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ROLE OF EFFECTIVE MICROORGANISMS (EM) IN WASTE WATER TREATMENT AND THEIR EFFECT ON THE GROWTH PARAMETERS AND YIELD OF VIGNA MUNGO LINN. IN THE KLT SERIES OF THIRUVARUR DT, TAMILNADU, INDIA

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ABSTRACT

A study on the determination of the use of Effective Microorganisms (EM) was carried out. EM was purchased from the office of *'Ecopro'* Auroville, Auroshilpam, Tamilnadu, India. The waste water was from STET Women's College, Sundarakkottai, Mannargudi (Tk), Thiruvarur (Dt). The parameters that indicate the waste water treatment process such as odour, pH, DO, BOD, COD, TDS, TS, TSS, Nitrate and Phosphate were determined before and after the treatment of wastewater, to observe the efficiency of selected process. There was an appreciable reduction in the all the parameters. The parameters showed an elevated level in the raw sewage but after treatment there was a steady reduction after 5, 10, 15 and 20 days of incubation. No reduction was observed in the level of DO. All the parameters were reduced to tolerable environmental standard. The treated waste water was reused for the cultivation of the secondary crop,*Vigna mungo*. Soil samples were collected from the village Vangathangudi, Thiruvarur District, Tamilnadu, India which consists of Kalathur (Klt) soil series, one of the major soil series of Thiruvarur District. The experimental set up was designed as T1-EM alone, T2- treated waste water, T3-EM plus EM treated waste water and C-control.T3 showed the highest results in all the growth parameters and yield of the plant.

KEY WORDS: Effective Microorganisms, Kalathur, Waste water, Treatments,*Vigna mungo*

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INTRODUCTION

Soil is the outer covering of earth, which consists of loosely arranged layers of materials composed of inorganic constituents in different stages of organization. Different types of macro and micro nutrients of soil provide a natural environment for the survival of living things. The fertility of the soil depends not only on its chemical composition, but also the qualitative and the quantitative nature of the microbes. Soil contains many kinds of microorganisms such as bacteria, fungi, algae, protozoa and nematodes. Environment protection is getting more important for the agrarian because of the purpose of sustainable agriculture. The excessive use of agrochemicals has polluted the environment. Soil fertility is diminishing gradually due to soil erosions, loss of nutrients, accumulation of salts and other toxic elements, water logging and unbalanced nutrient compensation. Farmers have adopted the strategy of increasing crop yields by applying large amounts of chemical fertilizers and pesticides. Large quantities of chemical fertilizers are used to replenish soil N and P, resulting in high costs and severe environmental pollution. Environmental pollution is mainly caused by excessive soil erosion and the associated transport of sediment, chemical fertilizer and pesticides to surface and ground water and improper treatment of human and animal waste has caused serious environmental pollution and social problems throughout the world. Many farmers and agriculture scientist had a blind faith in chemical fertilizers and pesticides. Application of organic matter positively affects the growth and development of plants roots and shoots [1] Microorganisms are important attributes in agriculture to promote the circulation of plant nutrient and reduce the need for chemical fertilizers. One of the alternatives of nutrient supply is the integration of effective microorganisms inoculum and organic/inorganic materials.

Effective microorganisms (EM)

The technology of Effective Microorganism (EM) was developed during the 1970's at the University of Ryukyus, Okinawa, Japan[2]. Studies have suggested that EM may have a number of applications, including agriculture, livestock gardening and landscaping, composting, bioremediation, clearing septic tanks, algal control and household uses [3]. The practical application was developed by Professor Teuro Higa. He has found microbes that can coexist in mixed cultures and are physiologically compatible with one another. When these cultures are introduced, beneficial effects are greatly magnified in a synergistic fashion[4]. A microbial inoculant containing many kinds of naturally occurring beneficial microbes called 'Effective Microorganisms' has been used widely in nature and organic farming[5]. EM contains selected species of microorganisms such as lactic acid bacteria; *Lactobacillus casei,* Photosynthetic bacteria*, Rhodopseudomonas palustris,* Yeasts: *Saccharomyces cerevisiae, Candida utilis,* Actinomycetes: *Streptomyces albus.* All of these are mutually compatible with one another and coexist in liquid culture [6]. The application of EM will improve the quality of soil and irrigation water system. It can be used in seed treatment. It can be used to make organic sprays for the enhancement of photosynthesis and control of insects, pests and diseases. Moreover, EM can show better performance if they are mixed with suitable ingredients which may act as nutrients, adhesives or wettable agents [7]. EM has a sweet-sour taste and smell (pH below 3.5). It needs to be stored in an airtight plastic container. Gas needs to be released occasionally. For smaller quantities this can be done by opening the container. The best temperature for storage is between 15 and 20^{o}C with little fluctuation (less than 10^{o}C in 24 hours).

Waste water

In India, the abundance of soils with low organic matter content, favours the use of industrial waste waters containing organic matter as an organic amendment and nutrient supply to the soil. Although the benefits of wastewater use in irrigation are numerous, but precautions should be taken to avoid the short and long term environmental risks related. Earlier studies have shown that the effect of an industrial effluent varies from crop to crop. Waste water consists of approximately 99.9% water, 0.02 to 0.08% suspended solids and other soluble organic and inorganic substances. In general the waste water is weak in nature that is Biological Oxygen Demand (BOD) is normally not high. It was rich in nutrients like Nitrate (N) and Phosphate (P).

MATERIALS AND METHODS

Collection of waste water sample

The waste water was collected in a sterilized plastic container from STET Women's College, Sundarakkottai, Mannargudi (Tk), Thiruvarur (Dt). Immediately after collection, the waste water was brought to the laboratory for further analysis. The collected waste water sample was subjected to physico-chemical parameters analysis.

Analysis of Physico-chemical Parameters of Waste Water Samples

The laboratory experiment was conducted to evaluate the effect of EM on waste water treatment with three replicates and untreated control. The physico-chemical properties such as pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Total Solids (TS), Total Suspended Solids (TSS), Nitrate (N) and Phosphate (P) of the waste water samples were analysed before and after the addition of activated EM solution [9].

Collection of soil sample

Soil samples were collected from the village Vangathangudi, Thiruvarur District ,Tamilnadu, India which consists of Kalathur (Klt) soil series ,one of the major soil series of Thiruvarur District. Five spots were fixed in a plot for taking one composite mixture of the soil.

The surface of the field was scraped away to obtain a uniformly thick slice of soil from the plough depth from each place. A V-shaped cut was made with a spade to remove 1 to 2 cm slice of soil. The sample collected on the blade of the spade was put in a clean bucket. In the same way the samples were collected from all the spots selected for one sampling unit. Thus the samples were poured on the clean paper and mixed thoroughly. Then the samples were spread evenly and then divided into four equal parts. The two opposite quarters were rejected and the remaining samples were mixed. The same process was repeated until the reach of half kg of soil. The sample was collected in a clean bag and marked properly. The mouth of the bag was tied carefully. The same soil was also collected for pot culturing of the plants *Vigna mungo* for testing the efficiency of EM on the growth parameters and yield of the plants.

Analysis of soil samples

Physico-chemical parameters of the Klt series

Klt soil series samples thus collected were first air dried at room temperature, then crushed using a porcelain mortar and pestle and then sieved for further analysis[10].The physicochemical parameters such as the pH[11], temperature, EC, Moisture content, Organic carbon[12], available nitrogen[13], available phosphate[14], available potassium[15], available sulphur [16], calcium and magnesium[17] were tested before and after the pot cultivation of *Vigna mungo* using EM and waste water treated with EM.

Studies on the growth promoting efficiency of Effective microorganisms in pot culture experiment

A pot culture experiment was conducted using the Klt series soil of Thiruvarur district as the culture medium. Three treatments (T1, T2 and T3) and control (C) pots were maintained. Seeds of *Vigna mungo* were surface sterilized with 1% Sodium hypochlorite for 3 min followed by several washings with sterilized water.

The randomized experimental design was set up.
T1 - EM alone
T2 – Treated Waste water alone
T3 - EM+ EM treated Waste water
C – Control
Seeds were sown in the pots. Each treatment was replicated 3 times.

Effective Microorganisms (EM)

Effective microorganisms (EM) used in this study was purchased from the office of *'Ecopro'* Auroville, Auroshilpam, Tamilnadu, India as EM stock liquid culture containing a mixture of lactic acid bacteria, *Lactobacillus casei* (10^5), Photosynthetic bacteria, *Rhodopseudomonas palustris* (10^1) and Yeast, *Saccharomyces cerevisiae.* EM solution is a yellowish liquid with a pleasant odour and sweet sour taste with a pH of 3 and stored in cool place without refrigeration [18]

Extension (EMe) and Activation (EMa) of EM Stock Solution (19)

For most applications EM stock solution is to be "extended or activated" prior to use. One litre of the EM stock solution and 1kg of jaggery were mixed with 20 liters of water. The water has to be clean and free from chlorine. The container should be of good- grade plastics. For the period of activation, the container was placed in shade at ambient temperature (20- 40°C) without exposure to strong temperature fluctuations. Extended EM (abbreviated as EMe or EMa) will be ready after 5-10 days. It can be verified by a pH of 3.5 or lower and a pleasant sweet sour smell.

EM Application Schedule

After activation the EM solution was diluted 1:1000 by adding sterilized water. The respective EM treated plots received diluted EM solution (1:1000) at 2 L /m^2 at fortnight interval throughout the experimental period.

Analysis of plant growth parameters of cultivated plants

Plants were harvested after 35 and 60 days after sowing at flowering and maturity stages, respectively. At flowering stage, alternative plants were harvested from each pot so that more space would be available to the remaining growing plants. At each harvest, plants were uprooted along with the rhizospheric soil and the following parameters were studied. Height of the plant (in cm), Shoot length (in cm), Root Length (in cm), Number of leaves (per plant), Leaf fresh weight (in mg),Leaf dry weight(in mg), Number of nodules(per plant), carbohydrate, protein and chlorophyll contents were recorded at both the flowering and harvesting stage. Number of flowers was recorded in flowering stage only. Root fresh weight (in mg), Root dry weight (in mg), Number of pods (per plant), Length of the pods (in cm) and Yield (in gms) were recorded in maturation. All the data were analyzed statistically by applying Duncan's Multiple Range 't' test [20] to separate the treatment means using SPSS-14.0 .

RESULTS

Analysis of physico chemical properties before and after the treatment of waste water

The collected waste water sample was analysed for the physico-chemical properties such as pH, BOD, COD, TS, TDS, TSS, Nitrate and Phosphate contents were recorded (Table-1).

Analysis of physico chemical properties of klt soil series

Physico-chemical parameters of the klt soil series were analysed using the standard methods. The soil's physical parameters, primary, secondary and micro nutrients were analysed and the results were recorded (Table-2).

Effect of EM and treated waste water on the growth parameters and yield of Vigna mungo Linn.

Height of the plant

All the treatments were observed for the increase in the height of the plants. The treatments showed significant differences (p≤0.05) for the tested parameter at flowering and maturity stages. The pots inoculated with EM and treated waste water showed the increased height followed by EM alone, untreated waste water and control (Table-3 and 4). The total height comprises of both the shoot and root length of the plant.

Shoot length

Shoot growth occurred in all the treatments over the experimental period. There were significant differences in shoot length among the treatments (p≤0.05).The treatment containing effective microorganisms and treated waste water showed the highest shoot length at both the flowering and the maturity stages when compared to all other treatments and un inoculated control.(Table-3 and 4).

Root length

Length of the roots was increased highly at the maturity stage when compared to flowering stage in all the treatments. The root length of the plants was significant in the EM amended treatments and insignificant with T2 and control. The untreated waste water treatment showed significance with the control (Table-3 and 4).

Number of leaves

Application of EM enhanced the leaf production in the treatments. The treatments T1 and T3 not showed significant differences (P≤0.05) in the production of leaves.T2 and control showed significance in their results for the production of leaves at both the flowering and maturity stage. The increase in the leaf number increases the synthesis of chlorophyll content which reflects in the production of more number of seeds i.e., the yield is increased (Table 3 and 4).

Leaf Fresh Weight

Plants inoculated with EM and treated waste water recorded the highest leaf fresh weight followed by the EM, treated waste water and control at both the flowering and maturity stage. In flowering stage, T1 and T3 showed significance in their results and also T2 and C showed significant results i.e., the leaf fresh weight of EM amended treatments had slightly similar results and the un amended treatments also showed the same. T1 and T3 showed significance in their results of increasing the leaf fresh weight when compared to control at maturity stage (Table 3 and 4).

Root Fresh weight

Maximum root fresh weight was recorded in the treatments inoculated with EM. There were significant differences among the treatments for this parameter. At maturity, the treatments with EM showed significance and unamended treatment showed significance at (P≤0.05) i.e., T1 and T3, T2 and Control respectively (Table - 4).

Root dry weight

Maximum root dry weight was recorded in the treatments inoculated with EM. There were significant differences among the treatments for this parameter at maturity (P≤0.05) i.e., T1, T3, T2 and Control respectively. Root dry weight showed quarter the weight of root fresh weight (Table -4).

Number of flowers

The parameter, number of flowers was studied at the flowering stage. The maximum the number of flowers reflects the maximum the number of pods and the yield. Treatments, T1 and T3 showed significance in their results and also T2 and C showed significance which represents that the number of flowers in the EM amended soils showed significance and the treatment with un amended soils showed the results as such of control (P≤0.05) (Table 3).

Number of Nodules

Number of nodules was studied at both the flowering and maturity stage. The parameter showed the reduction in the number at maturity stage when compared to the flowering stage due to the decomposition of the nodules. The increase in the nodule numbers was observed in the EM amended treatments than the others. When the nodule number increases, it increases the fixation of nitrogen in the soil improving the plant growth and yield.T3 showed highest nodule number followed by T1, T2 and Control. The results were significant (P≤0.05) for the EM inoculated treatments than the others (Table 3 and 4).

Number of Pods (per plant)

The plant *Vigna mungo* showed an increased number of pods in pots treated with EM .T1 and T3 showed a significant (P≤0.05) result when compared to other treatment and control. In T3 the number of pods was significantly high showing the best result of the parameter, and then came the T1, T2 and Control (Table - 4).

Length of the Pods

Length of the pods was studied for analyzing the improvement of seed yield per plant. Increased pod length was observed in the treatment T3 followed by T1. T1 and T3 showed the significant (P≤0.05) results and the treatments, T2 and C showed the significant results (Table - 4).

Yield (in gms)

Yield of the plant results due to the increase in all the parameters studied above. There were significant differences (P≤0.05) in the yield of the plants. Treatment T3 showed the highest yield when compared to other treatments. Thus, the results revealed that yield of the plant were significantly increased due to the amendment of EM to the soil (Table- 4).

Carbohydrate Content

Increased carbohydrate content was observed in the treatments inoculated with EM .All the treatments showed significant differences (P≤0.05) in the carbohydrate content. Among the treatments, T3 showed significant increase in the carbohydrate content followed by T1, T2 and control respectively (Table-5).

Protein content

Protein content of the plants was increased in the EM amended soils when compared to unamended treatments. All the treatments showed significant differences (P≤0.05) in the protein content. Among the treatments, T3 showed significant increase in the protein content followed by T1, T2 and control respectively (Table-5).

Chlorophyll content

The chlorophyll content of the plants was increased in the treatments inoculated with EM. If the chlorophyll content was increased then the synthesis of carbohydrate and protein content were also increased which in turn increases the yield of the plants. The total chlorophyll was calculated by analyzing the chlorophyll- a and chlorophyll- b contents of the plants.T3 showed the highest chlorophyll content followed by T1,T2 and control (Table-5). Thus, EM along with EM treated waste water showed an increased level in all the parameters followed by EM alone. The treated waste water and the control showed similar results in most of the parameters studied.

Table –1

PHYSICO – CHEMICAL PARAMETERS OF EM TREATED WASTE WATER

S.No	Parameter	Untreated Waste Water	Treated Waste water			
			Incubation time (Days)			
			5	10	15	20
1.	PH	7.0	7.0	5.4	4.7	3.5
2.	Dissolved oxygen (mg/l)	10.4	10.4	14.7	18.5	20.0
3.	Biochemical oxygen Demand (mg/l)	28.4	28.4	18.4	15.0	11.5
4.	Chemical oxygen Demand (mg/l)	54.4	54.4	50.4	42.5	32.4
5.	Total solids (mg/l)	94	94	88.4	80.4	71.4
6.	Total dissolved solids (mg/l)	60	60	58	52	48
7.	Total suspended solids (mg/l)	34	34	30.4	28.4	23.4
8.	Nitrate (mg/l)	6.7	6.7	5.9	2.8	1.6
9.	Phosphate (mg/l)	3.2	3.2	2.7	2.2	1.0

Table –2

Analysis of physico-chemical parameters of klt soil

S.No	Physico-chemical parameters	Before cultivation	After cultivation
1	Soil colour	Dark grey	Dark grey
2	Soil texture	Clay	Clay
3	Soil pH	7.7	7.2
4	Electrical conductivity ($dsm^{-1)}$	0.09	0.07
5	Salinity	NS	NS
Primary Nutrients			
6	Organic Carbon(%)	0.64	0.70
7	Nitrogen(Kg/ac)	128.2	143.4
8	Phosphorus(Kg/ac)	5.25	7.53
9	Potassium(Kg/ac	95	98
Secondary Nutrients			
10	Calcium(ppm)	11.3	12.01
11	Magnesium (ppm)	10.1	11.2
12	Sulphur (mg/l)	34	36
Micronutrients			
13	Iron(%)	8.74	9.23
14	Zinc(%)	1.26	2.25
15	Manganese (%)	4.24	4.98
16	Copper (%)	2.87	2.95
17	Molybdenum (%)	4.21	4.56

Table-3

Analysis of growth parameters of Vigna mungo Linn. at flowering stage

S.No	Treatments	Growth parameters							
		Height (in cm)	Shoot length (in cm)	No. of leaves (per plant)	No. of flowers (per plant)	Root length (in cm)	Leaf fresh weight (mg/plant)	Leaf dry weight (mg/plant)	No. of nodules (per plant)
1	T1	31.20a	25.11a	25.00a	18.33a	6.00a	14.66a	9.67a	25.00a
2	T2	28.13b	23.11b	22.66b	16.33b	5.00b	13.33b	8.33b	22.33b
3	T3	31.23c	25.29c	26.00a	19.00a	6.10a	15.66a	9.87a	27.33a
4	C	26.00d	23.03d	22.33b	15.66b	5.19b	12.67b	7.32c	22.33b

Values having the same letters not show the significant difference in the values by Duncan's Multiple Range 't' Test. a ,b,c and d are used to denote the significant difference among the ttreatments.

Table-4

Analysis of growth parameters of Vigna mungo Linn.at maturity stage

S.No	Treatments	Growth parameters											
		Height (in cm)	Shoot length (in cm)	No. of leaves (per plant)	Root length (in cm)	Leaf fresh weight (mg/plant)	Leaf fresh weight (mg/plant)	No.of nodules (per plant)	Root fresh weight (mg/plant)	Root dry weight (mg/plant)	Pod length (in cm)	No.of pods (per plant)	Yield (in gms)
1	T1	33.37a	27.57a	30.00a	10.11a	4.17a	16.68a	17.67a	5.46a	1.37a	3.74a	25.66a	3.50a
2	T2	31.27b	25.67b	28.67b	09.14b	3.83b	15.34b	14.33b	4.40b	1.14b	3.22b	23.33b	3.11b
3	T3	34.20c	27.67a	32.00a	10.98c	4.42a	17.67a	18.00a	5.63a	1.41c	3.73a	26.66a	3.52c
4	C	31.00d	25.02b	27.67b	08.06d	3.67b	14.67c	14.30b	4.26b	1.10d	3.20c	22.33b	2.97d

Values having the same letters not show the significant difference in the values by Duncan's Multiple Range 't' Test. a ,b,c and d are used to denote the significant difference among the ttreatments.

Table-5

Analysis of Total Chlorophyll, Carbohydrate and Protein content of Vigna mungo at flowering and Maturity stage

S.No.	Treatments	Flowering stage					Maturity stage				
		Chlorophyll					Chlorophyll				
		Chl-a	Chl-b	Total Chl	Carbohydrate	Protein	Chl-a	Chl-b	Total chl	Carbohydrate	Protein
1	T1	0.190	0.172	0.362	18.79a	80.43a	0.150	0.132	0.282	14.78a	40.42a
2	T2	0.182	0.160	0.342	17.16b	76.44b	0.142	0.120	0.262	13.77b	36.44b
3	T3	0.194	0.180	0.374	18.98c	80.46c	0.154	0.140	0294	14.78c	40.46c
4	C	0.180	0.143	0.323	17.59d	74.34d	0.140	0.103	0.243	13.59d	34.32d

Values having the same letters not show the significant difference in the values by Duncan's Multiple Range 't' Test for carbohydrate And protein analysis. a ,b,c and d are used to denote the significant difference among the treatments.

DISCUSSION

EM treated domestic sewage showed distinct reduction in all the tested parameters under all the tested incubation period. Total dissolved solid was found to be reduced from 2160 mg/lit to 1012, 940 and 901 mg/lit. pH was also reduced from 9.0 to 8.4, 7.4 and 7.1 alkalinity was reduced from 59 mg/lit to 41, 37 and 21 mg/lit. The BOD was reduced from 2.8 to 2.1, 1.5 and 0.9. No reduction was observed in DO content. The COD was decreased from 164 to 141, 112 and 112 and 109 mg/lit at the respective incubation time [21].In the present study, the BOD in raw wastewater was 28.4 mg/l. After EM treatment, 5 to 20 days the level of BOD was decreased, from 28.0, 18.4, 15.0 and 11.5 mg/l (Table-2). Analysis of all the generated data of untreated and treated wastewater samples observed that pH, BOD, COD, TS, TDS, TSS, Nitrate and Phosphate contents of treated water were reduced to tolerable environmental standard and the DO level of the treated waste water was increased. The results obtained for all the parameters were better at the 20th day of incubation (Table-1). Based on result obtained from liquid treatment it will be interpreted as one of the easy method which can be applied locally to convert the waste into byproduct which can help to reduce the environmental pollution. The results from the study indicate that inoculation of *Vigna mungo* with effective microorganisms increased the height of the plant (in cm), Internodal length (in cm), Shoot length (in cm), Root Length (in cm), Number of leaves (per plant), Leaf fresh weight (in mg),Leaf dry weight(in mg), Number of flowers (per plant) Number of nodules (per plant), Root fresh weight (in mg), Root dry weight (in mg), Number of pods (per plant), Length of the pods(in cm) and Yield (in gms), carbohydrate, protein and chlorophyll contents. Increase in leaf number, leaf fresh and dry weight increase the photosynthetic activity of the plants. Increase in leaf area and number should result to higher rates of photosynthesis hence increased plant growth. For plants, a high rate of net carbon assimilation can result in higher biomass accumulation, favouring future growth and reproduction. The position and distribution of leaves along shoot influences the sink strength of the plants. During early stages of leaf growth, synthesis of chlorophyll, proteins and structural compounds is high resulting in high catabolic rates to support energy needs by the plants. Inoculation of effective microorganisms can increase the available nutrition for plant roots and improve photosynthesis [22]. Likewise in this study, the inoculation of effective microorganisms an increased the leaf number and leaf fresh and dry weight of the plant *Vigna mungo* thus increasing the photosynthetic activity. Increase in chlorophyll contents of pigweed may contribute to increased photosynthetic activity. The synthesis and degradation of the photosynthetic pigments are normally associated with the photosynthetic efficiency of the plants and their growth adaptability to different environments[23]. In this study, chlorophyll a and b contents of the plants were increased in all the treatments whereas the treatments inoculated with effective microorganisms showed relatively higher rate of chlorophyll synthesis. When the chlorophyll content increases it increases the synthesis of protein and carbohydrate contents thus increasing the growth parameters and yield of the plants. Increase in leaf chlorophyll content could in turn lead to increased protein synthesis of the plants and this could have a direct consequence on the plant growth and photosynthesis. Nitrogen is one of the essential nurtrients invoved as a constituent of biomolecules such as nucleic acids,coenzymes and proteins[24], any deviation in these constituents would inhibit the growth and yield of plants. Protein concentrations in plants tend to increase with fertility level of the growth medium [25]. In this study, there was the increase in the number of nodules at the flowering stage increasing the nitrogen fixation thus increasing the nitrogen content of the plants. If the constituents decrease it increases the plant growth, yield and nutrient status of the plants. In general, effective microorganisms produced a direct impact on growth and yield of *Vigna mungo .* Previous studies have demonstrated a consistent positive response with the use of effective microorganisms in crop production and indicate the potential of this technology to reduce fertilizer use and increase the yield and quality of crops[26].

CONCLUSIONS

The results of this study reveal that the inoculation of effective microorganisms for the cultivation of *Vigna mungo* improved all the growth parameters, carbohydrate, protein and chlorophyll content of the plant. EM already having many beneficial potentialities, it produced more effects along with waste water treated with EM. Although waste water having much more nutrients, it showed more effects on plant growth on combination with Effective microorganisms. Day by day, the application of chemical fertilizers to the soil will make it sterile in the future i.e., making it unfit or unfertile for cultivation of crops. Thus to prevent environmental pollution and to reduce the extensive use of chemical fertilizers, the effective microorganisms can be recommended to the farmers to ensure public health and a sustainable agriculture. Steps have to be taken to introduce organic farming to the agrarians to achieve the goal of protecting the fertility of their cultivable lands.

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CONFLICT OF INTEREST

Author declared no conflict of interest

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