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DIVERSITY OF BACILLUS SPECIES FROM THANJAVUR AND NAGAPATTINAM DISTRICTS, TAMINLNADU, INDIA

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ABSTRACT

Biodiversity refers to the variety of life forms on earth including all living species of animals plants and microorganisms. *Bacillus* species has proved available model for research some species are produce copious amount of enzymes. Others can form intracellular inclusions of polyhydroxy alkanoates under certain adverse environmental conditions and few species are important pathogens. The present study was planned to isolation and identification of *Bacillus* species from Thanjavur district and Nagapattinam districts, Tamil Nadu India. Duration from November – February Isolation of bacterial Population in an around soil samples and physicochemical parameters of such soils were recorded such as P^H, moisture, Macronutrients (Nitrogen, Phosphours, Magnesium, Calcium) and Micronutrients (Iron, Copper, Zinc, Manganese). Totally 15 different species of *Bacillus* from Thanjavur District and 10 species Nagapattinam taluks species of bacterial were recorded from the soil sample. Among that the identified *Bacillus* species are *Bacillus subtilis ,B.coagulans, B.licheniformis, B.megaterium, B.mucoides, B.cereus, B.circulans, B.amyloliquefaciens, B.sphericus, B.clausii, B.odysseyi, B.halophilus, B.polymyxa, B.amylolyticus, B.thermophilus.* Hence it could be concluded that included that there is no uniformity in the diversity of population during the monthly interval their distribution pattern in different geographical regions.

KEYWORDS: Soil Biodiversity, *Bacillus species.*

INTRODUCTION

Soil is a unity of subsistence that includes the varieties of microbes, because microbes community is one of the important components of soil, therefore, the microbial activity and species compositions are generally influenced by the physical characteristic and soil chemical properties, climate and vegetation (Jha et al. 1992).Soil microbes are one of biota communities, which are interesting to be studied in order to find out their existence and uses. So, soil microbes have an important role to the subsistence on earth, because it has the role on biological and chemical cycling among the flora, fauna, and life of microbes itself. Nevertheless, not every soil microbe is suitable and compatible with the habitat and its host, and it is well known that they can perform symbiotic and com-mensalisms. Each type of microbes fills as a unique niche and plays a different role in nutrients cycling and soil structure. Microorganisms living in the soil can be grouped into bacteria, fungi, *actinomycetes,* algae, and protozoa (Rao,1994).Some groups of soil microbes are useful as biofer-tilizer and biocontrol. They were *Klebsiella, Nitrosomonas, Thiobacillus, Lactobacillus, Azotobacter, Azospirillum, Bacillus, Pseudomonas* and *Frankia* one of *actinomycetes* group). The group is *Streptomyces*. It is potential as a source of various bioactive compounds used in pharmaceutical industry, agriculture and for other purpose. These Streptomyces were found to have high biodiversity and can be used as source of germplasm.The work was also done to find candidate of bio-pesticide from *Streptomyces* that can be applied together with *Rhizobium* and phosphate solubilizing bacteria as bio-fertilizer(Lestari et al., 2002).Thus the soil microbes perform a wide range of function in the ecosystem.The aim of the research is to know the biodiversity of *Bacillus* species from rhizosphere soils of Thanjavur and Nagapattinam District, Tamil Nadu. India.

MATERIALS AND METHODS

Soil Samples Collection

The Soil samples were collected from in Thanjavur have been 8 taluks namely Kumbakonam, Orathanadu, Papanasam, Pattukkottai, Peravurani, Thanjavur, Thiruvarur, Thiruvaiyaru, Thiruvidaimarudur. District Tamilnadu India during (November-February) Followed by Nagapattinam District have been 5 taluks namely

Sirkali, Kivelur, Tharangambadi, Vedarnyam, Thirukkuvalai. Orthanadu taluk is located at 10.97^{o} N 79.42^{o}E. It lies in 96km (60m) east if Thruchirapalli and about 40 km (25m) northeast of Thanjavur. It lies in the region 'old delda' comparries the north western Taluk of Thanjavur district. In the present case, each sample were collected from Pattukkottai Taluk is located at 10.4218 79.3196. The soil samples were collected from Kumbakonam Taluk is 10.3^{o} N 79.3^{o} E. The Soil samples were collected from Papanasam located at 10.88228 79.9252 79.2708. The soil sample were collected Thirvaiyaru Taluk located at 10.9972 79.4524.

The Nagapatinam district at Vedaraniyam Taluk located at 10.3753 79.8503. The soil sample were collected from Tharangambadi Taluk located at 11.029 79.8507. The soil samples were collected from Kilvelur Taluk located at 10.6321 79.7218. The soil samples were collected from Sirkali located at 11.2428165 79.7282161. Collect the soil sample before remove the surface litter at the sampling spot. Collect at least 4 to 6 samples from each sampling unit and place. If make a 'v' shaped cut to a depth of 15cm in the sampling spot using spade. Mix the simple thoroughly and remove foreign material like roots stones and gravels Sandy loam to Sandy clay soil The method used for taking soil sample clean sterile polythene bags. All four random samples of each zone were put together to make single sample from each place. A total of three samples were prepared to investigate the diversity of the diversity of the bacteria.

Isolation of Bacteria from Soil

Soil samples were taken from each container and subjected to serial dilution followed by pour plate method (Aneja 2001).

Physico chemical properties (Griffin, 1970)

The pH, moisture, organic carbon Macronutrients (Nitrogen, phosphorus, Manganesium, Calcium) and micronutrients (Iron, Zinc, Manganese) were analysed and compared with seasonal variations of per standard method. (Table 4).

Estimation of Trace Elements (Piper, 1944)

Copper, Iron, Manganese and Zinc heavy were analyzed by using Atomic Adsorption Spectrophotometer.

RESULTS AND DISCUSSIONS

The present study was aimed to investigated for the bacterial *(Bacillus*) diversity from Thanjavur district and Nagapattinam district, Tamilnadu India. In Thanjavur district taluks are 8Kumbakonam, Orathanadu, Papanasam, Pattukkottai, Peravurani, Thanjavur and Thiruvidaimarudhur, Thiruvaiyaru. The soil samples were collected from the month of November –February 2017(Plate – I). Nearly 15 *Bacillus* species were recorded in Thanjavur district.15 species are namely *Bacillus subtilis, B.Cogualans, B.lichniformis, B. megarterium, B.mucoids, B.circulants, B.amylolique faciens, B.sphericus, B.mycodes, B.clausii, B.odysseyi, B.halodurens, B.firmus, B.halophilius, B.cereus.* In Nagapattinam taluks are sirkali, kivelur, vedharanyam, Tarangambadi, Thirukkuvalai. Nearly 10species were recorded in Nagapatttinum districts. The species are, *B.halodurens, B.firmus, B.halophilus, B.cereus, B. megaterium, B. Polymyxa, B.amylolyticus, B.thermophilus, B.mucoids, B.odysseyi.* The species are recorded in November to February.

Physico- Chemical Parameters

The p^{H} moisture, organic carbons, macronutrients, (Nitrogen, phosphorus, magnesium, calcium) and micronutrients (Iron, Zinc, Manganese) were analysed and compared with seasonal variation of Thanjavur and Nagapattinam districts.

P^{H}

The P^{H} values of the soil samples were recorded in the month of Novmber- Febraury species in Thanjavur district In Kumbakonam Taluk P^{H} were noticed as 7.20, 7.24,7.26,7.29,. Similar to Papanasam Taluk 7.35,7.56,7.13, and 7.29 respectively followed by Orarthanadu Taluk P^{H} were recorded 7.24,7.06,7.25, and 7.31 Peravurani Taluk P^{H} were noticed as 7.18,7.20,7.22, and 7.26 and Thanjavur Taluk recorded p^{H} were 7.00,7.02,7.25, and 7.35. Pattukkottai P^{H} were 7.35,7.56,7.13, and 7.29. Next Thiruvaiyaru P^{H} were 7.08, 7.02,7.22, Thiruvidaimarudhar as 7.21,7.08,7.14, and 7.16. In Nagapattinsm district Taluks P^{H} was recorded in Sirkali Taluk hs been 8.05,8.09,8.10,8.15. Vedaranyam Taluk P^{H} as 8.05,8.06,8.11,8.13. Tharangampadti Taluk P^{H} as 8.04,8.07,8.08,8.01. Kilvelur Taluk P^{H} were recorded as 8.02,8.04,8.07,8.09 and Thirukkvalai Taluk P^{H} was recorded as 8.03,8.05,8.11(Table 2,3,4 Figure –1).

Moisture

The moisture content were also recorded at Thanjavur and Nagapattinam District. Thanjavur District moisture content were 20 to 40%,20 to 30%,20 to 25%, 20 to 27%, 20 to 28%, 25 to 30%. Nagapattinam district moisture contents were 40 to 50%, 40to 55%, 40 to 60%, 40 to65%, 40 to 70%. (Table 2,3,4 Figure –5).

Organic carbon

The values of organic carbon were recorded in Thanjavur district and Nagapattinam district. In Thanjavur district taluks Kumbakonam(0.83%), Papnasam (0.87%), Orathanadu (0.89%), Pattukkottai(0.89%), Peravurani (0.96%), Thiruvaiyaru (0.99%), Thiruvidai marudur (100%). In Nagapattinam district Taluks are Sirkali (0.92%), Kivelur (0.96%) Vedarnayam (0.87%), Tharangambadi (0.85%), Thirukkuvalai(0.83%).(Table 2,3,4).

Estimation of macro nutrients

The availability of Nitrogen, phosphorus, Magnesium and Calcium were also analyzed from Thanjavur district and Nagapattinum district. In Thanjavur district availability of Nitrogen (kg/ac), from each Taluks were

95.6,93.4,88.3,74.5,95.2,66.7,58.6,77.4. Followed by Nagapattinam District the average nitrogen (kg/ac), from each Taluks 88.6,83.4, 74.5, 76.4, 69.3.

Moreover in Thanjavur District availability of phosphorus (kg/ac), from each Taluks were 4.12,3.27,3.18,4.09,4.11,4.08,4.01,4.07, followed by Nagapattinam district the average phosphorous (kg/ac) from each Taluks were 3.15,3.12,3.10,3.14,3.02.

Availability of Magnesium (Kg/ac) from each Taluks of Thanjavur were 9.5,9.3,8.7,9.15,8.01,9.76,9.01. Followed by Nagapattinam district the average Magnesium (kg/ac) from each Taluks were 8.5,8.0,7.9,7.5,6.5.

Similarly availability of calcium (kg/ac) from each Taluks were 8.5,7.3,7.9,6.5,6.2,8.9,7.6,7.5. Followed by Nagapattinam district Taluks were 7.6, 7.8, 7.5, 7.9, 7.4 (Table 4, 5, 6 Figure –4-10).

Estimation of micro nutrients

In Thanjavur district estimated micro nutrient such as copper (ppm) 1.9,1.11, 1.4,1.8, 1.6,1.9,1.7,1.6, Iron (ppm) 0.77, 0.79,0.80,0.81, 0.51,0.81,0.83,0.85. Manganese (ppm) 0.84, 0.86,0.82,0.83,0.86,0.89,0.85, 0.84. Zinc (ppm) 4.7,4.9,4.6,4.7,4.9, 4.5,4.3,4.7.

Similarly Nagapattinam district Taluks were estimated for micronutrient such as copper(ppm) 1.5,1.4,1.3,1.2,1.2, Iron (ppm) 0.84,0.88,0.83,0.84,0.87, Manganese (ppm) 0.83,0.82,0.85,0.87,0.89. zinc (ppm) 4.5,4.3,4.2,4.6.

Isolation and Identification of Bacillus Diversity

In this study soil samples were collected from Thanjavur and Nagapattinam district November - Febuary 2017. These sample were used for the isolation of bacterial species using serial dilution plating methods Serially diluted samples was poured into Nutrient agar medium showed the number of bacterial species. Bacterial colonies were identified by using manual of Determinative Bacteriology. In Thanjavur district has identified *Bacillus* species were *Bacillus Sub tills, B.coagulants, B.licheiformis, B.megaterium, B.Cereus, B. Circulants, B. amyloliquefaciens, B. sphericus, B.mycoides, B.clausii, B.halodurens, B.firmus, B.halophilus.*

Similar to Nagapattinam district *Bacillus* were isolates namely *B.halodurens, B.firmus, B,halphilous, B.cereus, B.megaterium, B.polymyxa, B.amylolyticus, B.thermophilus, B.mucoids, B.odyssei.*

Morphological characteristics of isolated organisms

Bacillus subtilis, gram positive, rod shaped, motile, indole negative, MR positive, VP positive, citrate negative, urease negative, triple sugar iron positive, catalase positive.

B.cereus gram positive motile, rod shaped, indole negative, MR negative, VP positive, citrate negative, Urease negative, triple sugar iron positive, catalase positive.

B.lichneformis gram positive, motile, rod shaped, indole negative, MR positive, VP Positive citrate positive, urease positive.

B.circulans gram positive, motile, rod shaped, indole negative, MR positive, VP positive, cirate positive, urease negative, triple sugar iron positive, catalae positive.

B.polymyxa, gram positive, motile, rod shaped, indole negative, MR positive, VP positive, citrate negative, urease positive, Triple sugar iron positive.

B.clausii, gram positive, motile, rod shaped, indole negative, triple sugar iron positive catalase positive.

B.mycoides, gram positive, rod shaped, motile, indole negative, MR positive, VP positive, citrate positive, urease positive, triple sugar iron positive.

B.megaterium gram positive, rod shaped , motile, indole negative, MR positive, VP positive, citrate positive, urease negative, triple sugar iron positive, catalase positive.

B. amyloliquefaciens gram positive, motile, rod shaped, in dole negative, VP MR positive, citrate positive, triple sugar iron positive positive urease positive catalase positive.

B.sphericus, gram positive motile, rod shaped, indole negative, MR positive, VP positive, citrate positive, triple sugar iron positive, catalase positive.

B. odyssi, gram positive, motile, rod shaped, indoile negative, MR positive,VP positive, urease positive, triple sugar iron positive, catalase positive.

B. halophilus, gram positive, motile rod shaped, in dole negative, MR positive, VP positive, the urease positive, citrate positive, triple sugar iron positive, catalase, positive.

B.thuringiensis, gram positive, motile, rod shaped, in dole negative, MR positive, VP positive, urease positive, citrate positive, triple sugar iron positive, catalase positive.

B. firmus, gram positive, motile, rod shaped, in dole negative, MR positive, vp positive, urease positive, catalase positive, citrate positive, triple sugar iron positive, catalase positive (Table-1).

Over all distribution of *Bacillus* was high in Thanjavur district than Nagapattinam district. This is due to P^H

moistures, Temperature, Micro nutrients, Macro nutrients, Organic carbon, salt tolerant nature also play an important role in the contributions of Bacillus Species in these districts.

Similar to Christensen *et. al.,* 2010. In the seasonal variation mostly *staphylococcus* sp., *Pseudomonas striata, Streptococcus* sp are present in low number in summer season. In our study *Bacillus* species are reduced from in the month November and January in Nagapattinam districts.

Our study was correlated to Uma Maheswari *et.al.,* 2013. From totally 36 different species were isolated from seven Taluks to Thirivarur (Dt). Diversity are dependent on the nature of substrate and temporal regions that from colonization. Here our study totally 15 different bacterial species were isolated and identified form Thanjavur and Nagapattinam Districts.

Table1: Morphological characteristics of *Bacillus* species.

Organisms	Gram strain	Cultural characteristics	Motility	Indole	MR	VP	Citrate Utilization	Catalase	Urease	TSI
Bacillus subtilis	+	Rod	Motile	-	+	+	-	+	-	+
B.cereus	+	Rod	Motile	-	+	+	-	+	-	+
B.licheniformis	+	Rod	Motile	-	+	+	+	-	+	-
B.circulans	+	Rod	Motile	-	+	+	+	+	-	+
B.polymyxa	+	Rod	Motile	-	+	+	-	+	+	+
B.clausii	+	Rod	Motile	-	+	+	-	+	-	+
B.mycoides	+	Rod	Motile	-	+	+	+	-	+	+
B.megaterium	+	Rod	Motile	-	+	+	+	+	-	+
B.amyloliquefaciens	+	Rod	Motile	-	+	+	+	+	+	+
B.odyssi	+	Rod	Motile	-	+	+	+	+	+	+
B.halophilus	+	Rod	Motile	-	+	+	+	+	+	+
B.thuringiensis	+	Rod	Motile	-	+	+	+	+	+	+
B.firmus	+	Rod	Motile	-	+	+	+	+	+	+
B.utilis	+	Rod	Motile	-	+	+	+	-	-	+
B.coagulans	+	Rod	Motile	-	+	+	+	+	-	-
B.amylolyticus	+	Rod	Motile	-	+	+	-	+	+	-

Table 2: Total number of *Bacillus* species isolated from Thanjavur (Dt) and Nagapattinam (Dt).

District	November	December	January	February	Total
Thanjavur	2	7	2	4	15
Nagapattinam	2	3	2	3	10

Table 3: Physico - chemical parameters of the soil Thanjavur (DT).

Name of the parameters	November							
	S1	S2	S3	S4	S5	S6	S7	S8
pH	7.20	7.24	7.26	7.29	7.35	7.56	7.13	7.29
Moisture (%)	20-40	20-30	20-25	20-27	20-28	25-30	30-35	35-40
Carbon (%)	0.83	0.87	0.89	0.86	0.96	0.99	100	0.88
Nitrogen (kg/ac)	95.6	93.4	88.3	74.5	95.2	66.7	58.6	77.4
Phosphorus(kg/ac)	4.12	3.27	3.18	4.09	4.11	4.08	4.01	4.07
Magnesium (ppm)	9.5	9.3	8.7	9.15	8.01	9.76	9.1	9.8
Calcium (ppm)	8.5	7.3	7.9	6.5	6.2	8.9	7.6	7.5
Copper (ppm)	1.9	1.11	1.4	1.8	1.6	1.9	1.7	1.6
Iron (ppm)	0.77	0.79	0.80	0.81	0.51	0.81	0.83	0.85
Zinc (ppm)	4.7	4.9	4.6	4.7	4.9	4.5	4.3	4.7
Manganese (ppm)	0.84	0.86	0.82	0.83	0.86	0.89	0.85	0.84

Table 4: Physico - chemical parameters of the soil Thanjavur (DT).

Name of the parameters	December							
	S1	S2	S3	S4	S5	S6	S7	S8
pH	7.21	7.23	7.25	7.28	7.34	7.55	7.12	7.27
Moisture (%)	20-25	25-30	30-35	35-38	38-40	45-50	50-55	55-60
Carbon (%)	0.82	0.86	0.88	0.89	0.95	0.98	0.99	0.87
Nitrogen (kg/ac)	95.5	93.2	88.4	74.3	95.2	66.8	58.7	77.3
Phosphorus(kg/ac)	4.13	3.26	3.17	4.08	4.10	4.07	4.03	4.06
Magnesium (ppm)	9.4	9.2	8.6	9.14	8.02	9.75	9.2	9.7
Calcium (ppm)	8.4	7.2	7.8	6.4	6.1	8.8	7.5	7.4
Copper (ppm)	1.8	1.10	1.3	1.7	1.5	1.8	1.6	1.5
Iron (ppm)	0.76	0.78	0.77	0.80	0.50	0.82	0.84	0.86

S1-Kumbakonam, S2-Papanasam, S3-Orathanadu, S4-Pattukkottai, S5-Peravurani, S6-Thanjavur, S7-Thiruvaiyaru, S8-Thiruvidaimarudhur

Table 5: Physico - chemical parameters of the soil Thanjavur (DT).

Name of the parameters	January							
	S1	S2	S3	S4	S5	S6	S7	S8
pH	7.22	7.26	7.28	7.25	7.34	7.54	7.16	7.27
Moisture (%)	20-30	30-40	40-50	50-60	60-70	70-80	80-90	85-90
Carbon (%)	0.81	0.83	0.87	0.85	0.94	0.97	0.98	0.95
Nitrogen (kg/ac)	95.4	93.5	88.4	74.6	95.3	66.8	58.7	77.2
Phosphorus(kg/ac)	4.14	3.26	3.19	4.11	4.13	4.06	4.03	4.09
Magnesium (ppm)	9.6	9.5	8.6	9.13	8.03	9.78	9.04	9.7
Calcium (ppm)	8.3	7.1	7.7	6.3	6.4	8.7	7.4	7.3
Copper (ppm)	1.7	1.9	1.2	1.7	1.4	1.7	1.5	1.3
Iron (ppm)	0.75	0.77	0.84	0.83	0.53	0.84	0.85	0.86
Zinc (ppm)	4.8	4.7	4.5	4.4	4.6	4.3	4.7	4.9
Manganese (ppm)	0.85	0.87	0.83	0.84	0.87	0.88	0.86	0.85

Table 6: Physico - chemical parameters of the soil Thanjavur (DT).

Name of the parameters	February							
	S1	S2	S3	S4	S5	S6	S7	S8
pH	7.23	7.25	7.27	7.26	7.34	7.55	7.14	7.28
Moisture (%)	20-25	25-30	30-35	25-27	25-28	35-40	40-45	45-50
Carbon (%)	0.84	0.87	0.88	0.83	0.91	0.94	0.93	0.87
Nitrogen (kg/ac)	95.2	93.3	88.3	74.6	95.3	66.7	58.4	77.5
Phosphorus(kg/ac)	4.14	3.24	3.19	4.11	4.14	4.06	4.03	4.05
Magnesium (ppm)	9.4	9.2	8.9	9.13	8.03	9.73	9.5	9.5
Calcium (ppm)	8.3	7.2	7.3	6.6	6.9	8.4	7.5	7.8
Copper (ppm)	1.5	1.08	1.8	1.6	1.7	1.8	1.4	1.9
Iron (ppm)	0.75	0.77	0.09	0.43	0.58	0.87	0.85	0.87
Zinc (ppm)	4.5	4.7	4.3	4.6	4.2	4.8	4.7	4.1
Manganese (ppm)	0.82	0.84	0.88	0.85	0.87	0.83	0.81	0.86

S1-Kumbakonam, S2-Papanasam, S3-Orathanadu, S4-Pattukkottai, S5-Peravurani, S6-Thanjavur,S7- Thiruvaiyaru, S8-Thiruvidaimarudhur.

Table 7: Physico - chemical parameters of the soil Nagapattinam (DT).

Name of the parameters	November				
	S1	S2	S3	S4	S5
pH	8.05	8.07	8.10	8.09	8.06
Moisture (%)	40-50	40-55	40-60	40-65	40-70
Carbon (%)	0.92	0.96	0.87	0.85	0.83
Nitrogen (kg/ac)	88.6	83.4	74.5	76.4	69.3
Phosphorus(kg/ac)	3.15	3.12	3.10	3.14	3.2
Magnesium (ppm)	8.5	8.0	7.9	7.5	6.5
Calcium (ppm)	7.6	7.8	7.5	7.9	7.4
Copper (ppm)	1.5	1.4	1.3	1.2	1.8
Iron (ppm)	0.84	0.88	0.83	0.84	0.87
Zinc (ppm)	4.5	4.3	4.2	4.6	4.4
Manganese (ppm)	0.83	0.82	0.85	0.87	0.89

Table 8: Physico - chemical parameters of the soil Nagapattinam (DT).

Name of the parameters	December				
	S1	S2	S3	S4	S5
pH	8.04	8.06	8.08	8.07	8.05
Moisture (%)	45-50	50-55	55-60	60-65	65-70
Carbon (%)	0.91	0.93	0.85	0.86	0.82
Nitrogen (kg/ac)	88.5	83.2	88.3	88.1	95.4
Phosphorus(kg/ac)	3.13	3.22	3.17	3.15	3.25
Magnesium (ppm)	8.3	8.2	8.7	7.5	6.3
Calcium (ppm)	7.2	7.5	7.8	6.9	6.7
Copper (ppm)	1.4	1.6	1.7	1.9	1.8
Iron (ppm)	0.83	0.75	0.79	0.76	0.56
Zinc (ppm)	4.7	4.6	4.3	4.7	4.8
Manganese (ppm)	0.84	0.86	0.89	0.83	0.85

S1-Sirkali, S2-Kivelur, S3- Vedaranyam, S4-Tharangambadi, S5-Thirukkuvalai

Table 9: Physico - chemical parameters of the soil Nagapattinam (DT).

Name of the parameters	January				
	S1	S2	S3	S4	S5
pH	8.04	8.05	8.06	8.07	8.09
Moisture (%)	40-46	43-45	45-50	45-55	50-60
Carbon (%)	0.90	0.93	0.88	0.85	0.83
Nitrogen (kg/ac)	87.5	83.7	86.5	87.2	95.2
Phosphorus(kg/ac)	3.15	3.20	3.17	3.10	3.12
Magnesium (ppm)	8.7	8.5	8.4	9.4	8.6
Calcium (ppm)	7.3	7.5	7.7	7.3	7.9
Copper (ppm)	1.5	1.3	1.9	1.4	1.2
Iron (ppm)	0.74	0.73	0.64	0.46	0.36
Zinc (ppm)	4.8	4.5	4.6	4.4	4.7
Manganese (ppm)	0.83	0.88	0.84	0.86	0.85

Table 10: Physico - chemical parameters of the soil Nagapattinam (DT).

Name of the parameters	February				
	S1	S2	S3	S4	S5
pH	8.07	8.06	8.03	8.05	8.07
Moisture (%)	40-45	45-50	50-55	55-60	60-65
Carbon (%)	0.89	0.91	0.87	0.85	0.95
Nitrogen (kg/ac)	86.5	84.7	85.3	86.2	86.4
Phosphorus(kg/ac)	3.12	3.15	3.18	3.09	3.16
Magnesium (ppm)	8.3	8.7	8.5	8.6	8.2
Calcium (ppm)	7.5	7.4	7.6	7.8	7.3
Copper (ppm)	1.3	1.7	1.6	1.5	1.2
Iron (ppm)	0.73	0.75	0.77	0.65	0.55
Zinc (ppm)	4.3	4.5	4.7	4.9	4.6
Manganese (ppm)	0.84	0.87	0.83	0.85	0.87

S1-Sirkali, S2-Kivelur, S3- Vedaranyam, S4-Tharangambadi, S5-Thirukkuvalai

CONCLUSION

Here it concluded that, microbes are especially important components of biodiversity. Particularly fungi and bacteria are crucial as they change and release many nutrients playing important roles in nutrients and sustainable vegetable. Diversity of *Bacillus* species are useful for former, Researchers Microbiologist for future activities of *Bacillus* enrichment.

Further studies is to be planned for seasonal wise distribution of *Bacillus species* diversity in these districts throughout the year.

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