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# Assessment of Different Concentrations of Organic Manure on the Growth and Yield of Solanum Lycopersicum L. (Tomato)

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**ABSTRACT:** Experiments were conducted to evaluate the influence of organic manure on the growth and yield of *S. lycopersicum* (tomato) plants. Three different particle sizes of organic manure were prepared from cynaopith and equal volume of Jiwamrita and incubated for 30 days. During incubation, the nutrient status and microbial population of organic manure were analyzed and different concentrations (10-50g) of minimum particle size (0.01-0.1mm) of organic manure were selected to scrutinize the growth promoting efficacy using *S. lycopersicum* as an experimental crop. Results revealed that the application of 20g of minimum particle size of organic manure significantly increased the morphological, biochemical and yield attributes of tomato plants than the other concentrations and control plants.

KEYWORDS: Coir pith, Cyanopith, Jiwamrita, Organic manure, Particle size, Tomato.

### I. INTRODUCTION

Organic manuring is becoming an important component of environmentally sound Sustainable agriculture. Residual nature of organic sources makes them more value based for the whole system compared to individual crops [1]. Organic materials hold great promise as a source of multiple nutrients and ability to improve soil characteristics [2]. Recently, the use of organic materials as fertilizers for crop production has received attention for sustainable crop productivity [3]. Coir pith is an agro industrial by product, which is considered as a waste and cause environmental pollution. In organic production system, organic wastes and other biological materials, as available *in situ* are utilized along with beneficial microbes to release the nutrients to crops [4].

Cyanobacteria are naturally occurring in most ecosystems and fix nitrogen gas from the atmosphere into forms which are useable by plants [5]. Many studies have been conducted for improving the productivity of crops using cyanobacterial inoculants as a biofertilizer [6]. The work conducted by [7] also shows the coir pith can be partially decomposed through the action of Cyanobacteria and can be used as biofertilizer for all varieties of food crops. Some enhanced techniques show the use of coir pith based Cyanobacterial biofertilizer in sustainable integrated agro ecosystems [8].

Tomato is one of the most popular and versatile vegetables in the world, because of its high nutritive value, taste, color and its diversified use. It is the world's largest vegetable crop after potato and sweet potato, and tops the list of canned vegetables. According to recent FAO (Food and Agricultural Organization) statistics, approximately 160 million tones tomatoes are produced annually on 4.7 million hectares of land [9]. Tomato and its products are rich in antioxidants and considered to be a good source of vitamins C, E and carotenoids, particularly lycopene and b-carotene and other phenolic compounds [10, 11]. Hence, the objective of this present study is to evaluate the physicochemical parameters of the organic manure and to assess the different concentration of minimum particle size of organic manure on the growth and yield of *S. lycopersicum* (tomato) plants.



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### II. MATERIALS AND METHODS

### **Preparation of organic manure**

The coir pith based cyanobacterial biofertilizer (cyanopith) [12] was sieved into three different particle sizes (a. 1-10mm; b. 0.1-1mm; c. 0.01-0.1mm) and mixed with equal volume of jiwamrita [13]. During incubation on 30 days, the physical and biochemical parameters such as pH (Potential metric method), EC [14], Phosphorus [15], Nitrogen and potassium [16], Calcium and Magnesium [17], lignin [18], cellulose [19], microbial flora (spread plate method) were analyzed.

### Seedlings of tomato

Tomato seeds were collected from Pudukkotai District, Tamilnadu, India. Seeds were sowed in two pots and were irrigated twice a day. After three weeks, the nursery was grown upto 20 cm and equal length of plants were selected for transplanting.

### Experimental design

Pot experiment was conducted at Model Organic Farm (MOF), Bharathidasan University, Tiruchirappalli, Tamilnadu, India. In this study, *Solanum lycopersicum* L. plant was treated with different concentrations of minimum particle size (0.01-0.1mm) of organic manure. There were 9 sets of pots in each treatment and without application of organic manure was considered as control. Single seedling of around 3 weeks old was planted per pot and was irrigated twice a day. Different concentrations (10-50g/pot) of minimum particle size of organic manure were applied two times before harvesting.

### Analysis of Morphological and Biochemical parameters

The morphological parameters such as shoot length, shoot width, No. of leaves, No. of Flowers, No. of Fruits, root length, root width, plant fresh and dry weight, root fresh and dry weight and yield were analyzed and the biochemical parameters such as moisture, acidity, calcium, magnesium, carbohydrate, reducing sugar, protein, amino acids, vitamins, carotenoids, lycopene contents were estimated by colorimetric method.

#### Statistical analysis

All data were subjected to one way analysis of variance (ANOVA) with SPSS version 16.0 by using Duncan's test at p<0.05 level of significance.

### **III. RESULTS AND DISCUSSION**

### Estimation of pH

The pH values in three different particle sizes of organic manure were increased during incubation on 30 days when compared to initial day estimation. However, Fig. 1a showed that there is no significant variation among all the particle sizes of organic manure on 30<sup>th</sup> day. The increased pH of vermicompost and pit compost was also reported by [20] and these evidences concordance with the present investigation. Supporting evidence showed that at the end of aerobic and anaerobic decomposition process, the pH was increased in poultry manure with sorghum straw composting [21] and [22] reported increased pH level in cattle dung vermicompost. The increased pH of vermicompost from different wastes has also been reported like sheep manure [23] and sewage sludge [24].

### **Estimation of EC**

In this present study, 0<sup>th</sup> day results showed very low EC in all particle sizes of organic manure and the elevated EC was observed during 30 days incubation (Fig.1b). Nevertheless, the maximum EC was noticed in the minimum particle sizes of organic manure Degradation of manure by the microbes present in jiwamrita released nutrients to the surrounding environment. This could be attributed to increased EC in different particle sizes of organic manure when compared to initial day. Furthermore, the minimum particle size among all the three the EC was significantly increased and it is indicated that it was equally proportional to the minimum particle size. This could be as a result of the minimum particle sizes favouring microbial degradation. The chicken manure has a high electrical conductivity, organic matter and available plant nutrients when compared to rice husk got very low electrical conductivity and was also low in organic matter and other nutrients [25]. Increased EC in cattle manure vermicompost was probably due to the degradation of organic matter releasing minerals such as exchangeable Ca, Mg, K and P in the form of cations in the vermicompost and compost [27, 28, 29].



0

**1**0

20

30

0.01-0.1

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Fig. 1(a & b). Estimation of pH and Electrical Conductivity in different particle sizes of organic manure

1--10

0.1 - 1

Different particle sizes of organic manure (mm)

0

0.01-0.1

### **Estimation of NPK**

9 8

7

6

4

3

2

1

1--10

0.1-1

Diffferent particle sizes of organic manure (mm)

Hd 5

The Nitrogen, Phosphorous and Potassium (Fig.1c-e) contents in three different particle sizes of organic manure were increased after 30 days of incubation. Among the three particle sizes, the minimum size (0.01-0.1mm) showed rich in NPK than the other two particle sizes. It could be due to the N2 fixing bacteria present in jiwamrita which easily degraded the minimum particle size when compared to other sizes. These results correlated with the following investigations. The nitrogen and phosphorus contents were increased in poultry droppings than the municipal waste and cow dung whereas the potassium level was increased in cow dung than the other organic manures [30]. Nitrogen, phosphorous and potassium contents were gradually increased from initial day to the final day in vermicompost and in control compost [31]. The poultry manure had increased NPK level than cocoa pod ash [32]. The composting of poultry manure blended with straw would enable to enhance the N, P and carbon status of the manure and thus improving its quality [21]. The organic fertilizers and soil enhancers were used for their organic matter contribution and nutrients, mainly total P [33] and nitrogen [34] found in soils are associated with organic matter.



Fig.1(c-e). Estimation of NPK in different particle sizes of organic manure



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### Estimation of calcium and magnesium

The calcium and magnesium contents from three different particle sizes of organic manure showed a significant effect during incubation on 30 days. Among these, the minimum particle size of organic manure showed elevated level of calcium and magnesium content (Fig. 1f & g) than the other two particle sizes. The calcium content were increased in poultry dropping incubated for 42 days than the other organic residues (*Chromoleana odorata, Pennisetum purpureum*, maize stoves, soybean straw and cow dung) whereas, the magnesium content was increased in *Pennisetum purpureum* than the other organic residues [35]. The calcium and magnesium were increased in T4 treatments (coir pith + *Pleurotus sajor caju* + cow urine) when compared to other treatments [36].



Fig.1(f & g). Estimation of calcium and magnesium in different particle sizes of organic manure

### Estimation of lignin and cellulose

Fig. (1h &i) indicated that changes in the lignin and cellulose content during 30 days incubation from three different particle sizes of organic manure. However, the lignin and cellulose contents were gradually decreased on 30<sup>th</sup> day from the initial level. Moreover, the minimum particle size of organic manure showed a significant variation among all other treatments. This could be due to the degradation ability of microbes present in the Jiwamrita that enhanced in the minimum sizes. Lignin and cellulose are chemically hardly destructible complex polymeric materials of organic origin, which have accumulated an enormous amount of photosynthetic energy [37]. The greatest lignin and cellulose degradation was measured after *Galactomyces geotrichum* 30 and 60 cultivation days [38]. There was significant reduction of lignin content in the biodegradation of coir pith by *Oscillatoria annae* was reported by [39].



Fig. 1(h & i). Estimation of lignin and cellulose in different particle sizes of organic manure



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### **Isolation of Bacteria and Fungi**

The bacterial and fungal populations were isolated from three different particle sizes of organic manure during incubation on 30 days. Table -1&2 shows that the number of bacterial and fungal population were increased in three particle sizes of organic manure after 30 days of incubation and these results revealed a remarkable diversity of bacteria in organic manure that enriched available nutrients and the moisture provided for the enrichment which also nourishes the fungal growth during incubation. The reason might be jiwamrita nourished with three different particle sizes of cyanopith (coir pith based cyanobacterial fertilizer) provided an important habitat for microorganisms. In composting process, the application of jiwamrita enriches the microbial population of organic manures and also speeds up the composting process.

	Different particle sizes of organic manure (mm)	Number of Bacterial colonies (CFU/g)				
S. no		Without Jiwamrita		With Jiwamrita		
		0 <sup>th</sup> day	30 <sup>th</sup> day	0 <sup>th</sup> day	30 <sup>th</sup> day	
1.	1-10	15	240	25	1840	
2.	0.1-1	30	1910	40	2000	
3	0.01-0.1	80	2010	95	2180	

Table -1. Bacterial population in three different particle sizes of organic manure

Table -2. Fungal populations based on colony morphology in three different particle sizes of organic manure

S. no	Different particle sizes of organic manure (mm)	Number of Fungal colonies (CFU/g)				
		Without Jiwamrita		With Jiwamrita		
		0 <sup>th</sup> day	30 <sup>th</sup> day	0 <sup>th</sup> day	30 <sup>th</sup> day	
1.	1-10	20	295	30	2000	
2.	0.1-1	35	855	55	3500	
3	0.01-0.1	60	1445	80	6000	

The population of bacteria in microbial enriched manures (compost, vermicompost and biogas slurry) significantly increased by 65 % as compared to the manure before enrichment. Among the manures, enriched biogas slurry had maximum fungal population [40]. [41] reported the highest bacterial and fungal population associated with the application of vermicompost as N (75%) with Azospirillum which had been five times higher than 100 % urea received plots. This might be attributed to the organic biofertilizer containing higher amount of growth promoting substances, vitamins, and enzymes, which in turn increased the microbial population and increased the root biomass production, resulted in higher production of root exudates increasing the beneficial bacteria, fungi and actinomycetes population in rhizosphere region [42, 24]. [43] reported that the application of organic manures like poultry manure, meat and bone meal not only increased the microbial biomass (both bacterial and fungal) in the soil but also inhibited the causative agent of southern blight (Sclerotium rolfsii) in tomato and also reported that it might be due to the addition of N containing amendments which had stimulated the population of antibiotic producing organisms associated with the sclerotia. Fungal communities of compost from a mixture of dairy manure and silage-based bedding were distinguished by a greater relative abundance of *Pezizomycetes* and *Microascales*. Hay recipes uniquely contained abundant Epicoccum, Thermomyces, Eurotium, Arthrobotrys, and Myriococcum [44]. [45] showed the fungal isolates which have the ability to degrade lignin, hemicelluloses simultaneously possess higher cellulolytic activity, where higher content of lignin will blocks the activity of cellulose.

#### Analysis of Morphological and yield parameters

In this pot experiment, application of different concentrations of minimum particle size (0.01-0.1mm) of organic manure showed significant effect on all morphological characteristics features when compared to control. Nevertheless, maximum increase in all parameters such as morphological (Fig. 2a &b), weight (Fig. 2c) and yield (Fig. 2d) in 20g/ pot of minimum particle size of organic manure when compared to other concentrations and control. Release of nutrients in optimized concentration due to easily degradation by microorganisms could be the reason for the better growth and yield of tomato plant when compared to control and other treatments. Application of other concentrations showed normal growth and yield when compared to optimized concentration (20g/pot). Those



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treatments take more time to degrade because of the concentrations when compared to optimized concentration and also, the 10g concentration may be insufficient for the growth and other parameters.

The minimum particle size (0.01-0.1mm) of organic manure has enriched nutrient status, as well as induces the plant growth and gives good yield of tomato (*Solanum lycopersicum*) plants as compared to that of other particle sizes and control [13]. [46] stated that application of 50 ppm Giberellic Acid 3 (GA3) by root soaking had significantly increased the number of flowers, fruits and fruit yield per plant but similar results were achieved when only 25 ppm GA3 was applied at the flowering stage. The fruit yield of tomato per plant increased linearly with the increased number of flowers and fruits per plant. [47] stated that vermicompost can effectively enhanced growth and yield of tomatoes by improving various physico-chemical properties of the soil. Stem growth was significantly higher in tomatoes grown on SVG beds (with charcoal and covered with veil) than traditional beds without charcoal and without covering [48]. Water hyacinth compost application rate (74.1 t·ha<sup>-1</sup>) had significantly higher mean plant height and yield than the control [49].



Fig. 2( a-d). Effect of minimum particle size of organic manure on morphological and yield parameters of S. lycopersicum L.

[50] on tomatoes found that, vegetative growth, such as plant height, number of leaves and branches per plant was significantly influenced by the application of biofertilizers alone or in combination with NPK. The fertilizers could enhance the morphological parameters such as height of the tomato plant, number of leaves, number of roots, shoot length and root length were analyzed at 45<sup>th</sup> day [51]. The application of organic fertilizer greatly enhanced growth, development and yield performance of rape in terms of plant height, leaf number, leaf area and fresh weight [52]. Compost and poultry manure significantly increased growth fresh and dry weight of shoot and root and yield of tomato compared to control [53]. The application of coir pith based cyanobacterial biofertilizers cyanopith (100g) and cyanospray (0.4%) increased significantly the morphological and yield characters of *Aloe barbadensis* Miller than the control [54]. The combined application of basal (25g) with foliar spray (0.4%) of cyanopith biofertilizer significantly increased the morphological, biochemical and yield of *Zea mays* when compared to control [55]. Results revealed that the significant improvement in both morphometric and yield parameters in the *Helianthus annuus* L. (sunflower) plants treated with coir pith based cyanobacterial biofertilizer treated plants [56].



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### Analysis of biochemical parameters

The moisture contents presented in Fig. 3a indicated non-significant differences among different concentrations of minimum particle size of organic manure applied plant fruits. However, 20g/ pot applied plants showed slight variation among all other treatments and control plant fruits. Concerning the acidity level in all treatments exhibited significant variations when compared to control. There is no much variation in 10, 20 and 40g/ pot of organic manure but 50g of organic manure was significantly decreased when compared to control (Fig. 3b). Nevertheless, the 20g of optimized concentration of organic manure applied plant fruits contained more acidity level than other treatments and control. [57] reported that there is no significant results regarding moisture content in tomato genotypes (93.8 to 94.1%) in ripe tomato. [59] stated that acetic acid treated tomato fruit recorded significantly higher moisture, mean titratable acidity and ascorbic acid (vitamin C) over all other treatments followed by CaCl<sub>2</sub> treated fruit and control treatments.



Fig.3(a & b)- Effect of minimum particle size of organic manure on moisture and acidity contents of S. lycopersicum L.

The biochemical parameters such as calcium, magnesium, carbohydrate, reducing sugar, protein, free amino acids, vitamins, carotenoids, lycopene contents were analyzed in tomato fruits to evaluate the effect of different concentrations (10-50g) of minimum particle size of organic manure. Results revealed that application of different concentrations of organic manure showed a significant effect on the biochemical contents when compared to control plant fruits (Fig. 3c & d). Furthermore, 20g of minimum particle size of organic manure applied plant fruits exhibited rich source of nutrient contents than the other treatments and control. This could be due to the presence of micro and macro nutrients in the optimized concentration of organic manure can be easily assimilated by the plants.



Fig.3(c &d). Effect of minimum particle size of organic manure on Biochemical parameters of S. lycopersicum L.



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Moreover, [60] found that total sugar content of fresh tomato fruit was varied from 2.19 to 3.55%. Concentrations of sugars and vitamin C contents were highest in tomato fruits treated with chicken manure and lowest in chemical fertigation [61]. Lycopene is the most abundant carotene in red tomato fruit, accounting for up to 90% of the total amount of carotenoids. Typical red pigmented tomato fruit also contains lesser amount of  $\beta$ -carotene and other carotenoids [62]. [63] reported that fruit quality was improved in terms of lycopene content (35.52%), antioxidant activity (24–63%) and defense enzymes activity (11–54%), in tomatoes in Effective microorganism compost as compared to the application of recommended dose of fertilizers. [64] also reported that compost as organic fertilizers influences the lycopene content and antioxidant properties in different cultivars of tomato.

#### **IV.**CONCLUSION

The present study deals about three different particle sizes of organic manure and it was incubated for 30 days. During incubation, the enhanced nutrient level was observed in organic manure due to the activity of microbes present in Jiwamrita. Then, different concentrations of organic manure were applied to the experimental crop (*S. lycopersicum*). The growth, biochemical and yield parameters were increased by the addition of 10-50g concentration of minimum particle size of organic manure as compared to control. Among these, 20g of minimum particle size of organic manure induced the plant growth, biochemical contents and gave better yield of tomato as compared to that of other concentrations and control. Hence, it can be concluded that organic manure as soil additives to improve plant nutrient, which in turn enhances all the physiological reactions that lead to a good growth of *S. lycopersicum*.

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