Journal of Soil and Water Conservation 13(2): 155-163, April-June 2014
ISSN: 022-457X

Multi-parametric influence of fly ash as a soil ameliorant and its influence on soil microbial properties- A review

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Received: 10 November 2013; Accepted: 19 May 2014

ABSTRACT

Solid waste utilization is assuming an important place in environment-friendly soil amelioration programmes. The need of the hour is to devise long-lasting solution to the ever impending problem of their disposal. Waste utilization for soil amelioration in a scientifically substantiated and conscious manner provides an eco- friendly and affordable alternative for remediation of former mining sites, re-vegetation of barren lands, or amelioration of agricultural lands. This kind of strategy represents a new, holistic approach in waste management and soil amelioration, where the needs of bad quality soils can meet the values of waste materials. Soil ameliorants such as agricultural residues, organic wastes, domestic and poultry waste, fly ash etc. can be characterised and tested for use in agriculture and they can be integrated in nutrient management programmes. Fly ash is one such versatile and heterogeneous waste which upon addition to soil at optimum dose can help in maintenance of soil quality and also contribute to agro-ecosystem protection and environment conservation. The present paper is a comprehensive review of fly ash effect and benefits on soil physical, chemical and microbiological properties in diverse ecosystems in conjunction with nutrient management practices.

Key words: Fly ash, amelioration, soil quality, nutrient management, microbial properties

INTRODUCTION

Soil is the fundamental and irreplaceable part of the terrestrial environment that supports all terrestrial life forms (Nanniperi *et al.*, 2003). The living population inhabiting soil includes macrofauna, mesofauna, microfauna and microflora. Focus on the relationship between microbial diversity and soil functionality has evoked immense interest world over, considering that 80–90% of the processes in soil are reactions mediated by microbes (Coleman and Crossley , 1996 and Nanniperi *et al.*, 2003).

Soil health is the manifestation of a unique balance of physical , chemical and biological (including microbial) components which include soil type and texture (Cavigelli *et al.*, 2005;

Girvan *et al.*, 2003; Ulrich and Becker, 2006), aggregate size (Schutter and Dick, 2002), moisture (Williams and Rice, 2007), predation (Griffiths *et al.*, 1999), pH (Fierer and Jackson, 2006), temperature (Norris *et al.*, 2002), soil microbial community (Schimel, 1995 and Sowerby *et al.*, 2005), heavy metals, water and oxygen availability, along with the host plant, also play a major role in influencing the soil health (Ross *et al.*, 2000 and Ibekwe *et al.*, 2010).

Why soil amelioration?

Agricultural management for maximum productivity and keeping in lines with increasing trend towards business-oriented agriculture involves multi-faceted strategies based on fundamental factors such as tillage (Buckley and Schmidt , 2001a and Cookson *et al.*, 2008), cover cropping (Carrera *et al.*, 2007) and Schutter *et al.*, 2001), fertilizer (Grayston *et al.*, 2004), crop rotation (Olsson and Alstrom, 2000) and amendments in the form of soil ameliorants (Saison *et al.*, 2006 and Buyer *et al.*, 2010).

Plant growth, crop yield and quality depend on the soil's ability to provide nutrients and water at a rate that matches plant requirements and root architecture plays a significant role in this regard (Jones and Ljung, 2012). Nutrients from soil are drawn with the help of plant root system, its depth,

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