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**Research Article**

# STUDIES ON BACTERIAL, FUNGAL DIVERSITY OF KUMBAKONAM TALUK THANJAVUR DISTRICT, TAMIL NADU, INDIA

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**ABSTRACT**

Soil are highly complex system, with many component playing diverse functions mainly due to the activity of soil organism. Soil flora plays a pivotal role in evaluation of soil condition and in stimulating plant growth. Microorganism are beneficial in increasing the soil fertility and plant growth as they are involved in several biochemical transformation and mineralization the activites in soils. The present study was aimed to, deals with the diversity at sites in Kumbakonam Taluk, Thanjavur District, TamilNadu. The study period was covering all the four seasons viz, Monsoon (October-December), Postmonsoon (January- March) Summer (April – June) Premonsoon (July – September) and distribution of bacterial and fungal population in around soil. The physico-chemical parameters of such soil were identified the includes pH and moisture content of the soil. macronutrient (Nitrogen, Phosphorus, Magnesium, Calcium) and micronutrient (Iron, Copper, Zinc, Manganese) were analyzed. Totally 50 species of soil bacteria and fungi were observed form the soil samples, they were collected from Kumbakonam, Krishnapuram and Cholapuram. About 30 different species belonging to Ascomycetes and Phycomycetes and most of them were isolated by using PDA medium and Nutrient Agar Medium identified with standard manuals .The dominant bacterial species are *Pseudomonas sp, Clostridium sp, Bacillus sp, Staphylococcus sp and Escherichia sp and* fungal species *Aspergillus sp, Rhizopus sp, Pencillium sp, and Fusarium sp* were recorded. Isolation of microorganisms were correlated to percentage frequency and heavy metal content were recorded. The physic –chemical parameters are rich in Kumbakonam as Silty Clay to Silty Clay Loam soil type.



## INTRODUCTION

Soil is a complex ecosystem, delimited by physiochemical parameters that hold enormous number of living organism. Nevertheless, microbes are the least understand mechanism of soil by both agronomists and soil practitioners. On the farm several soil organisms offer benefits to crop growing in an ecosystem, but are not well understood. The microbes decompose the plant and animal residues entering the soil and convert them into soil organic matter, which influences on soil physical, chemical and biological properties and on creating a complimentary medium for biological reaction and life support in the soil environment. Nonetheless, enhanced site-specific diversity typically results in higher levels of below ground microbial diversity and production (Olson *et al.,* 2000). Biodiversity refers to the variability of life on Earth, all the living species of animal, plant and microorganism. According to Hawksworth (2001), fungi are a major component of biodiversity, essential for the survival of other organisms and are crucial in global ecological processes. Biodiversity in not evenly distributed rather it varies greatly across the globe as well as within region. Among other factor, the diversity of all living thing (biota) depends on temperature, precipitation, altitude, soils, geography and the presence of other species.

Soil biodiversity reflects the mix of living organism in the soil. These organism interact with one another and with plants and animals forming a web of biological activity. Soil is by far the most biologically diverse part of earth. The soil food web includes beetles, springtails, mites, worms, spiders, ants, nematodes, fungi, bacteria, and other organisms. These organisms improve the entry and storage of water, resistance to erosion, plant nutrition, and break down of organic matter. A wide variety of organisms provides check and balances to the soil food web through population control, mobility, and survival from to season. Climate change affect Biodiversity (2014). Hence, the present study was isolate and identify bacteria and fungi in Thanjavur Dt, Tamilnadu during four different seasons.

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## MATERIALS AND METHODS

***Soil Sample Collection***

The soil samples were collected from Kumbakonam taluk, Thanjavur District, Tamil Nadu, India during Monsoon (October-December), Post monsoon (January- March) Summer (April – June) Premonsoon (July – September (2014-2015) season. In the present case, each sample was collected agricultural field, and from taluk namely Kumbakonam (S1), Krishnapuram (S2) and Cholapuram (S3). Collect the soil sample before remove the surface litter at the sampling spot. Collect at least 4 to 6samples from each sampling unit and place. If make a 'V' shaped cut to a depth of 15 cm in the sampling spot using spade.

Mix the sample thoroughly and remove foreign material like roots, stones and gravels. Silty clay to. Silty clay loam the method used for taking soil sample was a slight modification as that used by (Goddard 1913). Collect the in sample clean sterile polythene bags. All four random samples of each zone were put together to make a single sample from each place. A total of three samples was prepared to investigate the diversity of the bacteria and fungi.

***Isolation of Bacteria and Fungi***

Isolation was done by serial dilution and dilution plating (Gram's Staining, Motility) using and standard manuals (Bergy's manual of determinative bacteriology) and Identification in terms of biochemical test such as Indole, Methyl – Red and Voges- Proskauert, Citrate Utilization, Catalase, and Oxidase Test. The bactertial and fungal colonies were counted as cfu/ ml.

***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. (AAS Elico 196).

***Procedure***

Filter the samples and acidified with concentrated $HNO_3$ to a pH less then immediately after collection of soil.

Take 1.5 liter of filtrated sample was taken in a beaker with 5ml concentrated $HNO_3$. Evaporated the sample was dried on a hot plate to prevented the boiling process. Add another 5 ml of the concentrated $HNO_3$ in the sample. Then it allow to cooled and heated by adding some additional $HNO_3$ light colored residue were formed. Dissolve the residues by added 0.5N HCL and filtered the contents. Makeup the filtered content upto 50 ml with 0.5N HCL. After pretreatment the minerals can be analyzed by Atomic Adsorption Spectrophotometer.

***Statistical Analysis (Salil bose 1982)***

The results obtained in the present investigation were submerged to statistical analysis like mean (X) and Standard Deviation (SD).

## RESULTS AND DISCUSSIONS

The present study was aimed to investigated for the bacterial and fungal diversity from Kumbakonam taluk of Thanjavur district,sites such as, Kumbakonam, ($S_1$) Krishnapuram($S_2$) and Cholapuram ($S_3$). Tamilnadu in monsoon, postmonsoon, summer, and premonsoon seasons.

***Physico- chemical parameters***

The pH, moisture, organic carbon Macronutrients (Nitrogen, phosphorus, Manganesium, Calcium) and micronutrients (Iron, Zinc, Manganese) were analysed and compared with seasonal variation of Kumbakonamtaluk of Thanjavur District. (Table 4)

The bacterial and fungal organisms are isolated and identified as morphological and cultural characteristics (Table 9, 10). Nearly 32 species (bacteria 12 and fungi 20) were recorded in monsoon, 48 species (bacteria 14 and fungi 21) were recorded in post monsoon, 31 species (bacteria 16 and fungi 15) were recorded in summer and 47 species (bacteria 18 and fungi 29) were recorded in Premonsoon season. (Table 1). Bacterial and fungal colonies were counted and recorded as cfu/ml (Table 5,6).

**Table – 1** Isolation of bacteria and fungi from soil during four season

| | | Seasons | | | |
|---|---|---|---|---|---|
| **S.No** | **Species** | **Monsoon** | **Postmonsoon** | **Summer** | **Premonsoon** |
| 1 | Bacteria | 12 | 14 | 16 | 18 |
| 2 | Fungi | 20 | 21 | 15 | 29 |

In monsoon season, in the area of Kumbakonam (S1) site, fungal organisms are *Aspergillus niger, A. flavus, A.nidulans A. sulphureus, Pencillium sp, p. chrysogenum, P.bovis, R.oryzae, C. herbarum, Mucor sp, Alternaria sp, Fusarium solani, Phythium sp Verticillum sp R.nigricans* and bacterial species such as *Bacillus sp, Enterobacter sp, P.vulgaris, Streptococcus sp, E. aerogenes S.lactis, Azospirillum sp.* In Krishnapuram (S2) fungal organisms are *Rhizopus oryzae, Candida albicans, A. luchuensis Aspergillus flavus, C. herbarum, P. bovis, Fusarium solani F. semitectum* and bacterial species such as *Bacillus cerus, B. subtilis, Enterobacter sp, E. aerogenes, Pseudomonas sp, P.aeruginosa.* Next sites Cholapuram (S3) fungal organisms are *R.oryzae Aspergillus flavus, A.itaconicus, A.nidulans, A.sulphureus, Candida albicans, Pencillium chrysogenum, Mucor, Alternaria sp* and bacterial species *Micrococcus sp, P.vulgaris, Azotobacter, Pseudomonas sp P.aeruginosa and Staphylococcus sp* are dominants.

A review on post monsoon season **S1** site species are fungal *R.oryzae Aspergillus flavus,, A.itaconicus, A.nidulans, A.sulphureus, Candida albicans, Pencillium chrysogenum, Mucor, Alternaria sp* and bacterial species *Micrococcus sp, P.vulgaris, Azotobacter, Pseudomonas sp P.aeruginosa staphylococcus sp.* In **S2** site fungal organisms are *A.flavus, A.fumigatus, A.itaconicus, Rhizopus sp R.oryzae, C. herbarum, Fusarium sp, F.solani, Mucor sp R.nigricans* and bacterial species *Enterobacter sp, E. aerogenes, P.vulgaris, Psedomonas sp, P.aeruginosa, Lactobacilli sp.* In **S3** site fungal organisms *A.nidulans A.fumigatus, A. luchuensis, Pencillium sp P.chrysogenum Mucor sp, Candida albicans, R.oryzae, Fusarium sp F.oxysporm* and bacterial species *E.coli,*

*Micrococcus sp, Staphylococcus sp B. subtilis P.aeruginosa, Azospirillum* are dominants

Next Summer season **S1** site fungal organisms *A.niger, A.fumigatus, A.itaconicus, Rhizopus sp Candida albicans R.stolonifer, Verticillum sp R.nigaricans, Fusarium oxysporium, F. semitectum, T. viridae,* and bacterial species are *E.coli, S.lactis , E. aerogenes ,Micrococcus sp, Aerococcus sp Azotobacter P.aeruginosa.* In **S2** site species of fungal are *A.niger,A.flavus, A. sulphurous, A. luchuensis, Rhizopus sp R.oryzae R.nigricans Fusarium sp, F.oxysporum F.solani, T,viridae* and *Enterobacter sp*, *Pseudomonas sp, P.vulgaris, Lactobacillus sp B. subtilis. P.aeruginosa* and **S3** site *A.niger, A.flavus, C. herbarum, A.nidulans A.itaconicus, Candida albicans, Pencillium bovis, Verticillum sp, P.chrysogenum, Mucor sp, Fusarium solani, F.oxysporum,* bacterial species are *E. aerogenes*, *E.coli, Micrococcus sp, Staphylococcus sp S.lactis* are dominants.

In Premonsoon season **S1** site fungal species are *Aspergillus A. flavus A. sulphureus, A. luchuensis, Candida albicans F.solani ,Phythium sp Rhizopus sp, R.oryzae* and bacterial species are *S.lactis ,Enterobacter sp*, *E. aerogenes* and *Pseudomonas sp, P.vulgaris ,B. subtilis Staphylococcus sp.* In **S2** site fungal organisms are *Aspergillus niger, A.itaconicus A.nidulans A.oryzae ,Mucor sp, Fusarium oxysporium, Verticillum sp, Pythium, Helmithosporium* and bacterial species are *Micrococcus sp, Micrococcus sp Bacillus sp, Micrococcus sp* and In **S3** site fungal organisms are *A.itaconicus, pencillium chrysogenum, , R.nigricans, Candida albicans, Fusarium oxysporium Trichoderma viridae, Helmithosporium, R.oryzae* and bacterial species are *Azotobacter Bacillus sp, B. subtilis, Enterobacter sp, E. aerogenes E.coli ,S.lactis P.aeruginosa* are dominants (Table 2,3 ).

**Table - 2** Details of the bacteria isolated from soil

| S.No | Bactreial Species | Monsoon | | | Postmonsoon | | | Summer | | | Premonsoon | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S1 | S2 | S3 | S1 | S2 | S3 | S1 | S2 | S3 | SI | S2 | S3 |
| 1 | *B. cerus* | _ | + | + | _ | _ | + | + | _ | _ | + | _ | + |
| 2 | *B. subtilis* | _ | _ | + | + | _ | + | + | _ | + | + | + | _ |
| 3 | *B. circulans* | _ | + | _ | + | _ | _ | + | _ | + | + | _ | _ |
| 4 | *B. megaterium* | + | + | _ | _ | + | _ | + | _ | _ | _ | + | _ |
| 5 | *B. coagulans* | + | + | + | _ | _ | + | _ | + | + | + | _ | + |
| 6 | *B.mucoids* | _ | + | _ | + | _ | + | + | + | _ | + | _ | + |
| 7 | *B. licheniformis* | _ | + | _ | + | + | _ | _ | + | _ | + | + | _ |
| 8 | *S. aureus* | + | + | _ | + | _ | _ | + | + | + | _ | + | _ |
| 9 | *S. lactis* | + | _ | _ | + | _ | + | _ | + | _ | + | _ | + |
| 10 | *S. phyogens* | + | _ | + | _ | + | + | _ | _ | _ | + | + | _ |
| 11 | *E. aerogenes* | _ | _ | + | _ | _ | + | + | _ | + | _ | + | _ |
| 12 | *E.coli* | + | _ | _ | _ | _ | + | _ | _ | _ | _ | + | + |
| 13 | *C.pyogens* | + | + | _ | + | + | _ | + | _ | + | _ | + | _ |
| 14 | *P.aeruginosa* | + | + | _ | _ | _ | + | + | _ | + | _ | + | _ |
| 15 | *p.vulgaris* | + | + | _ | + | _ | + | + | + | _ | + | _ | + |
| 16 | *M.luteus* | _ | + | + | _ | + | + | + | + | _ | _ | + | _ |
| 17 | *Azotobacter* | _ | + | _ | + | _ | _ | + | _ | + | + | _ | _ |
| 18 | *Azospirillum* | + | + | _ | + | _ | + | + | + | _ | + | _ | + |
| 19 | *S. areus* | + | + | _ | + | _ | _ | + | _ | + | _ | + | + |
| 20 | *Enterococcus* | _ | + | _ | + | _ | + | + | + | _ | + | _ | + |
| 21 | *Vibrio sp* | _ | _ | + | _ | _ | + | + | _ | + | _ | + | _ |

S1 –Kumbakonam, S2-Krisnapuram, S3- Cholapuram (+ Present, - Absent)

Maximum number of fungi and bacteria were isolated from monsoon season, minimum number of fungi and bacteria isolated in postmonsoon season. Majority of soil fungi belongs to Ascomycota and Deutromycota.

**Table - 3** Details of the fungi isolated from soil

| S.No | Species | Monsoon | | | Postmonsoon | | | Summer | | | premonsoon | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S1 | S2 | S3 | S1 | S2 | S3 | S1 | S2 | S3 | SI | S2 | S3 |
| 1 | *Aspergillus flavus* | + | _ | + | + | + | + | _ | + | + | + | _ | + |
| 2 | *A .oryzae* | _ | + | + | _ | + | _ | _ | + | _ | + | + | + |
| 3 | *A.niger* | + | + | + | + | + | + | + | + | + | + | + | + |
| 4 | *A.fumigatus* | + | _ | _ | _ | + | + | + | _ | + | _ | + | + |
| 5 | *A.terrus* | + | + | _ | + | | | | + | + | _ | | + |
| 6 | *A.nidulans* | + | _ | + | _ | + | + | _ | _ | _ | + | + | _ |
| 7 | *A.vesicolar* | _ | + | + | _ | _ | + | + | _ | _ | + | _ | + |
| 8 | *A.itaconicus* | _ | _ | + | + | _ | + | + | _ | + | + | + | _ |
| 9 | *A. luchuensis* | _ | + | _ | + | _ | _ | + | _ | + | + | _ | _ |
| 10 | *A. sulphurous* | + | + | _ | _ | + | _ | + | _ | _ | _ | + | _ |
| 11 | *Cladosporium sp* | + | _ | + | _ | _ | + | _ | _ | _ | + | _ | _ |
| 12 | *C. herbarum* | _ | + | _ | _ | _ | + | + | _ | _ | + | _ | + |
| 13 | *Cunninghamella sp* | _ | + | _ | + | + | _ | _ | + | _ | + | + | _ |
| 14 | *Candida albicans* | + | + | _ | + | _ | _ | + | + | + | _ | + | _ |
| 15 | *Fusarium oxysporium* | + | _ | _ | + | _ | + | _ | + | _ | + | _ | + |
| 16 | *F. solani* | + | _ | + | _ | + | + | _ | _ | _ | + | + | _ |
| 17 | *F. semitectum* | _ | _ | + | _ | _ | + | + | _ | + | _ | + | _ |
| 18 | *Helmithosporium* | + | _ | _ | _ | _ | + | _ | _ | _ | _ | + | + |
| 19 | *Mucor sp* | + | + | _ | + | + | _ | + | _ | + | _ | + | _ |
| 20 | *Rhizopus stolonifer* | + | + | _ | _ | _ | + | + | _ | + | _ | + | _ |
| 21 | *R.oryzae* | + | + | _ | + | _ | + | + | + | _ | + | _ | + |
| 24 | *R.nigricans* | _ | + | + | _ | + | + | + | + | _ | _ | + | _ |
| 25 | *Trichoderma viridae* | + | + | _ | + | _ | _ | + | _ | + | + | _ | _ |
| 26 | *Penicillum chrysogenum* | + | + | _ | + | _ | + | _ | + | _ | + | _ | + |
| 27 | *P.bovis* | + | + | _ | + | _ | + | _ | _ | + | + | _ | _ |
| 28 | *Phythium sp* | + | _ | _ | _ | + | + | _ | _ | _ | _ | _ | + |
| 29 | *Verticillum sp* | _ | _ | + | _ | _ | _ | + | _ | + | _ | + | _ |

S1 –Kumbakonam, S2-Krisnapuram, S3- Cholapuram ( + Present , - Absent )

Diversity was found to be higer in postmonsoon season than summer. The season variation and (%) frequency of the bacterial and fungal flora were statistically analyzed (Table 7,8)

Our finding similar to this, Senthil kumar *et al* ., 2009 collected 15 soil samples from three different stations namely Koraiyar river head, Saradi, and Xavier munai along the Muthupet Mangroves in Tamilnadu and examined by dilution plating method of PDA medium to access fungal diversity and the population diversity. Out of 22 species screened the *Aspergillus* and *Penicillium* were represented as dominant one of each. In the present study also species like *Aspergillus* and *Penicillium* were common to all sites.

Our work is supported by V. Manimegalai 2011, population density during Monsoon season, maximum, fungal species was recorded in 2009-2010. In our study report also highlighted that fungal population also high in monsoon season and similar that dominant species are *Aspergillus, penicilliumwere* also the same to that study.

Our finding similar to that Kalaiselvi and Panneerselvam, 2011, seasonal variation of soil fungal population in Thanjavurdist, Tamilnadu viz., Nadur, Orathanadu, Punnainallur and Tholkappiyar Square totally 30 different species belonging to Ascomycetes and Phycomycetes were isolated by using PDA medium. The dominant species were *Aspergillusniger*, Cunninghamella sp. followed by Trichodermaviride. During rainy season maximum fungal count was recorded in sub soil layer.

**Table -4** Physico-chemical Parameters of the soil

| S.No | Name of the parameters | Monsoon | | | Postmonsoon | | | Summer | | | premonsoon | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ | $S_1$ | $S_2$ | $S_3$ |
| 1 | PH | 8.21 | 7.57 | 7.31 | 7.96 | 7.06 | 7.91 | 7.82 | 7.72 | 7.72 | 7.76 | 7.28 | 7.41 |
| 2 | Moisture (%) | 60 | 59 | 63 | 56 | 67 | 72 | 34 | 39 | 36 | 48 | 57 | 55 |
| 3 | Temperature(°C) | 38 | 36 | 39 | 42 | 45 | 47 | 59 | 62 | 67 | 35 | 36 | 29 |
| 4 | carbon(%) | 0.42 | 0.92 | 0.49 | 0.46 | 0.25 | 0.74 | 0.28 | 0.48 | 0.14 | 0.45 | 1.85 | 0.82 |
| 5 | Nitrogen(Kg/ac) | 87.6 | 89.3 | 81.1 | 90.28 | 89.5 | 73.2 | 87.5 | 87.9 | 90.6 | 91.6 | 84.6 | 90.2 |
| 6 | Potassium(kg/ac) | 81 | 73.6 | 72.4 | 68.9 | 69.1 | 66.7 | 74.6 | 71.2 | 71.5 | 72.3 | 78.8 | 70 |
| 7 | Phosphorus(kg/ac) | 4.12 | 5.15 | 3.11 | 2.15 | 4.31 | 4.2 | 3.19 | 2.57 | 1.24 | 1.54 | 4.35 | 3.24 |
| 8 | Magnesium(ppm) | 10.5 | 10.1 | 8.7 | 8 | 8.2 | 8.5 | 9.5 | 8.8 | 10 | 7.5 | 9.7 | 9.3 |
| 9 | Calcium(ppm) | 8.4 | 9.9 | 8.1 | 7.6 | 7.1 | 7.3 | 8.8 | 8.6 | 9.5 | 9.4 | 9.5 | 9.6 |
| 10 | Copper(ppm) | 0.78 | 0.79 | 0.84 | 1.9 | 1.4 | 1.8 | 0.96 | 0.88 | 0.92 | 1.8 | 1.6 | 1.9 |
| 11 | Iron(ppm) | 2.34 | 2.55 | 2.65 | 3.3 | 3.6 | 2.25 | 4.7 | 4.6 | 4.9 | 2.5 | 2.8 | 2.6 |
| 12 | Zinc(ppm) | 0.87 | 0.78 | 1.51 | 0.67 | 0.81 | 0.74 | 1.8 | 2.7 | 2.5 | 0.7 | 1.5 | 2.3 |
| 13 | Manganese(ppm) | 2. 31 | 3.5 | 2.8 | 2.1 | 1.9 | 2.4 | 3.5 | 3.8 | 3.5 | 2.2 | 1.7 | 2.8 |

S1 –Kumbakonam, S2-Krisnapuram, S3- Cholapuram

Our work similar to that, seasonal variation of soil fungal population in Thanjavurdist, Tamilnadu viz., Kumbakonam, Krishnapuram and Cholapuram surrounding totally 29 different species belonging to Ascomycetes. Our study monsoon season higher amount of fungal population recorded.

The present study was correlated to that Prince, (2012) that studies on soil mycoflora from the sugarcane field in Thanjavur District, Tamilnadu. About 50 different species belongs to Phycomycetes and Deuteromycetes were isolated. In our report highlighted that Ascomycetes and Deutromycetes were isolated.

**Table – 5** Details of the bacterial Colony forming units (CFU)

| S.No | Species | Monsoon | Post monsoon | Summer | Pre monsoon |
|---|---|---|---|---|---|
| 1 | *B. cereus* | 34 | 42 | 34 | 36 |
| 2 | *B. subtilis* | 46 | 38 | 27 | 44 |
| 3 | *B. circulans* | 42 | 36 | 23 | 39 |
| 4 | *B. megaterium* | 43 | 44 | 21 | 29 |
| 5 | *B. coagulans* | 55 | 39 | 32 | 32 |
| 6 | *B.mucoids* | 40 | 29 | 37 | 45 |
| 7 | *B. licheniformis* | 34 | 32 | 25 | 48 |
| 8 | *S. aureus* | 55 | 45 | 23 | 52 |
| 9 | *S. lactis* | 57 | 49 | 33 | 68 |
| 10 | *S. pyogens* | 48 | 38 | 28 | 64 |
| 11 | *E. aerogenes* | 52 | 48 | 39 | 68 |
| 12 | *E.coli* | 68 | 61 | 42 | 59 |
| 13 | *C.pyogens* | 64 | 57 | 28 | 57 |
| 14 | *P.aeruginosa* | 68 | 55 | 29 | 68 |
| 15 | *p.vulgaris* | 59 | 61 | 25 | 34 |
| 16 | *M.luteus* | 57 | 45 | 33 | 27 |
| 17 | *Azotobacter* | 68 | 66 | 27 | 23 |
| 18 | *Azospirillum* | 65 | 69 | 29 | 21 |
| 19 | *S. aureus* | 60 | 47 | 33 | 32 |
| 20 | *Enterococcus* | 56 | 48 | 27 | 37 |
| 21 | *Vibrio sp* | 53 | 51 | 24 | 35 |

Similar to that Sukumaran, (2013) reported by characterization of bacterial diversity in marine sediment at different season in karankadu, bacterial diversity incidence was quite comman in special and season fluctuation. The present study revealed that totally 18 bacterial species were recorded during Premonsoon season.

Our study was correlated to Uma maheshwari *et al.,* 2013, from that totally 36 different species were isolated from seven taluks of Thiruvarur Dt. They are dependent on the nature of substrate and temporal regions that form colonization. Here our study revealed that totally 18 different bacterial, and 29 fungi were isolated and identified from Kumbakonam Taluks of Thanjavur Districts.

The contribution of soil organisms was very significant in many soil functions such as supporting the growth of plants, absorbing, neutralizing and transforming compounds that might otherwise become pollutants in the environment. Some studies dealt with the influence of plant community and other attempted to examine seasonal trends on soil microorganisms.

**Table- 6** Details of the fungal Colony forming units (CFU)

| S.No | Species | Monsoon | Post monsoon | Summer | Pre Monsoon |
|---|---|---|---|---|---|
| 1 | *A. niger* | 56 | 42 | 34 | 39 |
| 2 | *A. flavus* | 54 | 39 | 27 | 33 |
| 3 | *A. terrus* | 45 | 36 | 23 | 31 |
| 4 | *A. Fumigatus* | 38 | 44 | 21 | 41 |
| 5 | *A. oryzae* | 58 | 42 | 32 | 33 |
| 6 | *A. nidulans* | 48 | 29 | 37 | 34 |
| 7 | *A. Vesicular* | 34 | 41 | 25 | 21 |
| 8 | *A. itaconicus* | 35 | 45 | 23 | 28 |
| 9 | *A. sulphurous* | 48 | 49 | 33 | 40 |
| 10 | *A. lughuensis* | 32 | 38 | 28 | 64 |
| 11 | *Cladosporium sp* | 68 | 61 | 42 | 59 |
| 12 | *C. herbarum* | 64 | 57 | 28 | 57 |
| 13 | *F. solani* | 59 | 61 | 25 | 34 |
| 14 | *F.oxysporium* | 57 | 45 | 33 | 27 |
| 15 | *F. semiectum* | 68 | 66 | 27 | 23 |
| 16 | *R. stolonifer* | 60 | 47 | 33 | 32 |
| 17 | *R. oryzae* | 56 | 48 | 27 | 37 |
| 18 | *R. nigricans* | 53 | 51 | 24 | 35 |
| 19 | *P. chrysogenum* | 32 | 23 | 68 | 34 |
| 20 | *P. bovis* | 33 | 33 | 64 | 35 |
| 21 | *P.expansum* | 25 | 28 | 59 | 48 |
| 22 | *C. albicans* | 21 | 42 | 57 | 32 |
| 23 | *T. viridae* | 30 | 38 | 34 | 68 |
| 24 | *T. harizonum* | 27 | 36 | 27 | 64 |
| 25 | *Phythium sp* | 31 | 44 | 23 | 37 |
| 26 | *Verticillum sp* | 21 | 39 | 32 | 25 |
| 27 | *Helmithosporiumsp* | 20 | 29 | 37 | 23 |
| 29 | *A.alternata* | 22 | 32 | 35 | 33 |

**Table -7** Details of frequency of bacteria in isolated sites

| S.No | Genus | Species | Average | S1 | S2 | S3 | Total | Frequency |
|---|---|---|---|---|---|---|---|---|
| 1 | *Bacillus sp* | *B. cerus* | 34 | 9 | 12 | 13 | 34 | 11.5 |
| | | *B. subtilis* | 46 | 8 | 10 | 9 | 27 | 9.18 |
| | | *B. circulans* | 42 | 6 | 9 | 8 | 23 | 7.82 |
| | | *B. megaterium* | 43 | 10 | 6 | 5 | 21 | 7.14 |
| | | *B. coagulase* | 55 | 11 | 8 | 13 | 32 | 10.8 |
| | | *B.mucolds* | 40 | 7 | 6 | 7 | 20 | 6.80 |
| | | *B. licheniformis* | 34 | 8 | 8 | 9 | 25 | 8.501 |
| | | *Total* | 294 | | | | | |
| **2** | *Staphylococcus sp* | *S. aureus* | 55 | 12 | 10 | 11 | 33 | 20.62 |
| | | *S. lactis* | 57 | 9 | 11 | 8 | 28 | 17.54 |
| | | *S. phyogens* | 48 | 7 | 8 | 6 | 21 | 13.12 |
| | | | 160 | | | | | |
| **3** | *Enterobacter sp* | *E. aerogenes* | 72 | 9 | 8 | 11 | 28 | 38.88 |
| **4** | *Escherichia sp* | *E.coli* | 78 | 10 | 12 | 7 | 29 | 37.17 |
| **5** | *Clostridium sp* | *C.pyogens* | 64 | 8 | 11 | 6 | 25 | 39.06 |
| **6** | *Psedomonas sp* | *P.aeruginosa* | 68 | 11 | 9 | 13 | 33 | 48 .52 |
| **7** | *Proteus sp* | *p.vulgaris* | 59 | 8 | 10 | 9 | 27 | 45.76 |
| **8** | *Micrococcus sp* | *M.luteus* | 57 | 5 | 7 | 6 | 18 | 31.56 |
| **9** | *Azotobacter sp* | *Azotobacter* | 68 | 10 | 12 | 11 | 33 | 48.52 |
| **10** | *Azospirillum sp* | *Azospirillum* | 65 | 8 | 11 | 8 | 27 | 41.53 |
| **11** | *Streptococcus sp* | *S. areus* | 60 | 10 | 7 | 6 | 23 | 38.35 |
| **12** | *Enterococcus sp* | *Enterococcus* | 56 | 8 | 6 | 7 | 21 | 37.51 |
| **13** | *Vibrio sp* | *Vibrio sp* | 53 | 9 | 8 | 6 | 23 | 43.39 |

**Table – 8** Details of frequency of mycoflora in the isolated sites

| S.No | Genus | Species | Average | S1 | S2 | S3 | Total | Frequency (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | *Aspergillu sp* | *A. niger* | 56 | 9 | 13 | 10 | 32 | 17. 14 |
| | | *A. flavus* | 54 | 7 | 10 | 16 | 33 | 17.36 |
| | | *A. terrus* | 45 | 8 | 8 | 9 | 25 | 15.58 |
| | | *A. Fumigatus* | 38 | 9 | 6 | 6 | 21 | 14.68 |
| | | *A. oryzae* | 58 | 11 | 9 | 10 | 30 | 16.69 |
| | | *A. nidulans* | 48 | 8 | 12 | 7 | 27 | 16.02 |
| | | *A. Vesicular* | 34 | 10 | 14 | 7 | 31 | 16.91 |
| | | *A. itaconicus* | 35 | 5 | 7 | 9 | 21 | 14.68 |
| | | *A. sulphurous* | 48 | 6 | 8 | 6 | 20 | 14.46 |
| | | *A. lughuensis* | 32 | 5 | 9 | 8 | 22 | 14.91 |
| | | | 448 | | | | | |
| 2 | *Cladosporium sp* | *Cladosporium sp* | 25 | 5 | 5 | 3 | 13 | 2.95 |
| | | *C. herbarum* | 19 | 6 | 3 | 6 | 15 | 1.89 |
| | | | 44 | | | | | |
| 3 | *Fusarium sp* | *F. solani* | 65 | 11 | 10 | 12 | 23 | 13.60 |
| | | *F.oxysporium* | 56 | 9 | 13 | 8 | 20 | 11.83 |
| | | *F. semiectum* | 48 | 7 | 8 | 6 | 21 | 12.42 |
| | | | 169 | | | | | |
| 4 | *Rhizopus sp* | *R. stolonifer* | 67 | 9 | 16 | 14 | 39 | 20.72 |
| | | *R. oryzae* | 63 | 14 | 10 | 9 | 33 | 17.55 |
| | | *R. nigricans* | 58 | 12 | 11 | 8 | 31 | 16.40 |
| | | | 188 | | | | | |
| 5 | *Penicillium sp* | *P. crysogenum* | 68 | 11 | 9 | 13 | 33 | 18 .71 |
| | | *P. bovis* | 59 | 13 | 10 | 11 | 34 | 19.54 |
| | | *P.expansum* | 47 | 8 | 7 | 6 | 21 | 12.06 |
| | | | 174 | | | | | |
| 6 | *Candida sp* | *C. albicans* | 58 | 10 | 18 | 12 | 40 | 15.5 |
| 7 | *Trichoderma sp* | *T. viridae* | 45 | 8 | 11 | 8 | 27 | 31.76 |
| | | *T. harzinum* | 40 | 10 | 7 | 6 | 23 | 23.05 |
| | | | 85 | | | | | |
| 8 | *Phythium sp* | *Phythium sp* | 56 | 8 | 6 | 9 | 23 | 14 .01 |
| 9 | *Verticillum sp* | *Verticillum sp* | 53 | 9 | 8 | 11 | 28 | 15.84 |
| 10 | *Helmithosporium sp* | *Helmithosporium sp* | 42 | 6 | 4 | 7 | 17 | 14.04 |

**Table – 9** Cultural characteristics of bacteria

| S.No | Organism | Gram stain | Cultural Characteristcs | Motility | Indole | MR | VP | Citrate Utilization | Catalase | Urease |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *E. aerogenes* | _ | Abundant thick, white, glistening growth | Motile | _ | _ | + | + | + | _ |
| 2 | *E.coli* | _ | White, moist, glistening growth | Motile | _ | _ | + | + | + | _ |
| 3 | *B. cereus* | + | Abundant, opaque, white waxy growth | Motile | _ | _ | + | + | + | _ |
| 4 | *C.pyogens* | + | Gray- white, convex growth | Motile | _ | _ | + | + | + | _ |
| 5 | *M. luteus* | + | Circular, entire, convex with regular edges | Non motile | _ | + | _ | _ | + | _ |
| 6 | *P.aeruginosa* | _ | White large wringled growth | Motile | _ | _ | _ | _ | + | _ |
| 7 | *S. aureus* | + | Smooth raised, gilstening with circular growth | Non motile | _ | + | _ | _ | + | _ |
| 8 | *p.vulgaris* | _ | Thin blue- gray, spreading growth | Non motile | + | _ | _ | + | + | _ |
| 9 | *S.lactis* | + | Thin even growth | Non motile | _ | + | _ | _ | _ | _ |
| 10 | *M.luteus* | + | Circular, entire, with regular edges | Non motile | _ | + | _ | _ | + | _ |

**Table – 9** Cultural characteristics of bacteria

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | *B.megaterium* | + | Abundant, opaque, white waxy growth | Motile | _ | + | _ | _ | + | _ |
| 12 | *B. coagulase* | + | White large wringled growth | Motile | _ | _ | + | + | + | _ |
| 13 | *Azotobacter* | _ | Thin blue- gray, spreading growth | Non motile | _ | _ | _ | _ | + | _ |
| 14 | *Azospirillum* | _ | gray, spreading growth | _ | _ | + | + | + | _ | _ |
| 15 | *B. subtilis* | + | Abundant thick growth | Motile | + | _ | _ | + | _ | _ |
| 16 | *S. phyogens* | + | Smooth raised growth | Non motile | _ | _ | + | _ | + | + |
| 17 | *B. circulans* | _ | Circular, entire, with regular edges | Motile | _ | + | _ | _ | _ | _ |

**Table -10** Cultural characteristics on a PDA of the isolated fungi

| S.No | Species | Upper surface | | | Lower surface | Observations |
|---|---|---|---|---|---|---|
| | | Cultural Aspect | Density | Colour | | |
| 1 | *Rhizopus stolonifer* | Effuse cotton | High | White at first become bluish black maturity | Idem to upper face | Rhizords rare sporangiophere |
| 2 | *Aspergillus flavus* | Effuse floccose | Medium | Conidial heads yellow to green | Idem to upper case | Hyphae, Septate with conidiophore |
| 3 | *A .oryzae* | Effuse globose | High | Orange to vinaceous or purple sclerotia | Idem to upper face | Hyphae, Septae with conidiophore |
| 4 | *Pencillium bovis* | Effuse floccose | Light | Grey green to brownish | Idem to upper face | Conidiophore (vertical of phialides) |
| 5 | *P. chrysogenum* | Effuse floccose | Light | Yellow to green | Idem to upper face | Conidiophore, compact vertical of phialides |
| 6 | *Trichoderma viride* | Effuse globose | Medium | Light green | Idem to upper face | Conidio elliptical and septae |
| 7 | *Fusarium sp* | Globose | Light | Grey colour | Idem to upper face | Conidia and septae |
| 8 | *Rhizopus sp* | Effuse cotton | Medium | Conidial heads yellow to green | Idem to lower face | Conidiophores |
| 9 | *Verticillium sp* | Thread like apperance | Light | Light to green White | Idem to lower face | Hyphae, Septae with conidiophore |

## CONCLUSION

The present study was planned to, Isolation and Identification of soil bacteria and fungi from Kumbakonam taluk of Thanjavur (Dt) Tamilnadu deals with diversity and distribution of bacterial and fungal population in an around soil. The physico – chemical parameters of such soils were recorded. Population of soil bacteria and fungi might also get affected by climate and resistance over extreme environmemtal condition.

Bacterial and fungal species are especially important components of biodiversity as major contributors to the maintenance of the earth's ecosystem, biosphere and biogeochemical cycle fungi perform unique and indispensible activities on which larger organism including human depend. The present study could be concluded that there is no uniformity in the diversity of population during season and their distribution pattern in different geographical regions. Several factors of salinity, origin, nature of substrata, pH and diversity bacteria and fungi. So it is obvious that a study based on biodiversity is a major challenging task as we try to predict the secret of nature.

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