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Impact on the combined effect of vermicompost and vermiwash on the growth and yield parameters of coriander

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Abstract
Vermiculture is gaining popularity as a means of converting various organic wastes into fertilizer. Earthworm mediated decomposition process could provide new opportunities for improving soil fertility in India. Earthworms play an important role in breaking down dead organic matter in a process known as decomposition. It releases nutrients locked up in dead plants animals and makes them available for use by living organisms. In India, enormous quantity of cow dung, agricultural and leaf litter wastes rich in organic nutrients are available. The percentage of germination was more in Treatment – 2 combined application. In, *Coriandrum sativum* higher percentage of germination was (94%) is recorded in T_2, followed by T1 (%) and in control the germination percentage was control (81%). These treatments were statistically significant over the control. Hence the use of combined application of vermicompost and vermiwash is recommended for improving crop productivity.

Keywords: Vermiculture, earthworm, vermicompost, vermiwash

1. Introduction
Vermicompost is an eco-friendly, non-toxic, consumes low energy input for composting and is a recycled biological product. Vermicomposting is a modified and specialized method of the process uses earthworms to eat and digest farm wastes and turn out a high quality compost. Vermicomposting is the bio-oxidative decomposition of organic matter by the mutual interaction between earthworms and microorganisms. vermicomposting through earth worms is an ecobiotechnological process that transforms energy rich and complex organic substances into a stabilized vermicomposts (Bentize *et al.*, 2000) [1].
Vermicomposting is the biological degradation and stabilization of organic waste by earthworm and microorganisms to form vermicompost (Edward and Neuhauser 1998) [2]. The best part is that the use of earthworms and vermicompost in farm production provides dual-benefit to crop. Vermicomposting is stabilization of organic material involving in the joint action of earthworms and microorganisms. During vermicomposting the nutrient are released and converted into soluble and available forms to plants.
Earthworms can affect soil microflora and fauna population directly and indirectly by three main mechanisms: (1) comminution, (2) grazing (3) dispersal. These activities change the substrate's physico-chemical and biological status and may cause drastic shift in the density, diversity, structure and activity of microbial communities within the drilosphere (Brown 1995) [3]. Therefore, earthworm communities may influence the spatial variability of resources altering their availability to microorganisms, thereby regulating nutrient cycling process (Marinissen and de Ruiter 1993 and Aira *et al.*, 2007) [4, 5].
The brownish – red liquid which collects in all vermiculture practices should be collected. This liquid partially comes from body of earthworm (as worms body contains plenty of water) and is rich in amino acids, vitamins, nutrients like nitrogen, potassium, magnesium, zinc, calcium, iron, and copper and some growth hormones like "auxins", "cytokinins" (Suthar, 2010). It also contains plenty of nitrogen fixing and *Phosphate solubilising bacteria* (*Nitrosomonas*, *Nitrobacter* and *Actinomycetes*). Spray of vermiwash effectively controlled all incidences of pests and diseases, significantly reduced the use of chemical pesticides and insecticides on vegetable crops and the products were significantly different from others with high market value.

Vermiwash has great growth promoting as well as pest killing properties (Buckerfield *et al*., 1999; Esakkiammal, 2015) [6, 7]. Vermiwash is the watery extract of vermicomposts extracted of earthworms. The treatment of vermiwash of vermicompost has been shown to reduced disease by necrotrophs as well as biotrophs and significantly decreases in soil borne pathogens and various pests. This spray containing nutrients can also compensate for the decline in nutrients uptake by roots with the onset of the reproductive stage a result increase in number of fruit. The uses of earthworm to management of animal, agrowastes are used for the production of vermiwash.

In India the first green revolution tremendously enhanced the agricultural production but on the other hand abundant use of synthetic fertilizers growth promoters pesticides and improved seed varieties, adversely affected ecosystems like; soil, water and food contamination and gene pool of wild seeds. The second green revolution started as organic farming (Sathe, 2004 and Sharma, 2003) [8, 9]. Keeping this view in mind a new vermiwash model, with five major modifications has been developed. The use of vermiwash on different types of crops and fruit trees shows good qualitative and quantitative effects for betterment of mankind and animals.

Earthworms live in moist soil, and if water logged conditions exist around, water enters into the coelomic fluid simply through body wall. This water when excludes out. Is rich source of organic and inorganic compounds. The integumentary, pharyngeal and septalnephridia are osmo-regulatory and excretory in functions (Ismail, 1997) [10] and remove out excess water along with organic and inorganic materials, symbiotic gut bacteria and fungi, called vermiwash, it is liquid bio-fertilizer obtained from the worms activities, i.e. coelomic fluid and vermicasting filtrate. Vermiwash is diluted with water (10%) before spraying. This has been found to be very effective on several plants. It need be vermiwash may be mixed with cow's urine and diluted (One Litre of cow's urine and 8 liters of water) and sprayed on plants to function as an effecting foliar spray and pesticide.

2. Materials and Methods

2.1 Collection of Animal Waste

Cow dung was collected from the cattle farms of nearby area.

2.2 Collection of Earthworms

The earthworms were collected from ICAR department of Sri Parasakthi College for Women, Courtallam. It is about only medium sized earthworms were collected without any damage.

2.3 Collection of other Materials

The stones coarse sand, loamy soil and water are collected from college campus.

2.4 Preparation of Vermicompost

Preliminary treated animal waste has to be pre decomposed in a pit size dug in soil in a length 2cm, breadth1-1.5m and height 0.9m-1m. First put one layer of cow dung maintaining 100% leave it for 20-30 days depending on the climatic conditions. When the material is partially decomposed. The material is decomposed the earthworm starts feeding from upper surface of the feed material. When the material becomes granular, blackish in colour. It indicates the materials to ready for harvesting scrapped this materials upto the depth where there is no vermicompost worms. Collect all scrapped material and make one heap and leave it for 2-3 days. Worms will go down to the bottom of the heap and it will easier to separate the worms manually.

2.5 Preparation of Vermiwash

Vermiwash is the organic fertilizer decoction obtained from vermicompost as drainage. Vermiwash is the liquid extract collected after the passage of water through the different layers of worm culture unit. A mud pot of 20 liters capacity, fitted with plastic tap at the lower side is used for producing vermiwash. Inside the barrel (bottom to top) three layers are arranged, first layer of brick pieces (7"), second layer of coarse sand (6") and third layer of fine sand (5").After third layer a mosquito nylon mesh is put. The total set up is fitted in an iron stand .After 60 days granular tea like vermicompost (vermicast) appear on the upper surface of beds. These final vermicompost with earthworms were used for extraction of vermiwash is extracted from above mentioned device by the method of GorakNath and KesavaSingh, 2011[11].The watery extract is vermiwash. The colour of vermiwash ranges from yellow and black. After 1 to 2 days the process of extraction has been completed. Vermiwash is generally diluted with water (10%) before spraying. This has been founded to be very effective on several plants. It need be vermiwash may be mined with cow's urine and diluted. One liter of cow's urine and eight liters of water. Sprayed on plants to function as an effective foliar spray and pesticide.

2.6 Treatment Structure

Number of treatment : 3
Number of replicates : 2
Substrate used: Leaf litter and Agriculture waste (Black gram waste)

C - Only Cow dung
T1 - Cow dung waste with *Eudrilus eugineae*
T2 - Agriculture waste with *Eudrilus eugineae*

2.7 Layout

Control plants grow without vermicompost and vermiwash. Treatment-1 plants grow with vermicompost and vermiwash prepared from cow dung waste with *Eudrilus eugineae*. Treatment-2 plants grow with vermicompost and vermiwash prepared from agriculture waste with *Eudrilus eugineae.*

Control - (C)
Treatment-1 - (T1)
Treatment-2 - (T2)

2.8 Collection of Experimental Data

Three plants in each treatment were randomly selected and tagged with a label for recording various growth yield parameters. The impact of treatment has been studied in terms of growth and yield parameters;

2.8.1. Germination (G%)

The number of seeds germinated in each treatment was counted on 7 DAS and the germination percentage (Anon, 1999) was calculated by using the following formula,

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

2.8.2. Plant height (cm)

The plant height was measured from base of the plant to the tip of the main shoot for five randomly tagged plants with the help of scale at every 10 DAS (days after sowing). The average of five plants was computed and expressed as the plant height in centimeters.

2.8.3. Shoot length (cm)
The earlier ten seedlings used for root length measurement were used for shoot length measurement also. The shoot length was measured from the collar region to the point of attachment of cotyledons to the tip of shoot. The average of ten seedlings was computed and expressed in centimeters.

2.8.4. Root length (cm)
Ten normal seedlings in each treatment were randomly selected from all the replications for measuring root length on 8th day of germination test. The root length was measured from collar region to the tip of root. Average root length of ten seedlings was computed and expressed in centimeters.

2.8.5. Number of leaves per plant
The numbers of green trifoliate leaves present on each plant were counted manually from the five tagged plants at 25 and 50 DAS. The mean number of leaves per plant was calculated and expressed in number per plant.

2.9 Statistical analysis
The result obtained in the present study was statistical analysis.SD, Student t' test.

3. Results
Plant Growth Parameters of Coriander

Table 1: Germination Percentage of *Coriandrum sativum*

S. No.	Treatments	Germination (%)
1	Control	81±0.24
2	Treatment-1	92±0.53
3	Treatment-2	94±0.75

Table 2: 10 days growth parameters of *Coriandrum sativum*

Treatments	Plant Height (cm)	Shoot Length (cm)	Root Length (cm)	No. of leaves
Control	11.33±0.88	2.8±0.45	4.3±0.67	1.06±0.12
Treatment-1	16.04±1.15	3.16±0.73	7±0.58	2.36±0.14
Treatment-2	18.23±0.11	3.36±0.14	8±0.57	2.76±0.11

Table 3: 20 days growth parameters of *Coriandrum sativum*

Treatments	Plant Height (cm)	Shoot Length (cm)	Root Length (cm)	No. of leaves
Control	20.33±1.20	4.5±1.04	10±1.15	4.23±0.21
Treatment-1	22.42±1.53	5.3±0.14	12.3±0.88	4.46±0.11
Treatment-2	25.06±1.23	6.2±0.17	13.3±0.57	5.02±0.17

Table 4: 30 days growth parameters of *Coriandrum sativum*

Treatments	Plant Height (cm)	Shoot Length (cm)	Root Length (cm)	No. of leaves
Control	29.3±1.20	8±1.53	14±1.0	4.04±0.32
Treatment-1	34.3±1.45	9.5±2.02	16.7±0.88	6.34±0.24
Treatment-2	36.7±1.53	11.05±0.0	20.3±1.15	7.13±0.53

Table 5: 40 days growth parameter's of *Coriandrum sativum*

Treatments	Plant Height (cm)	Shoot Length (cm)	Root Length (cm)	No. of leaves
Control	35±0.58	11±2.52	10±1.15	6.07±0.02
Treatment-1	37.96±1.22	12±2.52	26.3±1.86	7.37±0.34
Treatment-2	40.3±1.43	13±0.88	12.3±0.88	8.75±0.71

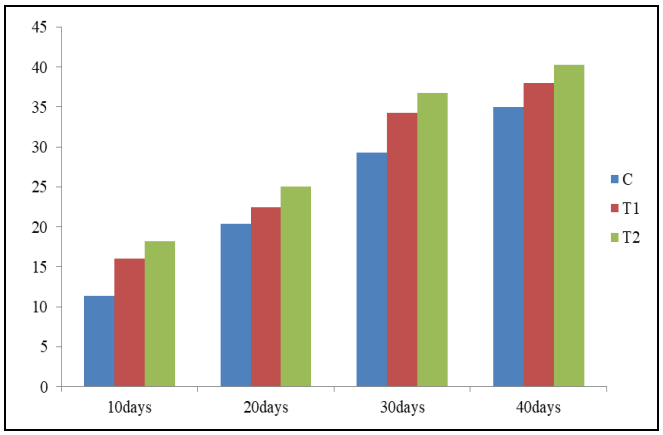

Fig 1: Plant Height of *Coriandrum sativum*

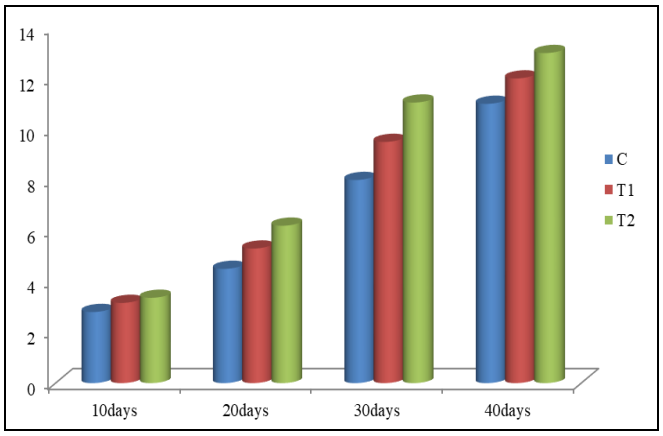

Fig 2: Shoot length of *Coriandrum sativum*

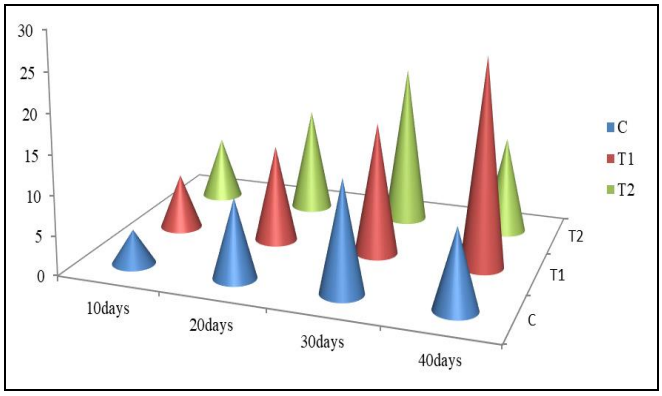

Fig 3: Root length of *Coriandrum sativum*

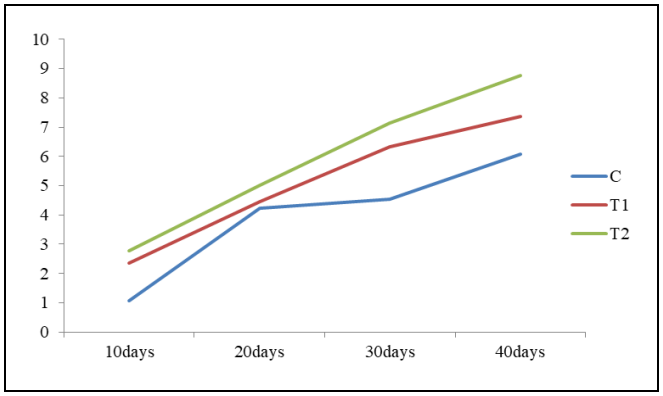

Fig 4: No. of leaves in *Coriandrum sativum*

4. Discussion

Combined Effect of Vermicompost and Vermiwash on the Plant Growth

Field experiment was conducted to know the changes in morphology of *Coriandrum sativum* with combined effect of vermicompost and vermiwash. The morphological parameters of *Coriandrum sativum* at various stages are shown in Table 3.1 -3 .5. The morphological parameters such as plant height, number of leaves, root length, shoot length of *Coriandrum sativum* were increased with the age of the plant. The experimental results on growth and yield attributes of *Coriandrum sativum* presented in Tables (3.1 - 3.5).

4.1 Plant Height (cm)

The combined effect of vermicompost and vermiwash on the plant height of *Coriandrum sativum* are presented in Fig 3.1. Significant variation was observed on the plant height of *Coriandrum sativum* when the field was incorporated with different treatment of compost. At 10 DAG, the plant height was significantly highest in the treatment given (T_2) 18.23cm followed by (T_1) 16.04cm. On the other hand, the lesser plant height 11.33cm was recorded on the control. (Table - 3.2).

4.2 Shoot Length (cm)

The shoot length of coriander at 10 DAG was significantly higher in T_2 treatments. On the other hand, the lesser shoot length per plant (2.8cm) was observed in the control treatment *i.e* Without fertilizer. Significant variation was observed on the shoot length of cucumber when the field was incorporated with different treatment of compost. At final days DAG, the plant shoot length was significantly highest in the T_2 over control (T_2) (3.36cm). (Table - 3.3).

4.3 Root Length (cm)

The data presented on root length of coriander presented in graphically illustrated in Fig 3.3. Significant variation was observed on the root length of coriander when the field was incorporated with different treatment of compost and vermiwash. At 30 DAG, the plant root length was significantly highest in the treatment (T_2) (20.3cm) followed by (T_1) 14cm. On the other hand, the lesser plant height 14cm was recorded on the control. (Table - 3.4).

4.4 Number of Leaves Per Plant

The number of leaves of coriander recorded from 10 to 40 DAG is presented in Fig 3.4. Significant variation was observed on the number of leaves in coriander when the field was incorporated with combined effect of vermicompost and vermiwash.

The concept of organic agriculture is receiving increased attention, and organic food markets are also expanding rapidly in many countries India. Hidlago *et al.,* 2006 [12] reported that incorporation of earthworm castings increased plant growth, leaf growth and root length. The plant height was significantly increased over control. Earthworm cast has been shown to increase plant height (Edwards, 1995) [13]. Nanjundappa *et al.,* 2000 [14], reported that the increased leaf length in Maize enriched with organic manure and vermicompost. Root initiation, elongation, enhanced plant and development are recorded by vermicasts treatment on plants in the study carried out by (Tomati *et al.,* 1995) [15]. The excellent plant growth in vermicompost was possible due to some plant growth promoters in worm casts. The vermicompost influence the development of the promote leaf length, root length and number of leaves, which suggest the linkage between biological effect of vermicompost and microbial metabolites that influence the plant growth and development (Tomati *et al.,* 1995) [15].

Vermicompost has an effect on vegetative growth, simulating shoot and root development *(*Edwards *et al.,* 2004) [16]. The effect includes alteration in seedling morphology such as increased leaf area and root branching *(*Lazcano *et al.,* 2010) [17]. Vermicompost has also been shown to stimulate plant flowering, increasing the number and biomass of the flowers produced *(*Arancon *et al.,* 2008) [18], as well as increasing fruit yield (Singh *et al.,* 2008) [19]. In addition to increasing plant growth and productivity, vermicompost may also increase the nutritional quality of some vegetable crops such as Chinese cabbage (Wang *et al.,* 2010) [20], strawberries (Singh *et al.,* 2008) [19], and sweet corn (Lazcano*et al.,* 2010) [17].

Vermicompost with high water-holding capacity and proper supply of macro and micro-nutrients has a positive effect on biomass production and subsequently the enhanced plant height. Improved growth, development and height of medicinal plants and other crops have previously been reported in the presence in the optimal amounts of vermicompost has significantly influenced the flowering and umbel number per plant. The results of the present work are in agreement with the reports of Ratti *et al.,* (2011) [21] in *Cymbogon martini*, Rashmi *et al.,* (2008) [22] on *Ocimum gratissimium* and Darzi *et al.,* 2012[23] on *Pimpin ellaanisum*.

Higher yields by the application of enriched manures have been reported by Zachariah (1995) in chilli. Arancon *et al.,* (2004) [24] reported positive effects of vermicompost on the growth and yield in strawberry, especially increase of leaf area, root length and fruit weight in field conditions. Mishara, 2005 [25] reported that vermicompost had beneficial effects on growth and yield of rice, especially caused significant increase of many growth parameters, seed germination and yield. Weerasinghe *et al.,* 2006 [26], has suggested the vermiwash is a natural growth supplements for tea, coconut and horticulture crops. Sobha *et al.,* 2003 [27] observed a significant growth and productivity in the black gram. Edwards *et al.,* 2004[16] have been suggested that vermiwash influence the fruit quality.

5. Conclusion

From the foregoing review, it can be concluded that plant growth substances present in the combined effect of vermicompost and vermiwash proves to be an effective fertilizer. The nutrient analysis of vermicompost and vermiwash showed significant increase in the level of macro and micro nutrients over control. The present study shows the growth and yield parameters such as number of leaves, shoot length (cm), root length (cm), luxurious growth and highest yield in Coriander are observed. Thus, vermicompost and vermiwash play a major role in organic farming and sustainable agriculture. Hence the use of combined application of vermicompost and vermiwash is recommended for improving crop productivity.

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