Influence Of Green Manure On Increase Cropping System Sustainability

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ABSTRACT: Maintenance of soil organic matter is important for the long-term productivity of agro ecosystems. Soil organic matter can increase by application of organic fertilizer such green manure and animal manure. Farmyard manure is traditionally used as organic amendment. But in many cropping areas where the breeding activity has disappeared there is a shortage of these kinds of organic matter and green manure can be useful amendments for agriculture. The application of green manures to soil is considered a good management practice in any agricultural production system because can increase cropping system sustainability by reducing soil erosion and ameliorating soil physical properties.

Key words: Soil enzymes, soil fertility, nitrogen cycling

INTRODUCTION

One of the major environmental concerns is soil degradation. Inappropriate technologies have resulted in soil quality deterioration, leading to soil organic matter losses and structure degradation, affecting water, air and nutrients flows, and consequently plant growth (Golchin et al., 1995; Tejada et al., 2006b). Maintenance of soil organic matter is important for the long-term productivity of agro ecosystems (Goyal et al., 1999). For this reason, the application of organic wastes rich in organic matter to soil, such as animal manure (Haynes and Naidu, 1998), sewage sludge (Fließbach et al., 1994; Albiach et al., 2001), compost (Sikora and Enkiri, 1999; Tejada and Gonzalez, 2003), crop residues (De Neve and Hofman, 2000; Trinsoutrot et al., 2000), by-products with high organic matter content (Madejon et al., 2001; Tejada and Gonzalez, 2004), etc. is a current environmental and agricultural practice for maintaining soil organic matter, reclaiming degraded soils and supplying plant nutrients. Legumes are thought to be superior to non-legume green manure crops, because they show an exceptional ability to utilize rather inaccessible soil phosphorus (P) and potassium (K) fractions (Yadvinder-Singh et al., 1992), thus improving availability of P and K to subsequent crops, and improve soil physical properties, through the addition of organic matter (Wade and Sanchez, 1983; Smith et al., 1987). For this reason, the application of organic wastes with a high organic matter content, such as fresh and composted urban wastes (Ros et al., 2003). One approach to soil fertility improvement was mainly based on the use of chemical fertilisers which are not affordable to a large majority of small holder farmers. Green manuring from legumes has been demonstrated as a promising opportunity for improving soil fertility at relatively lower costs compared to chemical fertilisers in agroecological zones similar to those of lower South Nyanza (Temu 1990, Chilagane, 1990, Onim et al., 1990). Chastin et al. (1995) showed that retaining crop residue on the soil surface provides a source of plant nutrients, improves organic matter level in the soil, and increase soil water content by reducing evaporation and increasing infiltration rate. Powlson et al. (2011) concluded that practices to encourage maintenance of soil C are important for ensuring sustainability of all soil functions. Sainju et al., (2006) concluded that sustainable management such as cover cropping, can increase soil organic matter and reduce soil erosion and nitrogen leaching. The amount of decayed organic matter found at the soil surface can also enhance infiltration. Soil organic matter can increase by application of organic fertilizer such green manure and animal manure. Farmyard manure is traditionally used as organic amendment. But in many cropping areas where the breeding activity has disappeared there is a shortage of these kinds of organic matter and green manure can be useful amendments for agriculture (Annabi et al. 2007). The application of green manures to soil is considered a good management practice in any agricultural production system because stimulate soil microbial growth and activity,
with subsequent mineralization of plant nutrients (Eriksen, 2005), and therefore increase soil fertility and quality (Doran et al., 1988). Physical and chemical properties have been used to evaluate the effects of the application of different sources of organic matter on soil during long-term experiments (Tejada and Gonzalez, 2004). However, such properties change very slowly and need many years to provide any significant results. In contrast, microbiological and biochemical properties are very responsive and provide immediate and precise information on small changes occurring in soil (Dick and Tabatabai, 1993). In fact, they may also indicate the soil's potential to sustain microbiological activity (Paul and Clark, 1989). The use of green manure by poor small scale farmers in developing countries will not only increase food crop yields by improving soil fertility but it will also improve soil physical properties (Evans et al., 1983).

**Leguminous and non-leguminous**

Leguminous and non-leguminous plants are used as green manures. Leguminous green manures can fix large quantity of atmospheric N2 and can provide useful amounts of organic matter on soil. Green manuring is the process of turning a crop into the soil, whether originally intended or not, irrespective of its state of maturity, for the purpose of affecting some agronomic improvement (Mac Rae and Mehuys, 1985). Leguminous plants form symbiotic associations with Rhizobium bacteria in order to fix N2. This fact causes that the green manures, which their principal component are leguminous plant debris, supply to the soil important amounts of N in relation to the green manures obtained from non-leguminous plants. berseem clover, Persian clover and Medicago are legume species well adapted to the soil and climate conditions of Mediterranean. They can also be cultivated as plants for green manure. berseem clover, Persian clover and Medicago can be seeded at the beginning of October and then ut and incorporated into the soil at the end of April. Data btained by other researchers (Bilalis et al., 2005; Mohammad nd Mahmood, 1997; Sangakkarara et al., 2004) clearly demonstrated the beneficial effects of legumes on the yields of the following crops (wheat, barley, canola, maize, mustard and rice). Arbuscular mycorrhizal fungi (AMF) are undoubtedly a vital component of the belowground system and their impact on the yield and sustainable agricultural systems has been largely documented (Srivastava et al., 1996).

**Soil enzymes**

The metabolic activity of soil microorganism is essential for organic matter turnover. The mobilization and immobilization of inorganic nutrients and trace elements are also mainly a result of microbial activities (KANDELER and MURER, 1993). Special enzymes catalyze the organic matter turnover (BANDICK and DICK, 1999). These enzymes are produced by the organisms and act intra- or extra cellular. Soil enzymes catalyze reactions in soils that are important in cycling of nutrients such as C, N, P, and S. Accumulated enzymes are primarily of microbial origin but may also originate from plant and animal residue. Soil enzymes form a part of the soil matrix as exoenzymes and as endoenzymes in viable cells. Soil enzyme activities commonly correlate with microbial parameters and have been shown to be a sensitive index of long-term management effects such as crop rotations, animal and green manures and tillage (CANARUTTO et al., 1995). The measurement of soil enzymes can be used as indicative of the biological activity or biochemical process (DICK et al., 1988). Soil enzyme activities have potential to provide a unique integrative biological assessment of soils because of their relationship to soil biology, easy of measurement and rapid response to changes in soil management (KIRCHNER et al., 1993). The effects of green manure on soil enzymatic activities were studied in many countries (CLARHOLM and ROSENGREN-BRINCK, 1995; DENG and TABATABAI, 1997).

**Influence of green manure on increase cropping system sustainability**

The application of green manures to soil is considered a good management practice in any agricultural production system because can increase cropping system sustainability by reducing soil erosion and ameliorating soil physical properties (MacRae and Mehuys, 1985; Smith et al., 1987), by increasing soil organic matter and fertility levels (Doran and Smith, 1987; Power, 1990), by increasing nutrient retention (Drinkwater et al., 1998; Dinnes et al., 2002), and by reducing global warming potential (Robertson et al., 2000).

**Increase soil fertility and quality**

The application of green manures to soil is considered a good management practice in any agricultural production system because stimulate soil microbial growth and activity, with subsequent mineralization of plant nutrients (Eriksen, 2005), and therefore increase soil fertility and quality (Doran et al., 1988).
**Improve the physical, chemical and biological condition of clay soils**

Green manure crops improve the physical, chemical and biological condition of clay soils. It is known that improvement of soils physical condition by adding green manure crops into the soil create the potential for crop growth. The long term benefit of green manure crops is to stabilize yields of subsequent crops during dry seasons (MacRae and Mehuys, 1988). Leguminous crops are the potential crops for their capability of nodule formation and nitrogen fixation. As for example, mungbean can fix nitrogen in the range of 30-40 Kg N ha\(^{-1}\) (Rupella and Saxena, 1989).

**Effect of green manure on nitrogen cycling**

Green manure application has also been found to influence N cycling in soil. Green manures could have benefits for soil N dynamics by recovering residual mineral N in soil, by fixing N from the atmosphere for leguminous green manures, and thereby contributing to subsequent crop N nutrition. N release from cover crop residues has been evaluated for corn (Wagger 1989b; Ranells and Wagger 1992), and for wheat (Janzen et al. 1990). However, estimating the amount of N released from green manures is difficult because of the many interacting factors, including temperature, moisture conditions and physical and chemical properties of the residues, involved in the mineralization process (Parr and Papendick 1978; Bending and Turner 1999).

**MATERIALS AND METHODS**

This paper is a review of the literature search on ISI, Scopus and the Information Center of Jahad and MAGIRAN, SID is also abundant. Search library collection of books, reports, proceedings of the Congress was also performed. All efforts have been made to review articles and abstracts related to internal and external validity.

**REFERENCES**


Janzen HH, Bole JB, Biederberk VO, Slinkard AE. 1990. Fate of N applied as green manure or ammonium fertilizer to soil subsequent cropped with spring wheat at three sites in Western Canada. Can. J. Soil Sci. 70: 313–323.


