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Efficacy of biowaste and bioagent on the growth of coriander and rumex plants.

Eficacia de bioresiduos y bioagentes en el crecimiento de plantas de cilantro y rumex.

K. Sarojini Chakravarthy[1] and Y. Rahel Ratnakumari[2]

[1]Assistant Professor, Department of Botany, Government Degree College, Khairatabad, Hyderabad-500 004.

Author for correspondence, e-mail: sarojinicb17@gmail.com

[2]Department of Botany, Osmania University, Hyderabad.

Author for correspondence, e-mail: rahel1984@gmail.com

ABSTRACT

This investigation was carried out to examine the effect of biowaste (Used Tea powder) and bioagent *Trichoderma harzianum* (NFCCI 2241) both alone and in combinations on the emergence of seedlings, growth and biomass of Coriander (*Coriandrum sativum*) and Green sorrel (*Rumex acetosa*) plants in a pot experiment. The biowaste and bioagent treatments were compared with chemical fertilizer treatment and control. There is a significant variation in the results among the treatments. Germination percentage of Green sorrel was more in the treatments of T2, T3, T4 when compared with T1 treatment. In Coriander, similar trend was observed but the percentage of emergence of seedlings was very much less when compared with Green sorrel. The growth of root and shoot in length in *Rumex* plants was recorded more with T3 and T1 treatments in coriander plants, whereas root growth was maximum with T3 and T5. For shoot growth, it was maximum in T1, T2 and T3 treatments. Biomass recorded maximum with T3, T4 and T1 treatments in coriander and *Rumex* plants. *Trichoderma harzianum* in combination with used tea powder (biowaste) i.e., T3 treatment showed significant effect on the growth and productivity of coriander and *Rumex* plants.

Key words: Used Tea powder, *Trichoderma harzianum*, Chemical fertilizers, coriander, *Rumex*

INTRODUCTION

Seed spices are one of the most important groups of spice crops in India. The world demand for seed spices is about 150,000 tonnes, of which India contributes 70,125 tonnes annually meeting 47% of the global demand (Anwar et al. 2011). Coriander (*Coriandrum sativum* L) belongs to Lamiaceae family and is one of the first seed spices used by mankind. It is one of the major spice crops in India (Raghavan 2000). All parts of this herb are in use as flavoring agent and/or as traditional remedies for the treatment of different disorders in the folk medicine systems of different civilizations (Sahib et al. 2012). It has been reported to possess many pharmacological activities like antioxidant, anti-diabetic, anti-mutagenic, antilipidemic and anti-spasmodic (Eidi et al. 2012).Vegetables are the most important component of a balanced diet and we can now, grow varieties of different vegetables round the year. India is the world's second largest producer of vegetables next to China. Garden Sorrel (*Rumex acetosa* L.) is one of the leafy vegetable crop belongs to family Polygonaceae and it is used regularly in our daily diet especially in the state of Telangana. The medicinal action of Sorrel is refrigerant and diuretic, febrile disorders and in scurvy. Both root and seed are formerly esteemed for their astringent properties, and are employed to stem haemorrhage (Ambuse et al. 2012). The inorganic fertilizers mainly contain major nutrients NPK (Nitrogen, Phosphorus and Potassium) and these synthetic fertilizers in large quantities are harmful for soil and aerial environment as well as threat to entire globe. Excessive applications of chemical fertilizers reduce plant performance due to soil acidification, reduced soil biological activities, degradation of soil physical features, and lack of micronutrients (Adediran et al. 2004). At the same time the use of organic manures are being neglected due to several reasons even though they have substantial advantages over chemical fertilizers.

In order to save the environment, the microbial ecosystem in the soil and to improve plant health, organic agriculture is an alternative. In this context, bio-fertilizers are given an importance to have eco-friendly usage in agriculture. It has paved a way to control deterioration of soil health and in turn ill-effects on plants, human being and livestock (Choudhry 2005, Abbas et al. 2011).The reuse of wastes for agricultural purpose to improve soil properties and increase crop yield is a good solution for minimizing these problems. Recently, in agriculture, especially in organic agriculture, the use of organic fertilizers such as manure, compost, bioagents and biowaste of plant and animal origin has been important components of farming practices (Quintern et al. 2006).The organic waste of plant and animal origin provides a good source of nutrients to improve soil productivity (Tejada and Gonzalez 2006, Tejada et al. 2007, Padmavathiamma et al. 2008).

Among biofertilizers, the hostile activity of *Trichoderma* species showed that it is parasitic on many soil-borne and foliar plant pathogens. Recent studies showed that this common soil fungus not only acts as biocontrol agent but also stimulates plant resistance, plant growth and development resulting in an increase in crop production (Ghazanfar et al. 2018). The application of biocontrol agents and botanicals improved growth and yield characters of pathogen inoculated as well as in uninoculated Coriander plants (Khan and Parveen 2018). However, application of biocontrol agents in soil supplemented with botanicals was found more beneficial in improving the growth, yield and reducing the stem gall intensity than individual inoculations (Khan and Parveen 2018). Soil is the most important source and an abode for many nutrients and microflora. Due to rapid depletion soil quality by means of an excessive addition of chemical fertilizers, a rehabilitated attention is a need of the hour to maintain sustainable approaches in agricultural crop production. Biowaste and food waste increase pH, nitrogen content, cation exchange capacity, water holding capacity, and microbial biomass in soil. These organic wastes have a great positive impact on soil physical, chemical, and biological properties as well as stimulate plant growth and thus increase the yield of crops (Hossain et al. 2017).

Nowadays, with the increasing demand to conserve natural resources and energy, recycling of wastes assumes major importance (Padmavathiamma et al. 2008). Recently, in agriculture, especially in organic agriculture, the use of organic fertilizers such as manure and compost has been important components of farming practices (Quintern et al. 2006). In general, composting from household food waste and tree pruning residues was the most satisfactory due to the production of compost that significantly increased plant biomass, and can be considered an effective technique for recycling this organic waste (Ferreira et al. 2018). Hence, a project study was taken up with an aim to investigate the effect of biowaste (used tea powder) and bioagent (*Trichoderma harzianum*) alone and in combination on the seedlings emergence, growth and productivity of Coriander and *Rumex* plants in pot experiments in comparison with NPK treated and untreated controls.

The objectives of the present study are: 1) To evaluate the effect of biowaste, bioagent and chemical fertilizer on the emergence of seedlings of Coriander and *Rumex* plants. 2) To evaluate the effect of biowaste, bioagent and chemical fertilizer on the growth parameters such as root length and shoot length of Coriander and *Rumex* plants. 3) To evaluate the effect of biowaste, bioagent and chemical fertilizer on the biomass of Coriander and *Rumex* plants. 4) To evaluate the reuse of biowaste from plant origin (Used Tea powder) as a biofertilizer. 5) Comparative study of the effect of biowaste and bioagent alone and in combination with NPK treated and untreated controls.

MATERIALS AND METHODS

Pot Experiment: Pot experiment was conducted from the month of November – January, 2019 at Nizam College, Hyderabad. The experiment was laid out in a Randomized Completely Block Design (RCBD) comprising of four treatment combinations along with control and each replicated three times.

Experimental Plants:

1. Coriander (*Coriandrum sativum*) – P1
2. Green sorrel (*Rumex acetosa*) – P2

Treatments:

1. Biowaste (Used Tea powder) – T1
2. Bioagent (*Trichoderma harzianum*) – T2
3. Biowaste and bioagent – T3
4. Chemical fertilizer (NPK) – T4
5. Untreated control – T5 (without bioagent, biowaste and chemical fertilizer)

Each pot of 25cm radius was taken and filled with red loamy soil. In T1 treatment, 20g of used tea powder (biowaste) was added to each pot. In T2 treatment, 20g of *Trichoderma harzianum* (bioagent) inoculum of $1x10^{-7}$cfu/gm soil was added in each pot. In T3 treatment, to each pot biowaste and bioagent of 10g each was added. In T4 treatment, 5g of NPK was added to each pot and it was denoted as treated control. In T5 treatment nothing was added to the soil and it was denoted as untreated control.

Used tea powder was collected from homes and different tea stalls around our college campus and houses. Bioagent *Trichoderma harzianum* (NFCCI 2241) was provided by Dr. Rahel Ratna Kumari.Y, from Osmania University, Hyderabad. Each pot was sowed with 25 seeds of Coriander and *Rumex*.

Growth parameters such as root length (cm), shoot length (cm) and biomass (gm) were taken in triplicates for each treatment along with control at an interval of weekly and monthly intervals at different growth stages of plants. The average data of the each treatment was presented.

RESULTS AND DISCUSSIONS

After one week of sowing the seeds of Coriander and *Rumex*, the emergence of seedlings were observed and the germination percentage in different treatments was calculated. Compared to Green sorrel the germination was slow in Coriander (table 1 and

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table 2). There was insignificant variation among the treatments in the emergence of seedlings of Coriander. But in *Rumex*, a significant variation was observed. In biowaste treated pots (T1), used tea powder doesn't have a prominent effect on the seed germination. In comparison to T1 other treatments had shown a good effect on the germination of seeds (table 1). On par with treated control (T4) i.e., pots treated with NPK, the bioagent (*T. harzianum*) treatment alone (T2) and amended with biowaste (T3) showed good effect on seed germination (figure 1., figure 2).

Table 1: Effect of biowaste, bioagent on the emergence of seedlings after one week of sowing of Coriander and *Rumex* seeds in comparison with positive and negative controls

	Coriander					*Rumex*				
Treatments	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
No. of seeds sown	25	25	25	25	25	25	25	25	25	25
No. of seeds germinated	01	02	02	02	03	14	21	22	24	20
Germination %	4%	8%	8%	8%	12%	56%	84%	88%	96%	80%

Table 2: Effect of biowaste, bioagent on the emergence of seedlings after two weeks of sowing of Coriander and *Rumex* seeds in comparison with positive and negative controls

	Coriander					*Rumex*				
Treatments	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
No. of seeds sown	25	25	25	25	25	25	25	25	25	25
No. of seeds germinated	22	22	24	24	21	16	21	22	24	20
Germination %	88%	88%	96%	96%	84%	64%	84%	88%	96%	80%

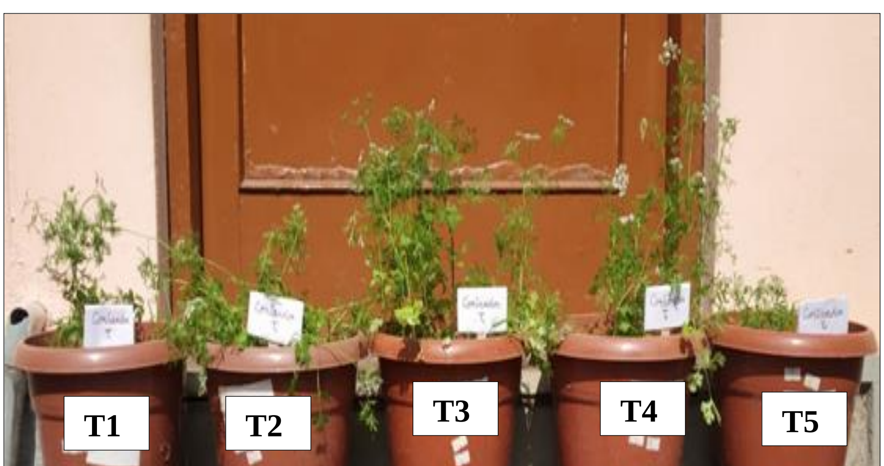
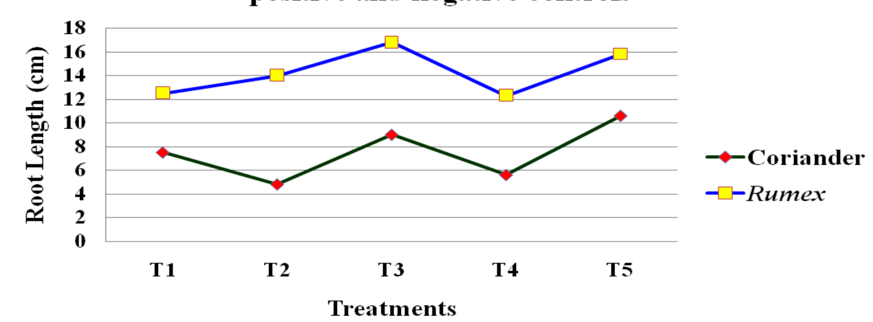


Fig. 1: Coriander plants at the time of harvest in

Fig. 2: *Rumex* plants at the time of harvest in different treatments

In *Rumex*, the germination is very low in T1 when compared to control (T5). When biowaste was combined with *Trichoderma*, the germination is as similar to control. Similar trend was noticed with coriander also. Initially the emergence of coriander seeds was slow but later they showed very fast germination with good plant growth. After two weeks of sowing there was a drastic difference in the percentage of germination in coriander seeds. In T3 and T4 treatments out of 25 seeds 24 showed emergence followed by other treatments (table 2). At the time of harvest a significant variation in the growth of root length and shoot length of Coriander plants was observed among the treatments. Maximum root growth (Length in cm) was observed in T3 and T1 treated pots when compared with positive and negative controls (figure 3., figure 6., figure 7).

Fig 3: Variation in the root length (cm) of Coriander and *Rumex* plants in treated pots in comparison with positive and negative controls



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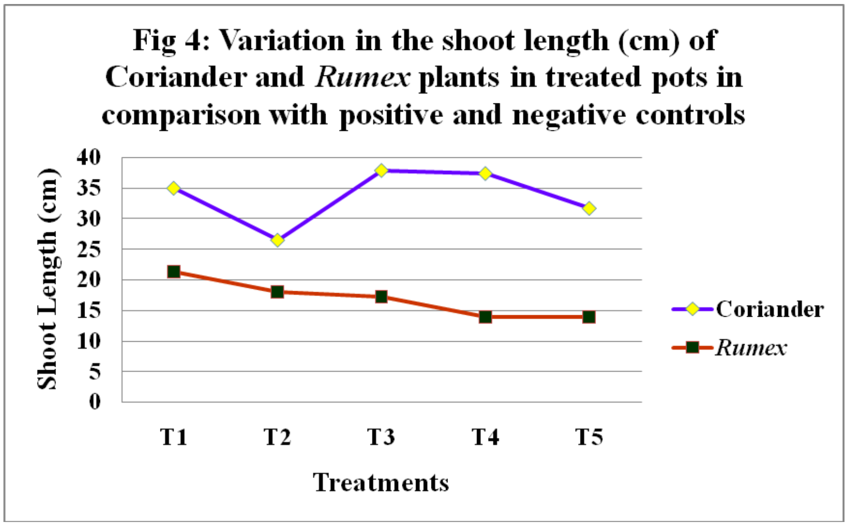

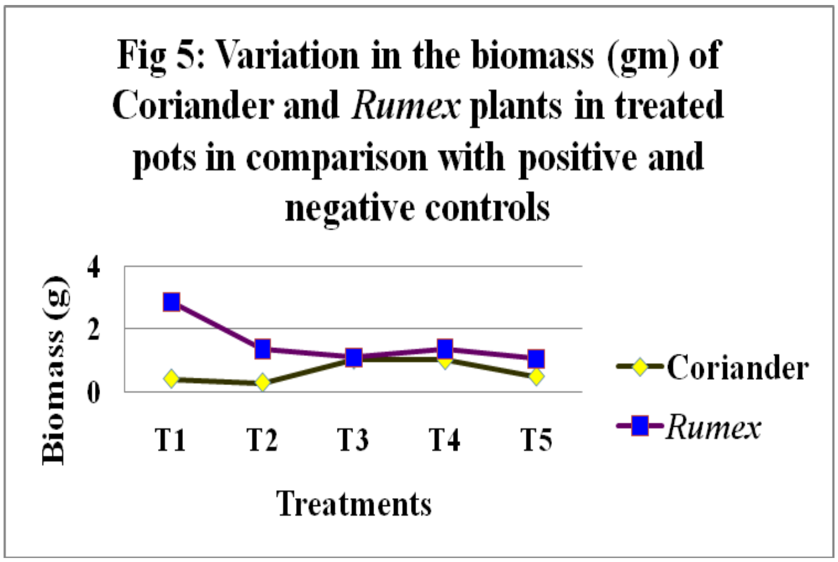

Maximum growth of shoot was observed with T3 followed by T4 and T1 treated coriander plants. *T. harzianum* (bioagent) in combination with biowaste i.e., (used tea powder) and biowaste alone i.e, T1 treatment showed a positive effect on the growth of coriander plants when compared to other treatments (figure 4., figure 6., figure 7). In *Rumex* plants too, a significant variation was observed among the treatments in the growth of root and shoot. Maximum growth of root was observed with T3 and T5 treatments, where T5 is a positive control i.e., without any treatment to the soil (figure 3., figure 6., figure 7). Regarding the shoot growth, it followed the same trend as coriander plants where T1, T2 and T3 showed maximum growth than positive and negative controls (figure 4., figure 6., figure 7).

When biomass (gm) was taken at the time of harvest, there is a significant variation among the treatments of coriander and *Rumex* plants (figure 5). Biomass of coriander plants was recorded maximum with T3 and T4 treatments and the least was with T2 treatment. The biomass of *Rumex* plants was maximum with T1 followed by T2 and T3 treatments.

Fig. 6: Variation in root length and shoot length of Coriander plants at the time of harvest in different treatments

Fig. 7: Variation in root length and shoot length of *Rumex* plants at the time of harvest in different treatments

Increased root and/or shoot biomass is the most common expression of growth promotion with *Trichoderma*. Various mechanisms of *Trichoderma* have been projected to explain plant growth promotion including enhanced nutrient uptake, increased carbohydrate metabolism and photosynthesis, and phytohormone synthesis. There is a strong evidence for the role of this microbe-producing indole acetic acid (IAA), although it is most likely that *Trichoderma* stimulates growth by influencing the balance of hormones such as IAA, gibberellic acid and ethylene (Stewart and Hill 2014). Plant growth also be enhanced by the solubilisation of mineral nutrients, for example *T. harzianum* strains were shown to increase the availability of plant nutrients by solubilising organic and inorganic phosphates, Fe_2O_3, CuO, metallic Zn, and MnO_2. Rhizospheric microbes play an important role in plant health. Rhizosphere is an area around the roots of plants where all microbes repose and influence the health of plants. These microbes require organic matter for their activity and provide nutrients to the plants and maintain the plant health. It was proved that *T. harzianum* alone and in combined form showed significant growth and development effect on seedlings of *Abroma augusta* (Prakash et al. 2019). In our study also T3 treatment showed a significant positive effect on the growth and productivity of coriander and *Rumex* plants. T3 treatment is a combination of *T. harzianum* along with used tea powder. Through this combination organic matter required for the activity of the fungus is supplied by the used tea powder (biowaste) and in return *T. harzianum* is providing the required nutrients for the plant growth promotion and maintenance of good health of the plant.

As conclusion, in addition to the direct benefits to plants by the introduction of organic waste materials (biowaste) together with the *Trichoderma* fungi (bioagent) to the soil, also have the long-term positive impact to the soil. The reason for the application of organic materials into the field improves soil structure and fertility and, on the other hand, helps in utilization of organic wastes from agriculture production. To conclude that the combination of used tea powder (biowaste) and *T. harzianum* (bioagent) constitutes a viable, environmental friendly strategy for improving coriander and *Rumex* plant growth and productivity.

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