

Impact of treated sewage effluent on soil fertility, salinization, and heavy metal content

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ABSTRACT: A long-term experiment (2013 to 2017) of treated sewage effluent (TSE) levels via fertigation in a humid tropical region was installed in Jaboticabal, state of São Paulo, Southeast of Brazil, to evaluate the impact of TSE on soil fertility and the potential for salinization and heavy metal contamination of an Oxisol. The area was cultivated with *Urochloa brizantha* under the application of four TSE levels at the irrigation depth (0, 11, 60, and 100% TSE) during the four years of the experiment. The TSE chemical composition was monitored throughout the experimental period. The heavy metal levels and soil fertility were evaluated in the 0–0.10 and 0.10–0.20 m layers at the end of the four years of the experiment. Fertigation using TSE did not increase the concentration of potentially toxic elements (As, Cd, Cu, Hg, Mo, Ni, Pb, Se, and Zn) in the soil due to their low concentration in the effluent. A higher Na concentration was also observed at high TSE levels (60 and 100%). However, the sodium adsorption rate in the TSE was low, generating no potential for soil salinization and sodification. Fertigation with TSE levels increased soil fertility, increasing by more than 30% the P content and base saturation in the soil compared to control. According to the chemical attributes evaluated in the soil and effluent, this long-term study showed that TSE application via fertigation in humid tropical regions on clayey soils cultivated with forage grasses is recommended.

Key words: water reuse, environmental contamination, soil chemical analysis, potentially toxic elements, wastewater.

INTRODUCTION

The increasing demand for food and water and the environmental pollution as a result of constant population growth are important global challenges facing humanity nowadays. Water consumption has increased in recent years at twice the rate of population growth and will continue to grow at a similar rate in the near future (Lavrnić et al. 2017). The agricultural sector is the most affected by water scarcity, as it accounts for 70% of global freshwater withdrawals for irrigation and over 90% of consumption (Norton-Brandão et al. 2013). On the other hand, the concentration of the human population in urban areas has significantly increased the production of sewage wastewater, which causes detrimental environmental impacts if appropriate actions are not taken.

In this context, wastewater can be an important component of an integrated water management policy (Van Lier and Huibers 2010; Andrews et al. 2016). Treated domestic wastewater is a widely available sustainable hydric source that can be used to meet the growing demand for agricultural irrigation (Santos et al. 2017). Thus, in recent years, wastewater recycling has gained importance as part of agricultural water sources in many countries facing water scarcity (Coelho et al. 2020).

The application of treated sewage effluent (TSE) in agricultural areas may be a viable alternative for nutrient recycling, reducing the water footprint in agriculture and increasing soil fertility. Therefore, it is necessary to examine the quality of the effluent to be used for this purpose. The application of TSE in agriculture provides essential nutrients to crops, especially

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Sewage and Biomass from Wastewater to Energy Inamuddin,Tariq Altalhi,Mohammad Luqman,Joseph K. Bwapwa,2024-06-21 Written and edited by a team of industry experts this exciting new volume covers clean energy production from sewage and biomass while achieving a zero waste strategy Wastewater treatment plants are critical in protecting both the environment s resources and human health A wastewater treatment plant s technological system focuses not only on the effectiveness of the treatment but on the costs and energy consumption of the entire system Municipal wastewater treatment produces a significant amount of sewage sludge all over the world The majority of this sludge s dry matter content is made up of organic compounds which are not toxic and they consist of both primary and secondary microbiological sludge There is also a substantial quantity of inorganic substances in the sludge along with a small quantity of toxic matter Also various raw sewage treatment options can include energy production heat electricity or biofuel to reduce dependence on external energy supply during treatment The most important options used for energy production from sewage and biomass can use the following approaches anaerobic digestion co digestion incineration with energy recovery co incineration pyrolysis gasification supercritical wet oxidation and hydrolysis Generally these processes or methods are cost effective but they can still have some setbacks related to the nature of the methods or the raw material used for conversion There are also operating conditions to comply with to get a successful outcome This book combines information from many disciplines related to wastewater treatment technologies to show how the circular economy approach can be used to achieve zero waste and produce energy that can be useful for plants and communities This approach focuses on clean technologies for green energy resources such as biohydrogen biofuels and biogas from biomass and sewage sludge for zero waste production This is aimed to also integrate the issue of energy demand and the one of energy production

Soil Fertility and Nutrient Management A.S. Jadeja,D.V. Hirpara,L.C. Vekaria,H.L. Sakarvadia,2021-06-23 The book entitled Soil Fertility and Nutrient Management is a compilation work and most of the information was farmed very critically covering all the main topics of plant nutrition The book will be serve as useful reference to students teachers researchers scientists policy makers and other interested in soil science agronomy crop science environmental sciences and agriculture Note T F does not sell or distribute the Hardback in India Pakistan Nepal Bhutan Bangladesh and Sri Lanka

Manures, Fertilizers And Soil Fertility S Mohandas,2023-09-20 Organic manure is the decomposition product of dead plant and animal residues which is added to soil to enrich soil fertility All the decomposable residues can be made into manure including human and animal excreta Manures Fertilizers and Soil Fertility is a comprehensive textbook comprising of eleven

chapters that cover the prime areas comprise of manures fertilizers and soil fertility thoroughly covering the syllabus sequentially arranged which imparts broad knowledge on three important areas of soil fertility management viz manures fertilizers and soil fertility This book will be useful for undergraduate students in the field of soil fertility and its management at various agricultural horticulture universities *Sustainable Use of Wastewater in Agriculture* Megh R. Goyal,Gaurav Saini,2025-07-11 Water is an essential resource for agriculture but harvesting water for irrigation is a major issue for farmers in developing and underdeveloped countries This new volume addresses the challenges of repurposing wastewater in agriculture processes with a special focus on low and middle income regions of the world The book details the application of wastewater treated and untreated in agriculture and the latest and most economical techniques for making wastewater suitable for irrigation purposes It also looks at the uptake of heavy metals and emerging contaminants by the irrigated crops soil etc from wastewater The book discusses utilizing water generated from rainwater harvesting systems use of water quality indices for checking water suitability the Internet of Agribot Things IoAT for wastewater applications and more

Effects of Sewage Sludge Applications to Agricultural Soils on Soil Microbial Activity and the Implications for Agricultural Productivity and Long-Term Soil Fertility United Kingdom Water Industry Research,2008-01-01

Turfgrass Soil Fertility & Chemical Problems R. N. Carrow,D. V. Waddington,P. E. Rieke,2002-08-26 Turfgrass Soil Fertility and Chemical Problems is the best single source practical management tool that will help you overcome every fertility management challenge you face Turfgrass Soil Fertility and Chemical problems will Help you pinpoint the effectiveness of fertilizer programs to ensure turfgrass quality water quality and environmental integrity Help you understand a multitude of turfgrass species and cultivars and their complex nutrient responses or requirements Explains site specific fertilization covering issues such as establishment on poor quality soils and the use of low quality irrigation water Show you how fertilization is important for environmental traffic and stress tolerance as well as recovery Show you how to apply the interpretation of soil tissue and water quality test information in the development of fertilization regimes Soil Fertility Evaluation and Control Charles A. Black,2013-12-29 Soil Fertility Evaluation and Control presents the theoretical background for practical applications of scientific work on soil fertility The book emphasizes the use of response curves as the basic biological standard for both evaluation and control and it discusses soil testing and plant analysis as secondary standards The principal application **Soil Health and Environmental Sustainability** Pravat Kumar Shit,Partha Pratim Adhikary,Gouri Sankar Bhunia,Debashish Sengupta,2022-09-27 This book demonstrates the measurement monitoring mapping and modelling of soil pollution and land resources This book explores state of the art techniques based on open sources software radioactive wastes microbiology of soil and sediments soil salinity and sodicity pollution from landfill sites soil erosion and contamination from agricultural activities heavy metal pollution and health risk environmental impact and risk assessment sustainable land use landscape management and governance soil degradation and risk assessment

agricultural soil pollution pollution due to urban activities soil pollution by industrial effluents and solid wastes pollution control and mitigation in extreme environments The content of this book is of interest to researchers professionals and policy makers whose work is in soil science and agriculture practices The book equips with the knowledge and skills to tackle a wide range of issues manifested in geographic data including those with scientific societal and environmental implications

Greeley Region Wastewater Management ,1976 *Waste Management, Sanitation and Society* Amrita

Dwivedi,2023-07-07 This book investigates municipal solid waste and its generation collection transportation and disposal It not only focuses on urban waste but also looks at various challenges and problems associated with the rural waste management practices adopted in Indian villages It also considers waste prevention strategies like recycling reuse and recovery which ease the burden on landfills contribute towards the conservation of natural resources and save energy The book highlights the connection between the clean water sanitation and waste management from an Indian perspective

Environmental Engineering and Waste Management Vineet Kumar,Sartaj Ahmad Bhat,Sunil Kumar,Pradeep

Verma,2024-07-04 This book presents fundamental principles and recent advancements in managing waste in an environmentally sustainable manner It explores a wide array of methods and technologies designed to transform waste thereby reducing health impacts across various stages such as waste minimization transportation handling storage and disposal of solid wastes Moreover the book delves into waste contaminated site assessment methods environmental issues and impacts as well as the latest regulatory and policy statutes The inclusion of case studies allows for the assessment of diverse waste management challenges showcasing how environmental engineering methods can be applied to process industrial waste sustainably For instance certain sections of the book delve into the intricate microbial communities and their metabolic pathways illustrating their role in the remediation and management of municipal waste at landfill sites This book caters to a broad audience including teachers researchers practitioners environmental engineers chemical engineers soil scientists policymakers and students specializing in environmental engineering chemical engineering environmental biotechnology and environmental science *Water Resources Management VIII* C.A. Brebbia,2015-06-15 *Water Resources Management VIII* contains papers presented at the eighth conference in a biennial series organised by the Wessex Institute First held in 2001 the Conference includes the work of scientists practitioners and other experts regarding the sustainable management of water resources It is predicted that population growth and irregular precipitation due to climate change may lead to more restricted access to water in certain regions of the world The problem will be aggravated by human activities that affect the quality of available water In order to improve strategies for dealing with a scarcity of potable water it is important to review and compare the performance of current technologies and practices in order to select those that will provide the most effective approaches It is also important that technologies and practices be able to respond with agility to changing conditions New ways of thinking are required in order to successfully predict future trends and prepare adequate

sustainable solutions The papers included in this book cover such topics as Water Management and Planning Water Rights and Accessibility Water Markets and Policies Climate Change Irrigation Urban Water Management Hydraulic Engineering Water Quality Pollution Contaminants and Control River Basin Management Flood Risk Management Geo politics of Water Water Resources and Economics Governance and Regulations Desalination Water Services Environmental Protection Research Catalog: Indexes Smithsonian Science Information Exchange,1972 **Environmental Science 6e (paper)** Daniel D. Chiras,2013 Recent Advances in Geo-Environmental Engineering, Geomechanics and Geotechnics, and Geohazards Amjad Kallel,Zeynal Abiddin Erguler,Zhen-Dong Cui,ALi Karrech,Murat Karakus,Pinnaduwa Kulatilake,Sanjay Kumar Shukla,2018-12-31 This edited volume contains the best papers in the geo engineering field accepted for presentation at the 1st Springer Conference of the Arabian Journal of Geosciences Tunisia 2018 In addition it includes 3 keynotes by international experts on the following topics 1 A new three dimensional rock mass strength criterion 2 New tools and techniques of remote sensing for geologic hazard assessment 3 Land subsidence induced by the engineering environmental effects in Shanghai China The book is useful for readers who would like to get a broad coverage in geo engineering It contains 11 chapters covering the following main areas a Applications in geo environmental engineering including soil remediation b Characterization of geo materials using geological geotechnical and geophysical techniques c Soil improvement applications d Soil behaviour under dynamic loading e Recent studies on expansive soils f Analytical and numerical modelling of various geo structures g Slope stability h Landslides i Subsidence studies and j Recent studies on various other types of geo hazards Environmental Chemistry, Eighth Edition Stanley E. Manahan,2004-08-26 Environmental Chemistry Eighth Edition builds on the same organizational structure validated in previous editions to systematically develop the principles tools and techniques of environmental chemistry to provide students and professionals with a clear understanding of the science and its applications Revised and updated since the publication of the best selling Seventh Edition this text continues to emphasize the major concepts essential to the practice of environmental science technology and chemistry while introducing the newest innovations to the field The author provides clear explanations to important concepts such as the anthrosphere industrial ecosystems geochemistry aquatic chemistry and atmospheric chemistry including the study of ozone depleting chlorofluorocarbons The subject of industrial chemistry and energy resources is supported by pertinent topics in recycling and hazardous waste Several chapters review environmental biochemistry and toxicology and the final chapters describe analytical methods for measuring chemical and biological waste New features in this edition include enhanced coverage of chemical fate and transport industrial ecology particularly how it is integrated with green chemistry conservation principles and recent accomplishments in sustainable chemical science and technology a new chapter addressing terrorism and threats to the environment and the use of real world examples

Bibliography of Agriculture ,1973 **Toxicology Research Projects Directory** ,1980 Development in

Wastewater Treatment Research and Processes Maulin P. Shah, Susana Rodriguez-Couto, 2022-02-16 Development in Wastewater Treatment Research and Processes Microbial Degradation of Xenobiotics through Bacterial and Fungal Approach covers the active and applicable role that bacteria and fungi play in the degradation of xenobiotic compounds from the environment The book gives up to date information on recent advancements in the field of environmental xenobiotics and how they disturb a plant's metabolism The book also gives information on aerobic and anaerobic degradation of xenobiotic compounds through bacteria or fungi and or a combined approach Finally the book covers the characteristics of environmental microbiology biochemical engineering agricultural microbiology environmental engineering and soil bioremediation Emphasizes up to date research on the microbial degradation of xenobiotic compounds through a bacterial fungal approach Covers multidisciplinary features of environmental microbiology biochemical engineering agriculture microbiology environmental engineering and soil bioremediation Includes sections on aerobic and anaerobic degradation Presents the significance of the bacterial fungal role and their metabolic activities in the digestion of xenobiotic compounds Focuses on the most recent developments in environmental biotechnology to enhance the action of the bacterial fungal systems in the remediation of xenobiotic compounds

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