

ABSTRACT

IMPACT ASSESSMENT AND MANAGEMENT OF PHARMACEUTICAL INDUSTRIAL WASTE FOR SUSTAINING SOIL AND ENVIRONMENTAL HEALTH

By

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The Pharmaceutical industries are less water intensive ones. The scientific ways and means of utilizing their solid and liquid wastes in a ecofriendly manner was the main objective of this present investigation.

It was found that the treated effluent released from the Imperial Chemical Industry (ICI) Pharmaceutical unit, Chennai was colourless and odourless in nature and the pollutant load in terms of BOD and COD and various parameters were within the permissible safe limits of Tamil Nadu Pollution Control Board. The biosludge of this industry was neutral in reaction and its organic carbon content was fairly high which was biodegradable. The nitrogen content of the biosludge was 1.24 per cent and its C/N ratio was very narrow. It has appreciable quantities of Ca and Mg hence has ameliorative property too. It was found that the spent carbon and organic waste were recalcitrant in nature.

The Ecotoxicological investigations revealed that the treated effluent at different concentrations were found to be non toxic to the aquatic fauna. Bioassay of the effluent with *Bacillus* and *Aspergillus* sp. revealed that the pharmaceutical effluent did not inhibit the growth of these microbes. The test crops, Radish and Cucumber registered higher germination percentage, dry matter production and vigour index under all dilutions levels and even under undiluted situation.

The pot culture investigations with biosludge incorporation and effluent irrigation on maize revealed that the undiluted effluent supported the growth and productivity of maize as compared to 50 per cent dilution enhancing the productivity by 4.5 per cent. The incorporation of biosludge at 200 t ha⁻¹ was found to be equal in effect with that of 100 per cent NPK fertilization with reference to grain yield and DMP of maize. The incorporation of biosludge @ 50 t ha⁻¹ was comparable in effect with that of FYM at 12.5 t ha⁻¹. The soil pH under 100 per cent effluent irrigation was found to be increased by 0.02 units during cropping season. The EC of soil too increased by 0.05 units. The available soil N and P were significantly higher under 100 per cent biosludge treatment. With reference to soil enzyme activity, it was found that the enzyme activity was higher under 50 per cent effluent irrigation than under 100 per cent concentration. Among the graded levels of biosludge, biosludge @ 200 t ha⁻¹ registered the highest enzyme activity revealing that 200 t ha⁻¹ level was favourable for good soil-biosludge-microbial interaction.

The pot culture studies with biosludge incorporation along with various amendments and effluent irrigation on maize revealed that among the amendments tried, incorporation of poultry manure or pressmud along with biosludge significantly enhanced the drymatter production, grain yield and nutrient uptake of maize. It was observed that application of gypsum with biosludge registered higher exchangeable Ca and Mg and accordingly ESP and SAR were lowered by this amendment. The poultry manure amended soil recorded higher enzyme activity with reference to amylase, invertase, catalase and phosphatase due to favourable microbial interaction.

The investigation on the use of biosorbents on sodium adsorption and consequential reduction of sodium in the effluent revealed that spent carbon of the pharmaceutical industry adsorbed the maximum Na from the effluent followed by rice husk and saw dust and the adsorption data followed the freundlich isotherm pattern of adsorption.

Thus the characterization, toxicological evaluation, pot culture experiments and adsorption studies with the treated pharmaceutical industrial effluent and that of the biosludge indicated that there are lot of potential to use the effluent as irrigation water substitute and the biosludge as organic manure and as an ameliorant for sustaining soil health and crop productivity. However their long term effect on soil-water-plant ecosystem needs to be investigated.