CONCLUSION

The present investigation has been taken up with the objectives of studying the effect of tannery effluents on physico-chemical properties of Ambur soils in Vellore district. An attempt has also been made to identify the suitable amendments for ameliorating the adverse effects of tannery effluent and thereby increasing the crop production. The influence of seepage effect of tannery effluent on the quality of well waters in the vicinity of factory site was also evaluated in this study.

The pot culture experiment consisted of soil with five different organic amendments namely Press mud, Poultry Manure, Vermicompost, Farmyard manure and composted Coconut coir pith. The amendments were added to the pots at a rate of 12.5 t ha^{-1}, mixed well with soils and incubated for 120 days.

Samples of well waters, initial soil samples as well as the post harvest soil samples of pot culture were analyzed for their physico-chemical properties. The yield of maize and straw were recorded and the above said data were subjected to statistical scrutiny. The salient findings from the present investigations are presented below:

In this study, the pH values ranged from 7.02 to 8.37. EC values ranged from 2.4 to 11.6 dS m^{-1}. TDS values varied from 964 to 4670 mg L^{-1}. The chloride values ranged from 464 to 4699 mg L^{-1}. The sulphate concentration ranged from 123 to 1345 mg/ L. The total hardness varied from 523 to 3138 mg L^{-1}. All the samples except Veerankuppam showed the total hardness values above the tolerance limit.

Calcium was found in the samples ranging from 5.0 meq L^{-1} to 14.6 meq L^{-1}. In the present study, magnesium hardness ranged from 4.2 meq L^{-1} to 22.7 meq L^{-1}. The

values of magnesium were higher than the permissible limit. The sodium values varied from 12.55meq L^{-1} to 81.00 meq L^{-1} and potassium values varied from 0.10 meq L^{-1} to 0.64 meq L^{-1}.

All the samples have very high values of COD (142 to 700 mg L^{-1}). The Somalapuram sample showed the highest value. Four villages have SAR vaues higher than the limit for S1 class. Govindapuram, Sandrourkuppam and Solur came under S2 class and Somalapuram came under S3 class. Somalapuram sample was more polluted since the well was very close to the tannery.

The chromium concentration in ground waters varied from 0.45 to 11.7 mg L^{-1}. All the samples had relatively higher concentration of chromium, exceeding the safer limit of drinking water (0.05mgL^{-1}) and irrigation water (2 mg L^{-1}). The soil pH values ranged from 8.3 to 9.3. So these samples need reclamation to make productive land. The soil samples showed the EC values from 0.2 to 0.3 dS m^{-1}.

The soil samples showed nitrogen values ranged from 143 to 266 kg ha^{-1}, Phosphorous values from 3.7 to 28.4 kg ha^{-1} and K values from 210 to 593 kg ha^{-1}. Somalapuram, Sandrourkuppam and Solur samples showed low nitrogen content. The soil samples were tested for the presence of $CaCO_3$ and 70 % of the soil samples showed medium level of $CaCO_3$.

The soil organic carbon values ranged from 0.43 to 0. 0.64 %. The soil sample of Kaspa showed the lowest value (0.43 %) and the soil sample of Somalapuram showed the highest value (0.64 %). Tannery effluents contaminated soils showed

Chromium values from 460 to 1521 mg kg^{-1} since they were contaminated by tannery effluents. The soil sample of Solur showed the highest chromium value (1521 $mgkg^{-1}$).

Therefore, in the current study, the potential of selective organic amendments on soil fertility and bioavailability of chromium and its uptake by maize was examined by conducting a pot experiment.

Surface soil sample of Govindapuram village of Ambur taluk was collected for conducting a pot culture experiment, to study the effect of tannery effluent and organic amendments on the physico-chemical properties of soil, as well as on the yield and uptake of nutrients by maize crop.

Initially, the soil organic carbon ranged from 5.2 to 7.24%. The soil with the application of composted coir pith (T_6) had the highest amount of soil organic carbon. Irrespective of treatments, the SOC was found decreased gradually during the incubation. At the end of 120 days of incubation, after harvesting the SOC ranged between 3.28 and 4.71%.

The contaminated soils had EC values varied between 0.21 to 0.37dSm^{-1}. The $KMnO_4$-N (available N) content of soils was generally low. The $KMnO_4$-N ranged from 220 to 282 kg ha^{-1}. Similarly, the soil available P contents were higher in most of the villages and it varied from3.41 to 19.8 kg ha-1.The K content of soils ranged between 368 and 489 kg ha^{-1}.

Due to the application of organic amendments, the grain yield of maize was significantly increased. Under the chromium contamination, the role of organic amendments microbes in reducing the toxicity of chromium is very important. The

application of organic amendments increased N, P and K contents of the soil. The applications of organic amendments have proved their effectiveness in not only increasing the available nutrient status but also suppress the Cr (VI) content in both in soil and plant.

From the results, it was evident that the values of all growth parameters shoot height, root length, fresh shoot weight, root weight, cob weight and straw yield increased in all the organic amendments treated soil compared to control. However the rate of increase differed among the amendments.

The difference in the efficiency of poultry manure and other organic amendments attributed mainly to the differential nutrients and organic matter contents. The higher yield obtained with poultry manure could be attributed to either an increase in the availability of nutrients or to reduced bioavailability of chromium in soil, leading to increased nutrient uptake.

The organic amendments treated soil samples were analysed for the micronutrients Copper, Manganese, Zinc and iron before sowing and after maize harvesting. It was found that the concentration of micronutrients Cu, Mn, Zn and Fe present in the soil increased compared to the control irrespective of the organic amendments.

When soil was treated with organic amendments, the concentration of chromium was found decreased irrespective of the amendments. The decrease in chromium concentration was more in poultry manure treated soil. After the maize harvesting, the poultry manure treated soil contained maximum amount of chromium

which implied that the Cr uptake by maize plant was less compared to other amendments.

Therefore from the chromium study, it was found that the organic amendments can be used for the bio-remediation of chromium contaminated soils and among the organic amendments, poultry manure was the best amendment in the treatment of chromium contaminated soil.

From the initial concentration 1140 $\mu g\ g^{-1}$, in soils under maize, a large reduction in the chromium (546 $\mu g\ g^{-1}$) was observed in the surface soil. This explained why the Cr content and uptake by maize were greater when they were grown on the control soil. There observed a positive correlation between chromium concentration in plants and chromium concentration in soil.

When organic amendments were added, the water soluble chromium decreased irrespective of the amendments. The rate of decrease in the concentration of water soluble - Cr was more in farmyard manure and vermicompost treated soil. The results of the pot experiment showed that maize growth and chromium uptake were significantly affected due to application of organic amendments.

The plants grown on soil without any amendments had lesser biomass. The application of organic amendments resulted in a significantly greater biomass of maize.

There exists a negative correlation between the biomass yield and water soluble fraction of chromium in soil. This suggests that with increasing concentration of chromium both in soil and plant, chromium exerted phytotoxicity on plants.

Relatively large amount of chromium was found accumulated in roots, than in shoot and cob of maize. The maize grown on control soil showed greater accumulation of chromium (416 µg/g). Whereas, maize when grown on soil amended with organic amendments appeared to have significantly lesser amount of chromium in roots, leaves and stem.

From the results, it was evident that the values of all the growth factors shoot height, root length and shoot biomass increased with the period of growth. The height of shoot, root and shoot biomass increased as the rate of poultry manure increased in both moisture regimes. But the height of shoot, root and shoot biomass was greater in complete saturation condition compared to alternate wetting and drying condition.

As the rate of poultry manure increased, the chromium uptake of plant decreased. From the study it was found that the chromium uptake by maize plant in complete saturation condition was less compared to the alternate wetting and drying condition.

The distribution of chromium in organic amendments treated soil was studied. A pot experiment was conducted. The changes in the concentration of soluble chromium (H_2O-Cr), exchangeable and adsorbed chromium (KNO_3-Cr), organic form of chromium (NaOH-Cr), iron and aluminium oxide bound – Cr (EDTA-Cr) and the residual Cr or acid soluble – Cr (HNO_3-Cr) during the incubation were presented. In the control soil, initially, the relative distribution of Cr species followed:

HNO_3-Cr >> NaOH-Cr > EDTA-Cr > KNO_3-Cr > H_2O-Cr

After the harvest of maize the Cr content in soil was examined. From the initial concentration of 1140 mg kg^{-1} in soil a large reduction in the chromium concentration (546 mg kg^{-1}) was observed. In the control soil, a reduction of about 53 percent in chromium content of maize was recorded. This explains why the Cr content (fig.34) and uptake (fig.35) by maize were greater when they were grown on the control soil.

The aim of the study was to investigate the relative efficacy of different organic amendments on soil microbial population and soil enzyme activity. As soon as the soil was mixed with compost, the microbial population was minimum. After six weeks the microbial population increased irrespective of the organic amendments. It was found that the bacterial population, actinomycetal population and the fungal population was maximum in vermicompost treated soil. At any stage, the microbial population of the organic amended soil was greater than the control soil. The addition of compost significantly increased the soil microbial biomass in comparison to the control.

The aim of the study was to examine the effects of different organic amendments on soil enzyme activities. The activities of all the enzymes varied significantly in different organic amendments. Initially the activities of all the enzymes were generally higher but it decreased after six weeks. The enzyme activities were higher than the control soil at any stage.

The high amount of organic carbon added through organic amendments also might have stimulated microbial and enzyme activities in soil which may be important for various biochemical processes involving soil fertility.

The high amount of organic carbon added through organic amendments also might have stimulated microbial and enzyme activities in soil which may be important for various biochemical processes involving soil fertility.

As the organic amendments contain significantly higher amount of NPK, large amounts of these nutrients might have added to the soil and increased the nutrient status. The organic amendments increased the bacterial population, enzyme activities and microbial activities, which are the key factors of nutrient availability to the plants. Rich microbial population and enzyme contents of the organic nutrient sources might have been responsible for soil biological quality.

The microbial population is more in the organic amendments treated soil. Microbial population is maximum for VC treated soil. But in this study it is found that poultry manure treated soil is more suitable for maize cultivation. Therefore microbial population alone could not be used as the indicator of soil fertility.

The difference in the efficiency of different amendments like poultry manure and vermicompost is attributed mainly to the differential nutrients and organic matter contents. The higher yield obtained with poultry manure could be attributed to either an increase in the availability of nutrients or to reduced bioavailability of Cr in soil, leading to increased nutrient uptake.

The current study has shown that the indiscriminate disposal of tannery wastes resulted in severe contamination of soil and ground waters with chromium in Vellore District. The results of laboratory and pot experiments have demonstrated the

effectiveness of organic amendments like in remediating the chromium contaminated soils.

The application of poultry manure or vermicompost was found to reduce the bioavailability and thus the biotoxicity of chromium mainly by immobilization, which restricts the Cr uptake by crop. The application of these organic amendments was also found to improve the fertility of chromium contaminated soil.