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ROLE OF COMPOST IN BIO WASTE MANAGEMENT IN CROPS

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ABSTRACT:

The present paper deals with role of compost in bio waste management in crops. The increase of separate collections of bio-waste, largely represented by food waste, and their biological treatment is an essential feature of the waste management strategy. An annual time-step model for estimating soil organic matter (SOM) stock dynamics in a two year time frame was developed and tested on cardoon cropping system. The model took into account few soil parameters, mean annual temperature, and the cultural systems management, in particular organic fertilizers and crop residues. This work indicates that compost use in crops agriculture management would be beneficial for SOM increase. The results showed how high-quality compost could represent the management in crops.

KEYWORDS:

COMPOST, WASTE, CROPS.

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INTRODUCTION

Composting predominates over anaerobic digestion for the bio-waste separately collected, resulting over 90% of food and garden waste being processed into compost. For the most part, food waste is still landfilled within Europe, leading to the release of uncontrolled greenhouse gases .In this paper, it is addressed the valuable effects of compost use in agriculture on Soil organic matter (SOM) management The SOM is primarily composed of carbon (C), and in soil plays a role in providing four important ecosystem services: (i) resistance to soil erosion, (ii) soil water retention, (iii) soil fertility for plants and (iv) soil biodiversity. SOM is therefore the main indicator of soil quality. Even small changes of the soil C pool could have strong effects both on agricultural yield and on global greenhouse gas cycle. Maintaining organic C-rich soils, restoring and improving degraded agricultural lands and, in general terms, increasing the soil C, could play a fundamental role in addressing food security .Organic matter (OM) in compost is rich in humifiable and humified materials and so it provides and improve SOM pool and consequently soil fertility. the valuable role of compost which represents the bridge between bio-waste strategy targets and sustainable agriculture principles as qualitatively described through a management of crops.

MATERIALS AND METHODS

An annual time-step model for estimating SOM dynamics was developed. The model takes into account the main soil characteristics, annual mean temperature, and management of cropping systems and in particular organic fertilizers and crop residues. The analysed agricultural system consists in a not irrigated one year rotation repeated until 2 years cardoon, one-year durum wheat (*Triticum durum* Desf.) one year field bean (*Vicia faba* cv Minor) and so on.

The model implements the Hénin-Dupuis equation which apply two different kinetic constants (k_1 and k_2) on annual step in the above complex cropping system.

$\Delta SOM = k1 * M - k2 * SOM$

(1) where M (dry matter, Mg/ha) stands for raw OM, exogenous OM and/or crop residues, k_1 (% w/w) as the humification constant (i.e. the organic matter that arrive to become humus) and k_2 (% w/w) as the mineralisation constant (i.e. how much humus is mineralised in CO_2). Soil type did not affect significantly the mineralisation behaviour of M according to Noirot-Cosson et al. [13], rather constant k_1 is specific for each M, and it is correlated to specific biological stability index (BSI, % w/w), calculated after a laboratory measurement of biochemical fractions [14], and OM, calculated as M without ashes content, by Eq. (2)

$k1 = BSI * OM / M$

(2) One gross estimate of the mineralisation constant k_2 depends on agricultural practices (P, i.e. tillage frequency and depth, irrigation, crop residues and organic

fertilizer frequency), clay content (A, g/kg), total carbonates (g/kg $CaCO_3$), site mean annual air temperature (T, °C):

k2=1200∗0.2∗(T−5)(200+A)∗(200∗0.3∗CaCO3)

(3) In addition, specific residual biomasses, agricultural practices (i.e. tillage frequency and depth, irrigation, crop residues and organic fertilizer frequency), were considered . The SOM stock (SOMS, Mg/ha) in 30 cm topsoil (h, m) were estimated taking into account soil organic carbon (SOC, % w/w), bulk density (BD, Mg/m^3), coarse materials (CM, % v/v):

SOMS=SOC0.58∗BD∗(1−CM)∗h

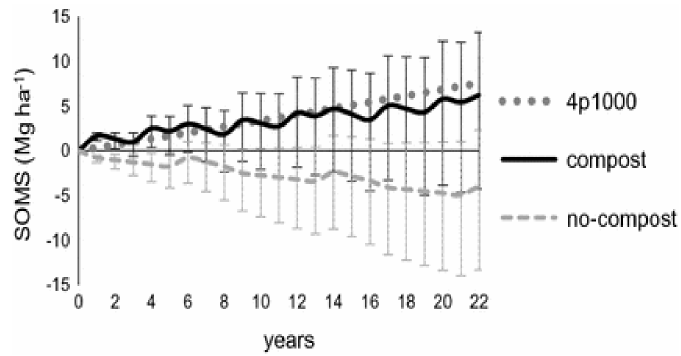
Six soils cultivated with cardoon were sampled within 10 km of Bodh, (Gaya Region, Bihar) and assessed for required parameters to make possible the model running.

Cardoon residues were harvested leaving on the ground 10% of above-ground biomass (w/w as dry matter).Two scenarios were considered: “compost” and “no compost”. Compost scenario planned for 20 Mg/ha compost application before cardoon sowing and 15 Mg/ha on the crop during the 4th year of cultivation. Compost incorporation applied dry matter (dm) 50% (w/w), Nitrogen (N) content 1.8% (w/w dm), organic carbon 48% (w/w dm), BSI 0.53, k_1 0.25 [16]. In “no compost” scenario the contribution of OM is represented only from the cardoon above-ground biomass (i.e. 10%) that remains in soil after harvesting.

RESULTS AND DISCUSSIONS

The model was firstly applied to cardoon cropping system, but it could be applied even to any other crop system (i.e. food and non-food) [8, 9]. Assessed scenarios showed that SOM increased by the supply of exogenous OM rich in humifiable materials, such as high-quality compost. The magnitude of GHG emissions or sequestrations caused by SOM variation depended on soil characteristics. The results obtained by the soil model with mean characteristic are reported in Fig. 1. Error bars show the variation due to the soil variability. For both compost and no-compost scenarios the upper SOMS values above the curves set a “C sink layout”, built implementing a “derived soil” having values obtained by mean plus standard deviation of parameters that contain mineralisation and mean minus standard deviation of parameters that increase mineralisation (Eqs. 3 and 4). On the contrary, the lower SOMS values below the curves in Fig. 1 set a “C source layout”, built considering the mean plus standard deviation of parameters that increase mineralisation and mean minus standard deviation of parameters that contain mineralisation

Fig. 1



Soil Organic Matter Stock (SOMS) variation on average soil (out of 6 soil samples) in 22-years cardoon-durum wheat-field bean cropping system simulation. Error bars shows C sink and source layout obtained by standard deviations of soil parameters. Compost application allows to increase, on average, the SOMS by the ≈0.4% per year

CONCLUSIONS

The SOM model developed within BIT3G in magadh region t compost use in agricultural sector is meaningful from a SOM management and carbon footprint perspectives as well. The SOMS after 2 years of cardoon cropping system with compost application resulted incremented of 6.2 metric tonnes per ha (first 30 cm of soil) whereas the scenario with zero inputs resulted decremented of 3.9 metric tonnes per hectare. In specific circumstances the CO_2 uptake overcomes GHG emissions making cardoon crop cultivation GHG balance neutral or even negative.

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