermicompost treated plants which may be due to the metabolic activity of microbes resulted in the release of plant growth regulating hormones, thereby enhancing plant growth and also control plant pathogens and reduce pest attack (Edward and Burrows , 1988). As reported by Grapelli et al. (1985) application of worm cast increased the height of plant, leaf area index, leaf length, number of ranches and number of leaves, stem girth and yield of plant. Maximum fresh biomass (18.65) was in 40% VC treatment which might be due to the enhancement in uptake of nutrients favored by the addition of vermicompost (Naikwade et al. 2012).

Maximum dry biomass (2.62) was observed in vermicompost which may be due to the application of vermicompost which is a source of slow releasing N and is beneficial during subsequent stages of development which might have resulted in increase in the total dry matter of plant.

Chlorophyll is the principal photoreceptor in photosynthesis. More is the chlorophyll more is the productivity, its measurement is an important tool as it plays an important role in plant metabolism and any reduction in the chlorophyll content corresponds directly to the plant growth (Joshi and Swami, 2009).Maximum chlorophyll content (2.56) was in 40% VC concentration and minimum (1.20) in control. The highest chlorophyll content in VC treated plants may be due to the presence of microorganisms in the organic manure that colonize in the rhizosphere and stimulate the plant growth and biochemical contents (Varma and Schuepp, 1995). Another possible reason for high chlorophyll content may be due to increase in nitrogen and magnesium (major components of chlorophyll molecule in plants) contents of the applied vermicompost (Santos, 2004).

Carotenoid is an accessory pigment in photosynthetic assimilation of plants. In present study carotenoid content ranges from 0.96±0.01 to 1.78±0.01. High value of carotenoid content was reported in VC treated plants and lowest in control plants. It is well known that carotenoids are involved in protection of photosynthetic apparatus against photo inhibiting damage by singlet oxygen (Foyer and Harbinson, 1994).

Table 1. Physico chemical characteristics of soil, compost and vermicompost

S.N.	**Parameters**	**Soil**	**CWC**	**VC**
1	Moisture Content (%)	19.13 ± 0.31	20.3 ± 0.27	21.37 ± 0.10
2	Water Holding Capacity (%)	62.3 ± 0.37	77.97 ± 0.52	83.39 ± 0.22
3	pH	7.09 ± 0.03	7.55 ± 0.01	6.83 ± 0.01
4	Organic Carbon (%)	3.01 ± 0.20	8.85 ± 0.17	16.99 ± 0.07
5	Organic matter (%)	5.14 ± 0.31	15.26 ± 0.30	29.29 ± 0.12
6	Total nitrogen (%)	0.42 ± 0.05	0.86 ± 0.04	1.33 ± 0.09
7	Inorganic Phosphorous (%)	4.94± 0.13	9.34 ± 0.07	10.76 ± 0.10
8	Exchangeable Calcium (meq/100g)	13.98 ± 0.05	16.63 ± 0.09	18.38 ± 0.08
9	Exchangeable Magnesium (meq/100g)	14.00 ± 0.05	16.66 ± 0.09	18.41 ± 0.08

Whereas; CWC= Cow dung compost, VC= cow dung vermicompost

Table 2. Morphological parameters of *Cicer arietinum*

S. No.	**Plant parameters**	**Control**	**CWC**		**Vermicompost**	
			20%	**40%**	**20%**	**40%**
1	Germination (%)	70%	92%	88.33%	93.33%	93.33%
2	Shoot length (cm)	26.27±3.13	29±0.0	29.18±1.1	32.06±0.56	33.43±1.37
3	Root length (cm)	6.5±0.87	8.97±0.90	7.81±0.51	10.00±0.40	12.04±0.19
4	Vigour Index	2293.9	3493.24	3267.32	3925.45	4243.71
5	Total fresh biomass (g)	8.55	11.98	13.36	15.35	18.65
6	Total dry biomass(g)	0.88	1.16	1.38	1.33	2.62
7	Chlorophyll (mg/g)	1.20±0.30	1.50±0.30	1.62±0.20	2.43±0.23	2.56±0.15
8	Carotenoids	0.96±0.01	1.17±0.12	1.25±0.08	1.32±0.12	1.78±0.01

4. Discussion

In present study it was observed that compost and vermicompost improve the soil quality by improving the growth charactersticts and biochemical properties of plant and increase the supply of macro nutrients. Nutrients like nitrogen, phosphorus, organic carbon, exchangeable calcium, exchangeable magnesium and organic matter were higher in vermicompost than in compost. Hence vermicompost produced by the action of earthworms are more nutrient rich and cheap organic manure. Morphological parameters of plant such as germination percentage, root shoot length and total biomass and biochemical parameters such as chlorophyll content and carotenoids were maximum in 40% vermicompost treatment. Stimulation of root growth (initiation and proliferation of root hair), increased root biomass, enhanced plant growth and development have been reported with the application of vermicompost, because of the presence of humic acids. Hence it can be revealed from above result that vermicompost is today's natural fertilizer as nature intended and it is the best solution to immediate problem of declining soil fertility and for production of food. The potential exists for growers to use vermicompost as potting substrates without the use of additional fertilizer. Thus utilization of vermicompost is the best means of abating pollution, soil degradation and mining in discriminate use of chemical fertilizers.

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