The sludge use in sugarcane fields

Science, Agriculture

The requirement of nutrients by sugarcane is very high. The most active uptake of nutrients is observed during the early stage of the sugarcane plant, during littering (from the third to the sixth months after planting). The nutrients need of sugarcane can be assessed by soil analysis, plant tissue analysis and /or deficiency system. A combination of these three methods gives the most complete inventory of the nutrient status of a crop. Overall nutrients required by the plants 16 out of which carbon, hydrogen, and oxygen are derived from the atmosphere and soil water rest 13 elements are nitrogen, calcium, potassium, phosphorus, magnesium, sulfur, iron, zinc, manganese, copper, boron, molybdenum, and chlorine. These 13 elements are supplies either by soil organic matter or soil minerals and can be introduced anthropogenically by use of organic or inorganic fertilizers. The decoction is the liquid mixed with minerals when they cross or pass through the solid matter. The suspended and soluble minerals get dissolved with the liquid making it rich in organics and nutrients. The infusion is collected from the leachate column which is formed by making layers of soils. The column is made up of three layers of soil i. e. topsoil, subsoil, bottom soil. Topsoil is formed by making three layers first layer is soil second is sludge and the third layer is again soil. The subsoil and bottom soil are made up of only soil gradients. The use of sludge is a benefit as it is rich in organic nutrients and thinking sustainably sludge management has emerged as a world major concern in today’s context of the environment and all the developed, developing or underdeveloped country are facing these problems. Solid Waste Scenario (International and National)

U. S. Natural protection agency (US EPA) proclaim a control at 40 Code of Federal Regulation (CFR) Part 503 to guarantee that slime is utilized or discard in a way that ensures human wellbeing and the Earth and the forces necessities for the land application, surface transfer and cremation of ooze. (U. S EPA as amended by sec. 15(c) of Pub. L. 91-604, 84 Stat. 1713). The increasing global population has directly resulted in the generation of huge amounts of diverse solid wastes worldwide. In this era of globalization; accelerated industrialization and urban development have led to the injudicious use of natural resources and consequent production of complex solid waste (Singh et al., 2014). Solid wastes from an urban area originate from a variety of sources like industrial, residential, and commercial sectors as well as from personal and public spaces (Table 1). Approximately, 4 billion tons of solid wastes (comprising of municipal, industrial and hazardous wastes), is produced annually on a global basis, of which generation of municipal solid waste (MSW) ranges from 1. 6 to 2 billion tons (Vaish et al., 2016a). In any country, the quantity of solid waste generated is directly governed by factors such as economic prosperity and strength of its urban population (Hassan, 2000). In countries with higher income, the residential sector contributes around 25–35% of the total waste generated (World bank, 1999). Solid wastes produced by the urban centers also comprise of industrial wastes produced by industries of small and medium scale (Singh et al., 2011a).

The global trend of the waste generation reveals faster growth in rates of MSW generation on the lines of urbanization and increasing GDP. In the present waste generation scenario, 1. 3 billion tons of MSW is generated by the world cities, which is likely to reach up to 2. 2 billion tons by the year 2025 (Hoornweg and Bhada-Tata, 2012). Significant variations in accelerated waste generation rates, among the different regions and countries of the world is visible based on the degree of their urbanization, economic development, population and industrial growth (Srivastava et al., 2015; Vaish et al., 2016b). Regional variation in global MSW generation rates is clearly evident in a World Bank report which approximates 62 million tons of annual waste generation in the Sub Sahara African region to 160 million tons in the Latin American and the Carribean region, reaching a figure of 572 million tons for OECD countries. According to the same report, the Asian region of the world accounts for a total generation of 433 million tons of solid waste annually comprising of 270 million tons by East Asia and Pacific region, 93 million tons by Eastern & Central Asia and 70 million tons by South Asia (Hoornweg and Bhada-Tata, 2012; Ofosu- Budu et al., 2015). A study by World Bank predicts an increase by 1. 14–1. 73 times in rates of per capita urban waste generation in both developed and developing countries between the period of 1995 and 2025 (Hoornweg et al., 1999; World Bank, 2008). With high urbanization and industrialization, Shanghai in China generates17, 000 tons day_1 waste.

Similar trends are also reported from major cities in developing countries like – Nepal, Pakistan, Guinea, Amman, etc. (World Bank, 2008). Similarly, the urban Indian population generates around 1, 09, 598 tons day_1 of MSW, which has been predicted to increase up to 3, 76, 639 tons day_1 by the year 2025 (Hoornweg and Bhada-Tata, 2012). During 2004–2005, the yearly generation of MSW in India ranged between 35 and 45 million tones with

Metropolitan cities like Mumbai, and Delhi generating 7000 and 6000 tons of waste per day respectively (Hanrahan et al., 2006). With the current population of 1. 28 billion, which includes 33% urban population, per year generation of MSW in India, is expected to augment over 150 million tons by 2025 (Hanrahan et al., 2006) and 300 MT by 2047 (Pappu et al., 2007). Huge areas of land are required for disposal of the enormous quantity of waste generated. In the year 1997, 20. 2 Km2 area of land was used to manage 48 MT of waste and 169. 6 Km2 area of land would be required for disposal of 300 MT by 2047 (CPCB, 2000; Pappu et al., 2007). With this trend of burgeoning population and increasing rate of waste generation, maintaining a pristine urban environment, for the future generations, appears to be a daunting task. Biosolids Biosolids is an important type of organic wastes among the various categories of solid waste (Singh et al., 2014). Biosolids also referred to as sewage sludge or domestic wastewater residuals is an insoluble biological solid residue or organic waste resulting from different sewage treatment processes (Singh and Agrawal, 2007, 2008, 2010a; Singh et al., 2011b; Usman et al., 2012) in wastewater treatment plants worldwide (Marguí et al., 2016).

In the present day world of diminishing natural resources and energy crisis, the importance and need of developing a sustainable approach towards environmentally sound solid waste management cannot be ignored (Pappu et al., 2007). The improper disposal of solid wastes like biosolids and other biowastes pose a serious threat to the environmental quality leading to problems like groundwater contamination, degradation of soil quality, etc. Over the time, different approaches of safe biosolids disposal such as incineration, soil application, landfilling (Marguí et al., 2016; Kominko et al., 2017) and sea dumping have been explored (Sanchez Monedero et al., 2004). Disposal methods like landfilling and ocean dumping have their own demerits due to the scarcity of land, pollution problem and also don't lead to reuse of the beneficial constituents of biosolids (Wong, 1995; Singh and Agrawal, 2008). As a result, the United States and several European countries have banned the ocean dumping of biosolids since 1991 and 1998 (USEPA, 1999a, b; Zhidong and Wenjing, 2009). According to CPCB estimates, out of 22, 900 million liters per day (MLD) of domestic cropland and 3. 5 billion ha as pasture land (Howden et al., 2007). Rotation of crops with regular fallow periods and animal manure or plant residue application were practiced in traditional agriculture to maintain soil fertility and health, thereby supporting crop production. However, to meet the projected increase in food demand due to an exponential growth in human population, these traditional methods have been replaced by the application of mineral fertilizers. Commercially available mineral fertilizers possess advantages such as high solubility, facilitating the nutrient uptake by plants, and better means of storage and handling (Jensen et al., 2011). However, high inputs of these chemical fertilizers contribute to soil degradation, damage to the environment, and loss of biodiversity. Most importantly, these chemicals have contaminated groundwater in many regions making it unfit for human consumption (Jiang and Yan, 2010).

Considering the global demands and increasing the cost of mineral fertilizers, use of organic amendments (OAs) including manures, composts, crops residues, and biosolids is rapidly increasing and their share of agricultural land and farms continues to grow in many countries. For example, globally, about 32. 2 million ha of agricultural land was managed organically using mainly OAs by more than 1. 2 million growers. Oceania, Europe, and Latin America are the regions with the largest organically managed land areas (Willer et al., 2009). Application of OAs is regarded as one of the most promising options to increase farmers' income by restoring soil fertility and at the same time to protect the environment. Organic agriculture possesses several advantages such as improving plant growth and yield, soil carbon (C) content, and microbial biomass and activity, and preventing desertification by improving soil structure and fertility. Lysimeter The term lysimeter is a combination of the Greek words " lusis" = solution and " metron" = measure (MULLER 1996, p 9), and the original aim was to measure soil leaching (KUTÍLEK And NIELSEN 1994, P 215). The First Lysimeter Was Used By DE LA HIRE In 1688 (CEPUDER And SUPERSBERG In BAL 1991, P 25). On Page 13, MULLER Provides The Following definition:– " a lysimeter is a device that isolates a volume of soil or earth between the soil surface and a depth given and includes a percolating water sampling system at its bottom". According to DVWK 1980, p 3, KLAGHOFER in BAL 1993, p13-14, KUTÍLEK and NIELSEN 1994, p 215, HÖLTING 1996, p 33, and HAIMERL and STROBL 2004, p 34 the explanation and the use of lysimeters are extended:

- The soil is hydrologically isolated from the surrounding soil,
- Lysimeters are containers filled with disturbed (= artificially filled) or undisturbed bare soil or soil covered with natural or cultivated vegetation,

- Seepage water is measured directly; vertical water movement is also to be determined,
- Percolating water is collected either gravimetrically (= gravitation lysimeter) or through suction cups/a suction plate with a negative soil water pressure head, identical to that in the field next to the lysimeter (= suction lysimeter),
- An artificial groundwater level can be simulated,
- Lysimeters are either weighable or non-weighable; weighable lysimeters provide information about the change of water storage W for any time period; non-weighable lysimeters collect only the water percolating from the soil column. Research Objective The original purpose—to determine transport and leaching losses of solutes—is not the only one; lysimeters are also used for determining actual evapotranspiration and groundwater recharge and therefore for setting up a water balance. Weighable lysimeters provide a good recording of evapotranspiration and are employed for that reason. Due to an increase in pollution and contamination of groundwater, the original sense of lysimeters gained more and more importance in the last decades and not only quantitative but also qualitative aspects predominate.