

Original Research Article

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Effect of Vermicompost with Microbial Bio Inoculums on the Growth Parameter of Coriander (*Coriandrum sativum* L.)

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ABSTRACT

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Vermicompost is an organic fertilizer which converts waste to wealth in a safe and healthy way as it is produced by biopotential of earthworm. It contains plant growth hormones, enzymes, microbial population, and free of harmful pathogens. Application of such a microbiologically active organic substrate may have important effects on the microbial properties of the media. A study was conducted to find out the effect of organic manures in combination with microbial bio inoculants on the growth, plant height, wet weight, dry weight, and yield of coriander. The experiment was carried out as in open field with seven treatments at National Institute of Plant Health Management, Rajendranagar, Hyderabad in December, 2019. The analysis of the variance results revealed that the effect of the type of treatments on fresh weight, number of leaves, root length, fresh weight, dry weight, chlorophyll content and biomass yield showed significant effect when compared to control. The results also showed that the interaction of vermicompost and bio inoculants were significantly enhanced the morphological character of the coriander crop. Therefore, the application of bio inoculants with any of the organic manure to be a potential source of plant nutrients which contributes the growth of coriander.

Introduction

“Sustainable agriculture” can be ensured in future with the help of organic farming systems which includes various processes of biological origin such as compost and vermin compost. Compost and vermicompost are appropriate technologies which convert waste to wealth. Vermicomposting is increasingly becoming popular as an organic farming and solid waste management technique and it produces two vital bio fertilizers, vermin compost and vermin wash (Kaur *et al.*, 2015).

Vermicompost is an organic manure produced as the vermicast by earthworm feeding on biological waste material; plant residues (Rathore *et al.*, 2007) and it is one of the best source of nutrients improves the physical and chemical properties of crops (Sinha *et al.*, 2010). The vermicompost is rich in NPK and micronutrients (Palanichamy *et al.*, 2011). Vermicompost and Biofertilizer are also useful substitutes to inorganic fertilizers which improves the soil quality. Biofertilizers are living organisms that have an ability to mobilize nutrients from unusable form

through biological process and these groups of microorganisms may either fix atmospheric nitrogen or solubilise insoluble phosphorus and make them available for crops. *Azospirillum*, *Phosphobacteria*, VAM, *Azotobacter*, *Rhizobium* etc., are the main types of organisms widely recommended for many field crops. Biofertilizers were found to have positive impact to soil fertility resulting in an increase in crop yield without causing any type of environmental wastes or soil hazards. Various studies proved that significant improvement in growth and yield and quality of vegetables with different biofertilizer applications on various crop (Yadav *et al.*, 2001 & Sanjukta Biswas, 2014). Similarly, application of organic manure, vermicompost and biofertilizer combinations has led to quality agricultural products (Sanchez *et al.*, 2008 and Velmurugan *et al.*, 2008).

Coriander (*Coriandrum sativum* L.) is one of the most important of vegetable, spice and medicinal plant which belongs to the family *Apiaceae* (Umbelliferae) is mostly cultivated from its seeds throughout the year. India is the major producer, consumer and exporter of coriander in the world with an annual production of approximately (1000 metric tonnes in 2019). This plant is very much aromatic and has several uses in food and in other industries. Plants have played a major role in maintaining human health and civilizing the value of human life for thousands of years (Dhankar *et al.*, 2011). It is also used to perfumes a usages. All parts of plant are edible, fresh leaves can be used for garnishing and are common ingredient in many foods like chutneys and salads. The green herb is also engaged for the preparation of either steam distilled essential oil or the solvent extracted oleoresin (Mhemdi *et al.*, 2011). Fresh juice of coriander is tremendously beneficial in therapeutic many deficiencies correlated to vitamins and iron.

Fresh leaves are being used in cooking, flavouring, beverages etc and seeds are used in preparation of value added products (Bhat *et al.*, 2014). It is sometimes used to mask odd flavors (Parthasarathy *et al.*, 2008). Several studies have reported that vermicompost can increase the growth and biomass of some medicinal plants such as chamomile (Fallahi *et al.*, 2008), plantain (Sanchez *et al.*, 2008), coriander (Singh *et al.*, 2009 & Darzi *et al.*, 2012), fennel (Darzi *et al.*, 2007), cumin (SaeidNejad and Rezvani Moghaddam, 2011), etc. Some other studies have reported that biostimulants such as *Azotobacter chroococcum* and *Azospirillum lipoferum* could cause increased growth and biomass in a few medicinal plants such as coriander (Darzi *et al.*, 2012), fennel (Mahfouz and Sharaf Eldin, 2007), turmeric (Velmurugan *et al.*, 2008) etc. The present study was carried out with a aim to evaluate the effect of vermicompost along with bioinoculants with due regards to growth, and biomass for coriander. The growth parameters were expressed as number of leaves, fresh weight and dry weight.

Materials and Methods

The experiment was carried out at National Institute of Plant Health Management, Rajendranagar during the period of December 2019 to January 2020. The experimental field were ploughed two times and divided into 7 plots. Each plots were 3 m long and 2 m wide in which the coriander seeds (local hybrid variety) were transplanted in seven rows. The experiment was conducted in an irrigated plots. One week old vermicompost (VC), Dry compost from kitchen wastes and composted Farm Yard Manure (FYM) was used as organic manure for the experiment. Further, mixture of bioinoculants (Biofertilizer (BF)- *Azotobacter*, Phosphorus Solubilising Bacteria and Biopesticides (BP) – (*Trichoderma* and *Pseudomonas*) were

admixed with the organic manures. All of these manures and bio fertilizers were produced at NIPHM. The experiment consists of seven treatments as follows:

All organic manures VC, FYM, dry compost were added @ 5kg per experimental plot at two times (one at the time of land preparation and another at on 5 DAS). The bio inoculants were applied along with vermicompost and FYM (@2g /kg) during transplanting of seedlings and 5 DAS in the experimental fields. Out of 7 rows, the middle 4 rows were selected for the collection of data to avoid the effect of other environmental factors. In each row 10 plants from each row was selected randomly (10 x 4 rows =40 plants) and uprooted to determine the following characters from each experimental plot - plant height, root length, number of leaves/plant, fresh weight and dry weight of the plants on 15th and 30th day of planting. The chlorophyll content in the leaves was measured by chlorophyll meter after the harvest of the plant (30th day).

The roots were cleaned carefully to remove adhering soil particles. After the harvest the plants were dried in oven at 65°C for 72 hours and dry weights were recorded in all the treatments. Total yield was measured based the total fresh weight of plant after the harvest (30th day). One-way analysis of variance (ANOVA) and Duncan's t multiple ranged test were used to identify the homogenous type of the data sets among different treatments for different plant parameters in different treatments.

Results and Discussion

Effect of different organic composts are admixed with bio inoculants on morphological characters such as plant height, number of leaves, root length, fresh weight and dry weight of the coriander crop is given in Table 2. The data tested by ANOVA

followed by Duncan test revealed that significant difference in plant growth parameters such as plant height ($F=113.73$, $P<0.001$ at 15 DAS & $F=112.09$, $P<0.001$ at 30 DAS), no of leaves/plant ($F=55.54$, $P<0.001$ at 15 DAS & $F=45.56$, $P<0.001$ at 30 DAS), root length ($F=55.12$, $P<0.001$ at 15 DAS & $F=58.79$, $P<0.001$ at 30 DAS), fresh weight ($F=4.58$, $P<0.001$ at 30 DAS) and dry weight ($F=24.43$, $P<0.001$ at 30 DAS) was among the treatments. Photo.1 showed the growth parameters of different treatments.

Plant Height (cm)

Among the different treatment, the highest mean plant height (cm) was recorded in T1 (12.87 ± 2.14), and T4 (11.28 ± 1.22) and lowest plant height (4.68 ± 0.94 cm) was observed in T7 (control) at 15 DAS of coriander plant. While at 30 DAS the highest mean plant height was recorded in three treatments T1 (20.25 ± 1.89) followed by T4 (20.15 ± 2.46) \approx T5 (20.00 ± 2.39) and lower plant height exhibited in control plot T7 (11.27 ± 1.13) (Table 2).

Root Length (cm)

The mean length of root length (cm) varied significantly among the different treatments when compared to control plot both at 15 & 30 DAS. The maximum root length (5.05 ± 1.23) was achieved in T1 followed by T4 (4.23 ± 0.88) \approx T5 (4.12 ± 1.32) and minimum root length observed in control (1.75 ± 0.56) at 15 DAS. Similarly, the maximum root length was found from T1 (6.69 ± 1.09) which was statistically identical with T3 (5.93 ± 1.04) \approx T5 (5.73 ± 0.95) while minimum from T7 (3.16 ± 0.54) at 30 DAS (Table 2).

Leaves Number (nos.)

Statistically significant variation was found among the treatments for number of leaves. Duncan's multiple range tests on mean

maximum number of leaves was found from T1 (6.02 ± 0.94), T4 (5.92 ± 1.24), T3 (5.75 ± 1.33), T5 (5.62 ± 1.12) and T6 (5.60 ± 0.95) followed by T2 (4.82 ± 0.71) whereas minimum from T7 (2.62 ± 0.58) at 15 DAS. However, the performance order of effect of different treatment on mean number of leaves per plant were T1 (10.05 ± 2.48) \approx T4 (10.05 ± 2.48) \approx T3 (10.02 ± 2.33) > T5 (9.42 ± 1.83) > T6 (8.42 ± 1.64) > T2 (7.40 ± 0.9) > T7 (5.72 ± 0.75) at 30 DAS (Table 2).

Fresh weight of Plant (g)

The ANOVA based Duncun test showed the highest fresh weight (g) of plant were obtained in 5 treatments (T1= 0.80 ± 0.07 ; T4= 0.79 ± 0.04 ; T5 = 0.78 ± 0.18 ; T3= 0.78 ± 0.05 and T6= 0.71 ± 0.18) followed by T2 (0.70 ± 0.15). The lowest fresh weight of plant (0.60 ± 0.25) was obtained in T7 (Control).

Dry weight of Plant (g)

Significant increase in dry weight of plant was observed among the different treatments. The highest dry weight of plant (g) were obtained in T1 with a mean value of 0.30 ± 0.12 g and less in the control treatment (T7) with value of 0.09 ± 0.00 (Table 2).The

present results show that the interaction of vermicompost and bio inoculant was significant.

Chlorophyll Content

One way analysis of variance test on chlorophyll content (g/kg) revealed significant differences among different types of treatment ($F=60.98$, $P < 0.001$ at 30 DAS). The maximum and minimum average chlorophyll Content (g/kg) was in T1 (21.50) and T7 (14.13), respectively. The Chlorophyll Content in coriander plant was in the order: T1 (21.50) > T5 (19.24) > T6 (18.72) > T2 (17.92) = T3 (17.62) > T4 (16.98) > T7 (13.38)(Figure 1).

Total Yield

Effect of different treatment on coriander yield based on the total weight (kg) measured after the harvest was presented in Figure 2. Significant increase in the yield of 1.66 kg was the recorded from plot treated with vermicompost + biofertilizers + biopesticides (T1). Followed by T4 (1.56 kg) > T5 (1.45 kg) > T3 (1.40 kg) yield better results. The poorest yield was received from the control plot (0.825 kg).

Table.1 Treatment design with bioinoculants

Treatments	Combination
T1 - VC+BF+ BP	Vermicompost + Biofertilizers + Biopesticides
T2 - FYM+BF+BP	Farm Yard Manure + Biofertilizers + Biopesticides
T3 - VC+FYM+BF+BP	Vermicompost + Farm Yard Manure + Biofertilizers + Biopesticides
T4 - VC+FYM+VW	Vermicompost + Farm Yard Manure + Vermiwash
T5 - Dry compost	Dry compost from vegetable waste
T6 –Vermicompost	Vermicompost
T7 – Control	No treatment

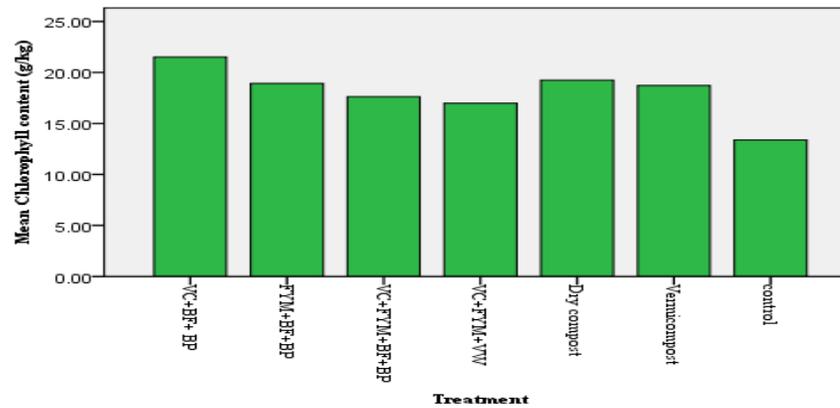
Table.2 Effect of vermicompost and other organic manures on morphological parameter of coriander

Treatments	Height of plant (cm) (mean ± SD)		Root length(cm) (mean ± SD)		No.of leaves /plant (mean ± SD)		Fresh weight (gm) (mean ± SD)	Dry weight (gm) (mean ± SD)
	15 days	30 days	15 days	30 days	15 days	30 days	30 days	30 days
T1-VC+BF+ BP	12.87 ± 2.14 ^a	20.25 ± 1.89 ^a	5.05 ± 1.23 ^a	6.69 ± 1.09 ^a	6.02 ± 0.94 ^a	10.57±2.21 ^a	0.80 ± 0.07 ^a	0.30±0.12 ^a
T2-FYM+BF+BP	10.95 ± 1.13 ^b	17.20 ± 2.05 ^b	2.53 ± 0.86 ^d	4.12 ± 1.09 ^c	4.82 ± 0.71 ^b	8.42 ± 1.64 ^c	0.70 ± 0.15 ^c	0.11±0.02 ^c
T3 VC+FYM+BF+BP	11.28 ± 1.22 ^a	19.80 ± 2.25 ^a	3.06 ± 0.89 ^c	5.93 ± 1.04 ^a	5.75 ± 1.33 ^a	10.02 ± 2.33 ^{ab}	0.78 ± 0.05 ^{ab}	0.12±0.02 ^c
T4-VC+FYM+VW	10.32 ± 1.73 ^b	20.15 ± 2.46 ^a	4.23 ± 0.88 ^b	5.34 ± 1.19 ^b	5.92 ± 1.24 ^a	10.05±2.48 ^{ab}	0.79 ± 0.04 ^a	0.25±0.12 ^b
T5-Dry compost	10.17 ± 1.23 ^b	20.00 ± 2.39 ^a	4.12 ± 1.32 ^b	5.73 ± 0.95 ^a	5.62 ± 1.12 ^a	9.42±1.83 ^b	0.78 ± 0.18 ^a	0.16±0.06 ^b
T6-Vermicompost	9.75 ± 1.54 ^b	15.19 ± 1.88 ^c	2.76 ± 0.93 ^d	4.74 ± 0.64 ^c	5.60 ± 0.95 ^a	6.40±0.90 ^d	0.71±0.18 ^b	0.14±0.07 ^b
T7- Control	4.68 ± 0.94 ^c	11.27 ± 1.13 ^d	1.75 ± 0.56 ^e	3.16 ± 0.54 ^d	2.62 ± 0.58 ^c	5.72±0.75 ^d	0.60±0.25 ^c	0.09±0.00 ^d

Significant differences($P<0.05$) are indicated by different letters

The values are represented a mean +Standard deviation of 20 samples

Figure 1: Chlorophyll content (g/kg) in the leaves of coriander (Coriandrum sativum L.) at 30 DAS (n=20)



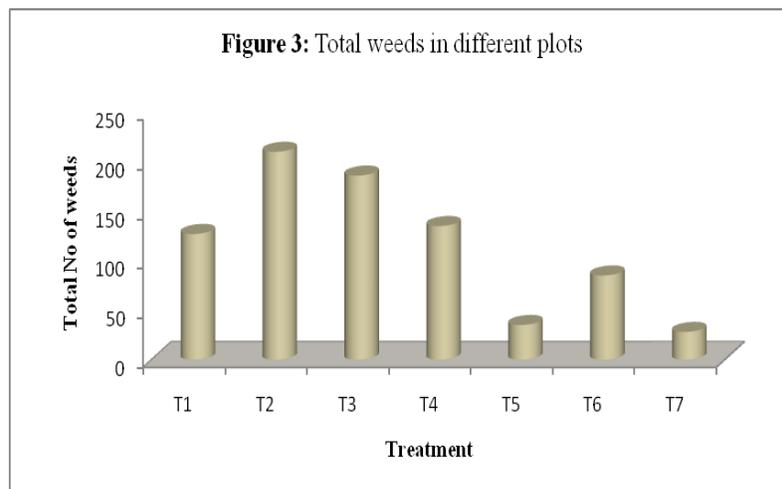
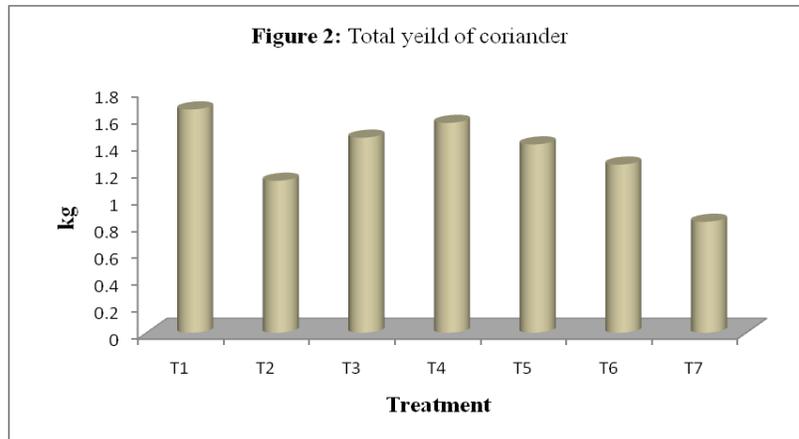


Photo.1 Effect of different treatments on plant growth parameters



Weed intensity

The weed intensity was measured after harvesting of the plants based on presence of total count in the experimental plots are 127, 210, 186, 135, 35,85, 28 in T1, T2, T3, T4, T5, T6, T7 respectively (Figure 3).

Among the various treatment used in the study, the significant effect on the growth parameter of coriander crop *i.e* plant height, no. of leaves, root length, fresh weight and dry weight as well as chlorophyll content were enhanced by the organic manures especially with vermicompost admixed with bio inoculant than the untreated plots (control). This might be due to excellent supply of better nutrients and plant growth promoters to the plants which is present in the worm casts. The vermicompost with a relatively high content of humus-like compounds, active microorganisms and enzymes, greatly contribute to the enhancement of the biochemical fertility of soils degraded by intensive – cultivation, pollution or natural causes (Perucci, 1992). The casts of earthworm is one of the most useful and active agent in introducing suitable chemical, physical and microbiological changes in the soil and, thereby, directly increasing the fertility and crop producing power in the soil (Joshi and Kelkar, 1951).

There are many reports that vermicompost increased the growth and yield of different plants *viz.*, rice (Gandhi and Sivakumar, 2010), garden pea (Meena *et al.*, 2007), cabbage (Mulusew Getnet and Nagappan Raja, 2013), wheat (Nijhawan and Kanwar, 1951), tomato (Hosseini Alidadi, *et al.*, 2014), coconut (Thomas *et al.*, 2012). Green gram (Manoharan and Ganesamoorthi, 2015), Brinjal (Maya and Satish, 2015), Garlic (Surindra Suthar, 2009). A study by Tomati *et al.*, (1983) revealed that positive effect of vermicompost on the growth of *Begonias* and

Coleus, especially a stimulation of rooting, time of flowering, lengthening of internode.

The chlorophyll is an integral component of plant pigments and plays a main role in the process of photosynthesis. It is the molecule that absorbs sunlight and uses its energy to synthesis carbohydrates from CO₂ and water. It also plays an important role in ATP synthesis (Kochot *et al.*, 1998 and Ravimycin, 2016). The increased chlorophyll content to the vermicompost application was recorded in the present study. Further, a study by Maya and Satish (2015) showed that the significant increase was observed in the brinjal plants which were sprayed with vermiwash and also added in the soil treatment. Study conducted by Thenmozhi, *et al.*, (2010), shows that bioinoculants *viz.*, *Azospirillum* and *Pseudomonas*, and organic manure as vermicompost had influenced the shoot and root length, plant biomass and number of leaves in *Amaranthus retroflexus*. A study by Ravimycin (2016) reported that application of vermicompost increased all the morphological, pigment, protein and nutrient content in coriander plants when compared to FYM and control treatment. Gandhi and Sivakumar (2010) reported that the combined form of inoculation of vermicompost increased the in rice grain quality like hulling percentage, milling percentage of grain and water uptake, volume expansion, elongation ratio, protein and amylose of rice kernel. It was reported that the combined inoculation of bioinoculants increased the number of panicle per plant (Yanni and El-Fattah, 1999 & Shanmugam and Veeraputhran, 2000). In the present work also similar trend was observed in T1 and T4. Hence, vermicompost with bioinoculants combination or vermicompost + FYM + vermiwash combination to be an effective organic fertilizer which contributes the growth of plants and helps in production of coriander crop.

In conclusion the results revealed that application of vermicompost in combination with microbial inoculums gave excellent results on the plant growth and yield parameter when compared with other treatments followed by T4, T3 and T5 also yielded better results over the control plot. Therefore, the vermicompost and enriched with bio inoculants or Vermicompost (50%) + FYM (50%) + Vermiwash may be used as plant growth media for sustainable coriander crop production.

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