# BHARATHIAR UNIVERSITY

COIMBATORE, INDIA.

# APPLICATION OF VETIVER FOR WATER AND SOIL RESTORATION

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# TIRUPUR'S CRISIS

**Orathupalayam Dam was constructed across river River Noyyal in 1981 and opened in 1992 for irrigating 30,000 acres of land and provide drinking water to the same people and cattle. But within 10 years of the dam's completion, the TIRUPUR town located in the upstream of Orathupalayam developed into a garment export centre.**

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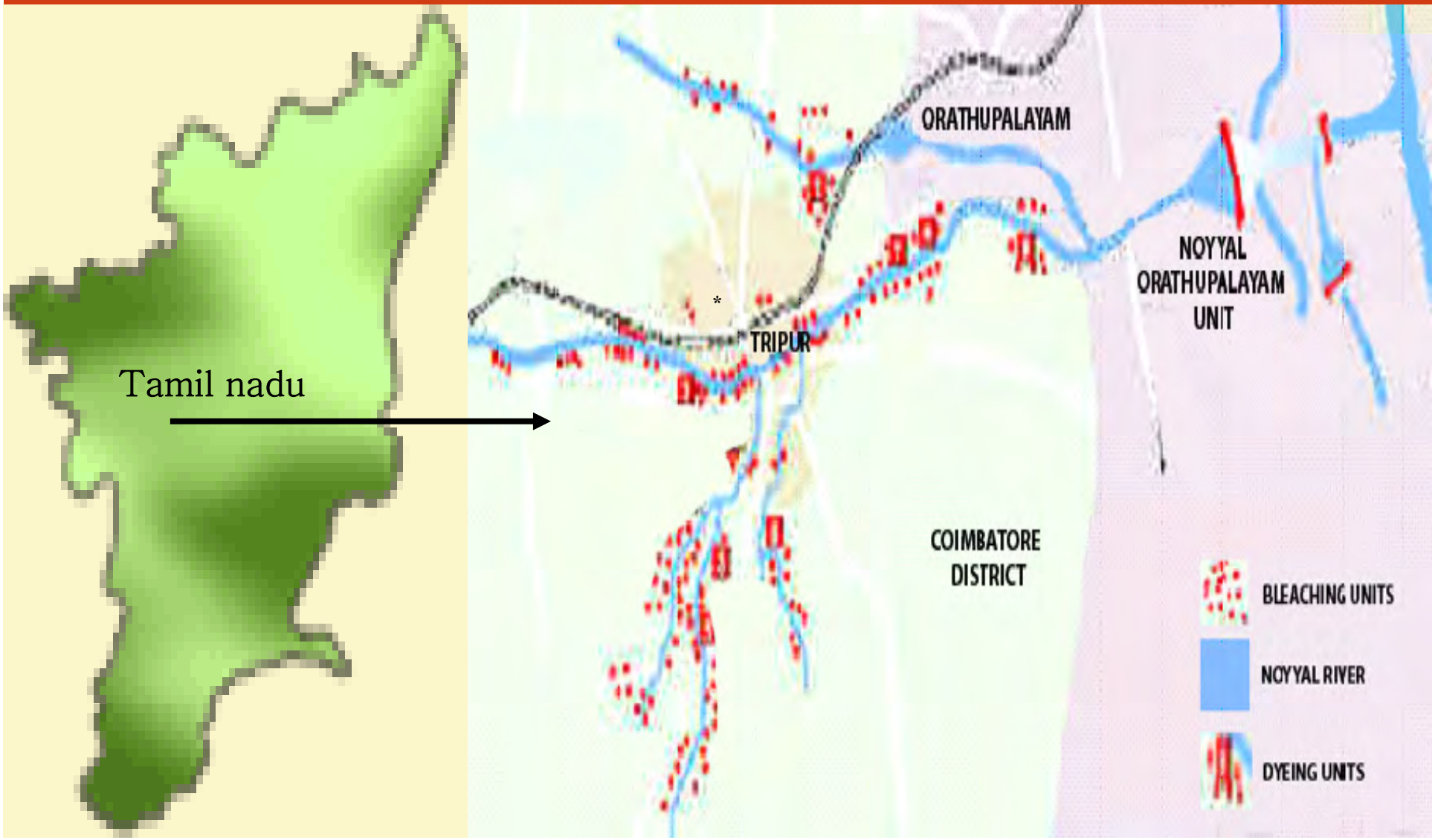
# MAP SHOWING THE LOCATION OF DYEING AND BLEACHING UNITS AND THE NOYYAL RIVER IN TIRUPUR AREA AND THE ORATHUPALAYAM DAM



➢**The dyeing industries and town sewage discharged enormous amount of polluted water, which flowed and polluted the Orathupalayam storage reservoir.**

➢ **The Dam water became highly toxic and caused great destruction to farmlands, livestock and the livelihood of the people downstream, when the dam was opened for the first time in 1992. The court has ordered the permanent closure of the Dam on appeal of Karur district farmers.**

➢**But the Dam has a continuous inlet of large quantity of polluted water discharged from Tirupur and reaches critical stage at many times.**

➢ **If the critically filled dam was opened, then the toxic water will affect the entire River Noyyal and River Cauvery downstream.**

# BEFORE 10 YEARS AT PRESENT .....

DAM

# DYE UNITS IN TIRUPUR TOWN

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Untreated effluents are discharged from dyeing units to the Orathupalayam reservoir. (Front line, Aug 13th, 2006).

# POLLUTED CITY

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The Department of Environmental Sciences, Bharathiar University, Coimbatore, through concerted effort to develop an affordable and environment friendly wastewater treatment technology and soil remediation technology harnessing the absorption, adsorption and degradation potential of microbes and plants. (THE HINDU, Nov 26th, 2006.)

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# REMEDIATION

## PHYTOREMEDIATION

Vetiver

## MICROBIAL REMEDIATION

Bacillus spp & Pseudomonas spp

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# PHYTOREMEDIATION

Phytoremediation is an emerging technology which uses plants and their associated rhizospheric microorganisms to remove, degrade, or contain chemical contaminants located in the soil, sediments, groundwater, surface water, and even the atmosphere.


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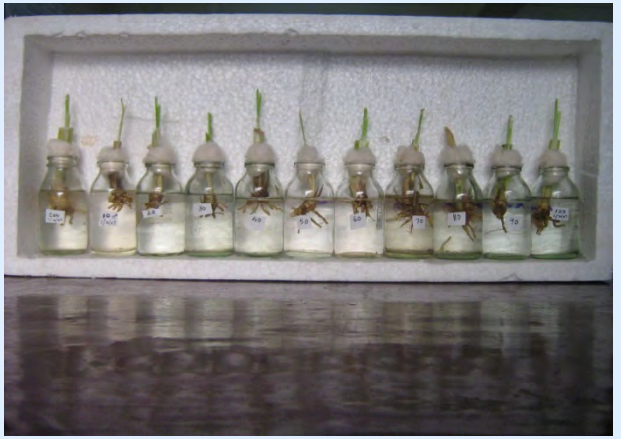
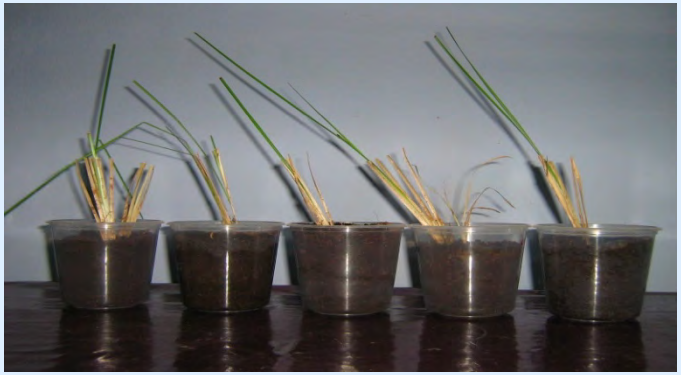
# PRODUCTION OF VETIVER CULMS IN THE LAB









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# IN WOODEN BOXES, BROKEN PIPES & SACS









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Dr.P.Lakshmanaperumalsamy

Dr.P.Lakshmanaperumalsamy


175cm

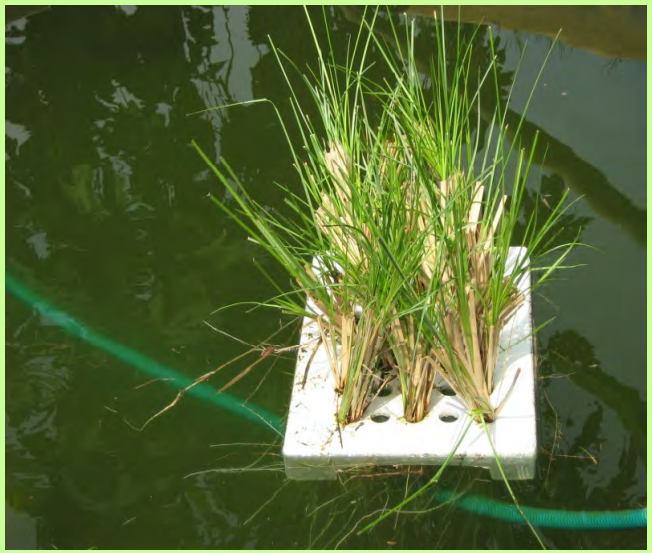

125cm


145cm


75cm








# Lab study – in the experimental tank

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# VETIVER CULMS

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# MUNICIPAL WASTE WATER SAMPLE TREATMENT




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# Table 1: Physico-chemical parameters of Municipal wastewater treated with *C.zizanioides*

| Parameters | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | T1 | | T2 | | T3 | |
| | Initial | Final | Initial | Final | Initial | Final |
| pH | 7.9 ± 0.1 | 7.7 ± 0.2 | 7.9 ± 0.1 | 7.2 ± 0.1 | 7.6 ± 0.2 | 7.3 ± 0.1 |
| EC | 1.36 ± 0.01 | 1.24 ± 0.01 | 1.36 ± 0.01 | 0.9 ± 0.02 | 1.33 ± 0.01 | 1.03 ± 0.01 |
| DO (mg/l) | 6.9 ± 0.1 | 6.7 ± 0.3 | 6.9 ± 0.1 | 5.2 ± 0.2 | 6.1 ± 0.1 | 5.7 ± 0.3 |
| BOD (mg/l) | 64.0 ± 1 | 58.2 ± 3 | 64.0 ± 1 | 29.6 ± 2 | 45.3 ± 1 | 25.4 ± 3 |
| COD (mg/l) | 160 ± 2 | 120 ±1 | 160 ±2 | 42.1± 1 | 104 ± 1 | 47.8 ± 1 |
| Nitrate Nitrogen (mg/l) | 0.81± 0.1 | 0.68 ± 0.2 | 0.81 ± 0.1 | 0.04 ± 0.01 | 0.59 ± 0.2 | 0.05 ± 0.02 |
| Phosphate (mg/l) | 54 ± 1 | 47.5 ± 2 | 54 ± 1 | 5.4 ± 1 | 35 ± 2 | 4.55 ± 1 |
| OC (%) | 12.33 ± 1 | 9.9 ± 1 | 12.33 ± 2 | 5.3 ± 0.5 | 8.32 ± 2 | 4.9 ± 0.5 |
| TDS (mg/l) | 189 ± 2 | 174 ± 1 | 189 ± 2 | 140 ± 1 | 101 ± 2 | 79 ± 1 |

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# Table – 2 Morphological parameters of *C.zizanioides* grown in different treatments (Municipal waste water)

| Parameters | T1 | T2 | | T3 | |
|---|---|---|---|---|---|
| | | Initial | Final | Initial | Final |
| Root length (cm) | Without plant | 10 ± 0.5 | 75 ± 1 | 10 ± 0.5 | 70 ± 2 |
| Shoot length (cm) | | 10 ± 0.6 | 64 ± 2 | 10 ± 0.6 | 59 ± 1 |
| Fresh weight (g) | | 8.8 ± 0.2 | 166 ± 1 | 8.8 ± 0.2 | 162 ± 3 |
| Dry weight (g) | | - | 20.63 ± 1 | - | 18.52 ± 2 |
| Total chlorophyll (mg/g) | | 0..81± 0.01 | 1.22 ± 0.03 | 0.81± 0.01 | 1.30 ± 0.02 |

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# Table – 3 Microbial population of municipal waste water in different treatments.

| Treatments | Bacteria (cfu x $10^5$/g) | | | | Fungi (cfu x $10^4$/g) | | | | Actinomycetes (cfu x $10^4$/g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rhizosphere | | Non Rhizosphere | | Rhizosphere | | Non Rhizosphere | | Rhizosphere | | Non Rhizosphere | |
| | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| T1 | - | - | 126 | 138 | - | - | 12 | 16 | - | - | 8 | 12 |
| T2 | 131 | 210 | 126 | 166 | 11 | 34 | 12 | 26 | 9.5 | 26 | 8 | 23 |
| T3 | 129 | 196 | 112 | 145 | 9 | 27 | 8 | 19 | 7.5 | 14 | 5.5 | 18 |

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# PHYTOREMEDIATION ORATHUPALAYAM SOIL SAMPLE TREATED WITH VETIVER



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# Physico-chemical parameters of Orathupalayam soil sample in different treatments

**Fig - 1 pH of treated soil**

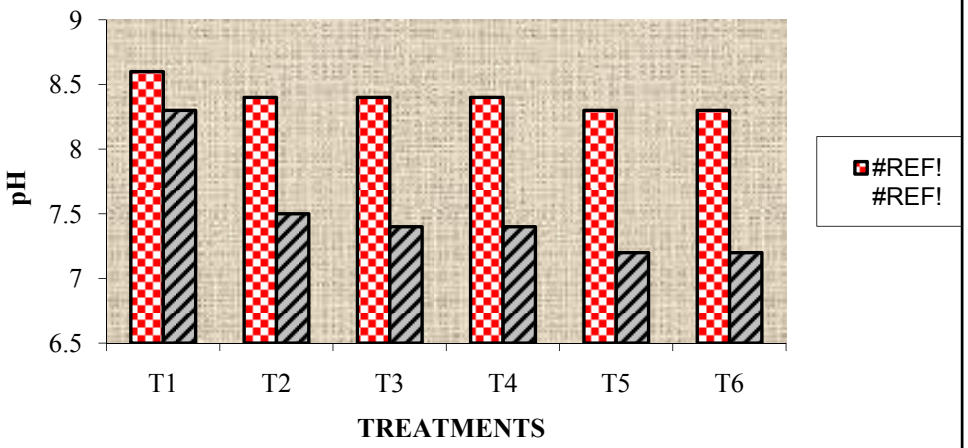



**Fig - 2 EC of treated soil**

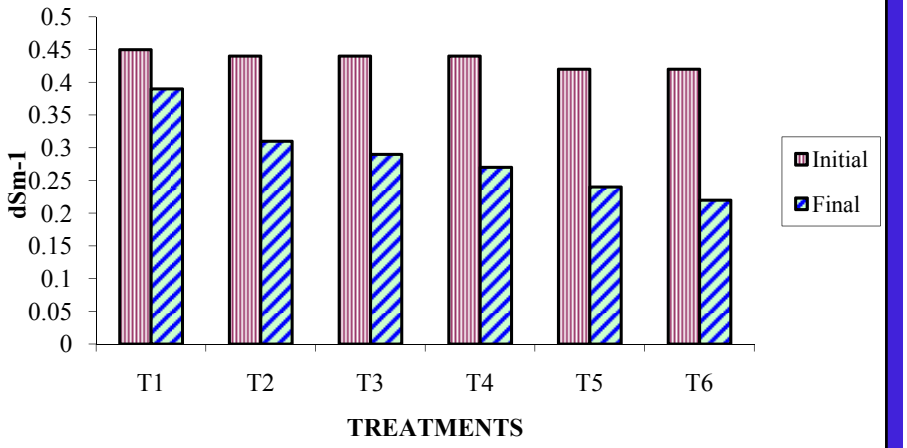
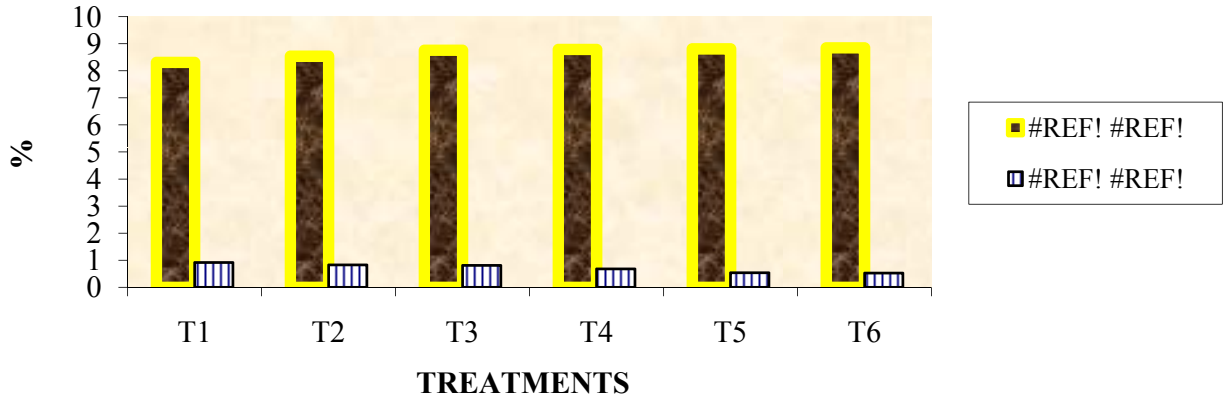



**Fig - 3 TKN % of treated soil**

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# Physico-chemical parameters of Orathupalayam soil sample in different treatments

**Fig - 4 Phosphorous % of treated soil**

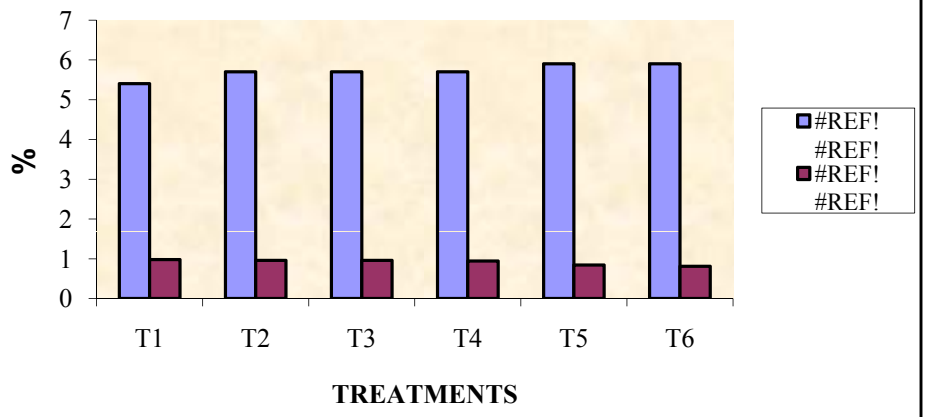



**Fig - 5 K % of treated soil**

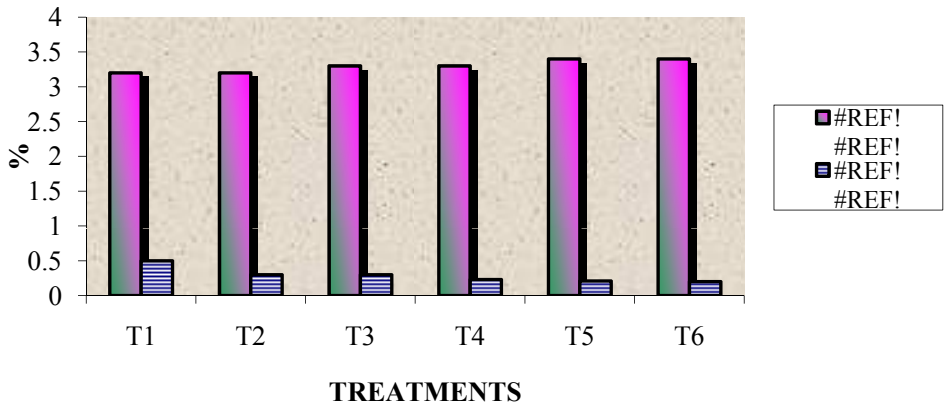
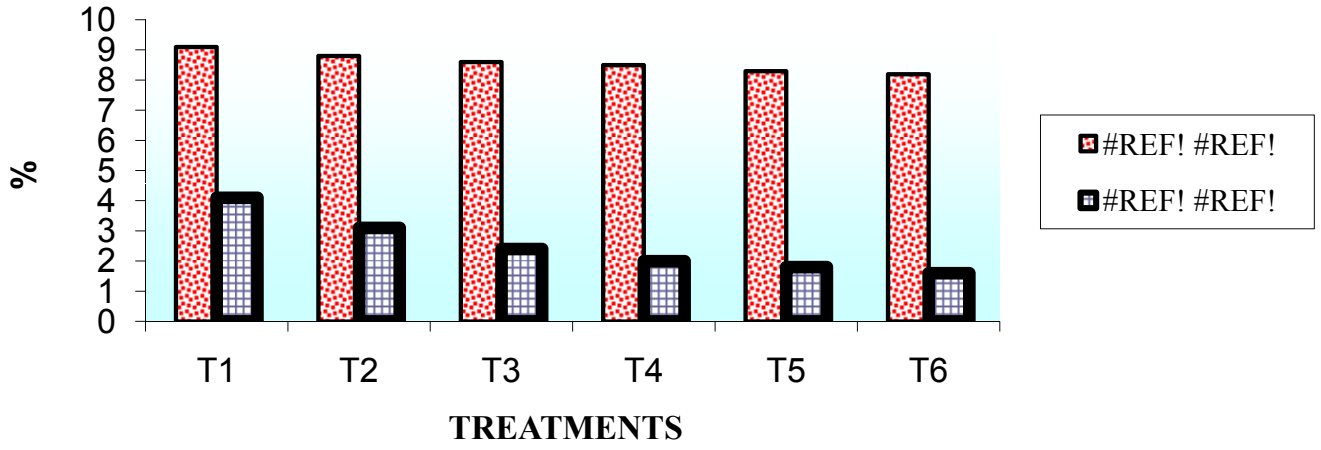



**Fig - 6 TOC % of treated soil**

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# Table – 4 Heavy metal contents of Orathupalayam soil sample in different treatments

| Treatments | Pb (ppm) | | Cd (ppm) | | Cu (ppm) | | Zn (ppm) | | Fe (ppm) | | Mn (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| T1 | 1.57± 0.01 | 0.55 ± 0.02 | 0.244 ± 0.01 | 0.044 ± 0.02 | 0.78 ± 0.02 | 0.07 ± 0.01 | 1.10 ± 0.02 | 0.63 ± 0.01 | 6.66 ± 0.02 | 3.01 ± 0.02 | 2.64 ± 0.01 | 0.44 ± 0.02 |
| T2 | 1.55 ± 0.02 | 0.53 ± 0.01 | 0.339 ± 0.02 | 0.041 ± 0.01 | 0.76 ± 0.01 | 0.05 ± 0.02 | 1.08 ± 0.01 | 0.45 ± 0.01 | 6.62 ± 0.02 | 2.84 ± 0.02 | 2.34 ± 0.01 | 0.40 ± 0.02 |
| T3 | 1.49 ± 0.01 | 0.48 ± 0.02 | 0.233 ± 0.01 | 0.039 ± 0.02 | 0.74 ± 0.02 | 0.04 ± 0.02 | 1.05 ± 0.02 | 0.33 ± 0.01 | 6.55 ± 0.02 | 2.62 ± 0.01 | 2.32 ± 0.02 | 0.32 ± 0.01 |
| T4 | 1.42 ± 0.02 | 0.40 ± 0.02 | 0.231 ± 0.01 | 0.035 ± 0.01 | 0.73 ± 0.02 | 0.04 ± 0.01 | 1.04 ± 0.02 | 0.32 ± 0.01 | 6.49 ± 0.02 | 2.35 ± 0.02 | 2.29 ± 0.02 | 0.25 ± 0.02 |
| T5 | 1.36 ± 0.02 | 0.32 ± 0.01 | 0.229 ± 0.02 | 0.032 ± 0.02 | 0.69 ± 0.01 | 0.03 ± 0.02 | 1.03 ± 0.01 | 0.29 ± 0.02 | 6.38 ± 0.02 | 2.28 ± 0.01 | 2.27 ± 0.02 | 0.14 ± 0.01 |
| T6 | 1.30 ± 0.01 | 0.28 ± 0.02 | 0.221 ± 0.01 | 0.029 ± 0.02 | 0.69 ± 0.02 | 0.01 ± 0.02 | 1.02 ± 0.02 | 0.28 ± 0.01 | 6.21 ± 0.02 | 2.21 ± 0.02 | 2.19 ± 0.02 | 0.12 ± 0.02 |

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Table – 5 Morphological parameters of *C.zizanioides* grown in different treatments (Orathupalayam soil)

| Treatments | RL (cm) | | SL (cm) | | FW (g) | | DW (g) | | Total chlorophyll mg/g | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initial | Final | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| T1 | 10 ± 0.4 | 18.2 ± 0.2 | 10 ± 0.1 | 43.0 ± 0.2 | 6.2 ± 0.1 | 180 ± 0.1 | - | 19.2 ± 0.1 | 0.123 ± 0.1 | 0.197 ± 0.1 |
| T2 | 10 ± 0.2 | 42.0 ± 0.2 | 10 ± 0.2 | 51.1 ± 0.1 | 6.2 ± 0.2 | 195.2 ± 0.1 | - | 20.1 ± 0.1 | 0.216 ± 0.2 | 0.297 ± 0.1 |
| T3 | 10 ± 0.1 | 48.2 ± 0.1 | 10 ± 0.4 | 55.2 ± 0.1 | 6.2 ± 0.1 | 210.3 ± 0.1 | - | 20.9 ± 0.1 | 0.262 ± 0.1 | 0.410 ± 0.1 |
| T4 | 10 ± 0.2 | 51.3 ± 0.2 | 10 ± 0.3 | 58.1 ± 0.2 | 6.2 ± 0.1 | 252.5 ± 0.2 | - | 28.1 ± 0.1 | 0.257 ± 0.2 | 0.624 ± 0.2 |
| T5 | 10 ± 0.1 | 69.4 ± 0.1 | 10 ± 0.1 | 59.7 ± 0.1 | 6.2 ± 0.1 | 260.0 ± 0.2 | - | 32.7 ± 0.2 | 0.272 ± 0.3 | 0.871 ± 0.2 |
| T6 | 10 ± 0.3 | 75.2 ± 0.1 | 10 ± 0.4 | 65.3 ± 0.2 | 6.2 ± 0.2 | 273.1 ± 0.1 | - | 35.3 ± 0.2 | 0.269 ± 0.1 | 0.981 ± 0.2 |

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# Microbial population of Orathupalayam soil sample in different treatments

**Fig -7 Bacterial population of treated soil**

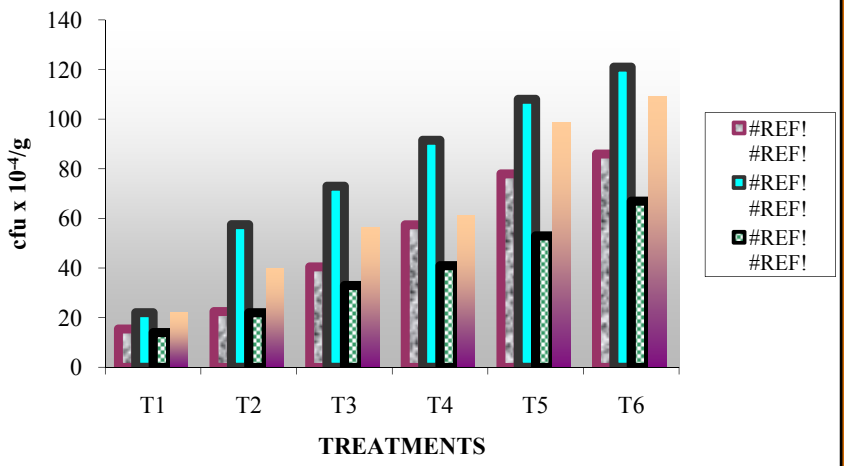



**Fig - 8 Fungal population of treated soil**

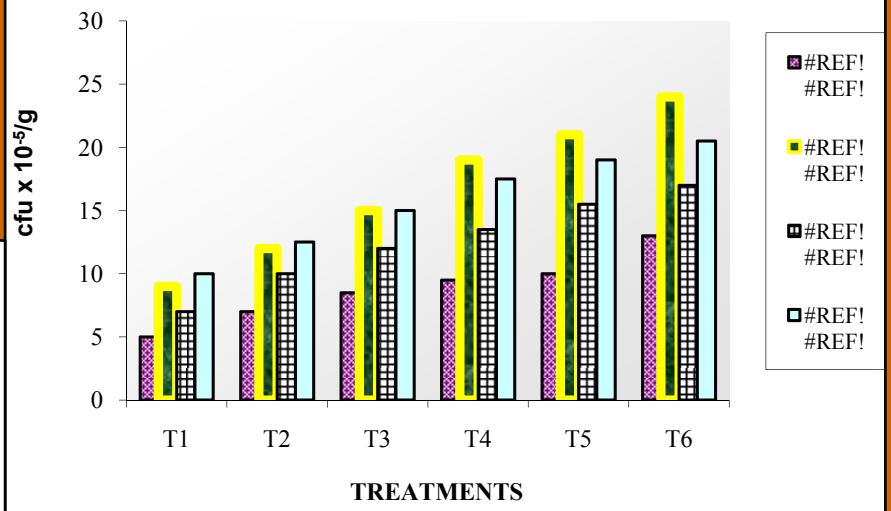
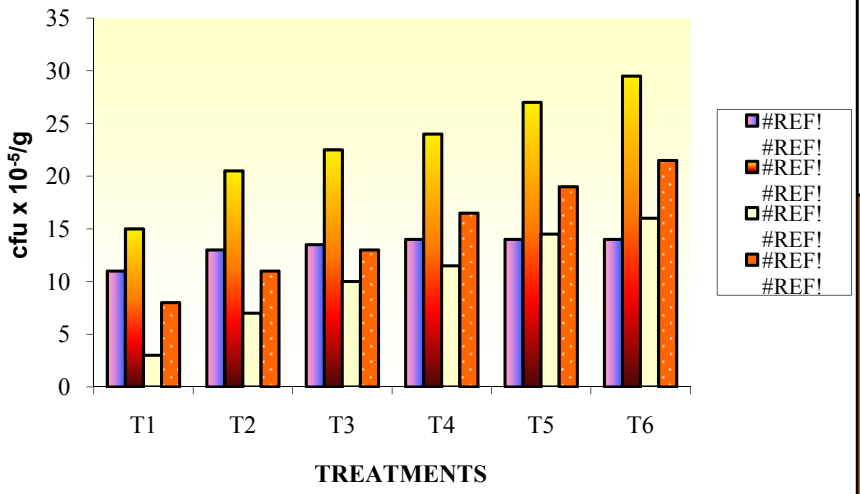



**Fig - 9 Actinomycetes population of treated soil**

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# VARIOUS PURPOSES OF VETIVER PLANTATION


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# TRIAL IN THE OOTY LAKE TO CHECK THE GROWTH OF VETIVER IN LOW TEMPERATURE

**PROFESSOR & PWD OFFICER**

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# TO CHECK SOIL EROSION

AFTER TWO WEEKS ...

PLANTATION IN THE UNIVERSITY STADIUM

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# VETIVER TO CONTROL SOIL EROSION IN THE UNIVERSITY CAMPUS

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# Vetiver as an intervening crop as a pest control

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# CONCLUSION

**VETIVER IS AN IDEAL PLANT FOR**

- **TEXTILE WASTE WATER TREATED SOIL AND MUNICIPAL WASTE WATER REMEDIATION (PHYTOREMEDIATION)**
- **SOIL CONSERVATION**
- **PEST CONTROL AS AN INTERVENING CROP.**

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THANK YOU