

Research Article

Evaluating the impact of compost and bio compost enriched with chemical fertilizer on soil biological properties

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ABSTRACT

Chemical fertilizer and an imbalance application of chemical fertilizer is a main causes of environmental pollution. the impact of compost and bio compost enriched with chemical fertilizer on soil biological properties such as soil organic carbon and soil respiration was studied as a split-plot with randomize complete and three replications. The main plot involved six levels of fertilizer including: 30 and 50 tons of compost enriched, 30 and 50 tons of bio compost enriched per hectare and Chemical fertilizer and control without fertilizer. The sub plot was considered the period of application (two and three years). The results showed that the use of compost and bio compost at all levels leads to increase soil organic carbon, soil respiration and soil fertility compare with controls ($p < 0.05$). The maximum soil respiration was observed in 50 tons of compost enriched with chemical fertilizer ha^{-1} with two years of application. Furthermore, there is a positive relation between application of compost and bio compost and soil organic carbon.

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Introduction

Industrial process waste is a major source of environmental pollution in the world. The usage of chemical fertility has been increasingly apparent over the last decade. Environmentalist say, there is a high risk of pollution from chemical fertilizers. Sustainable agriculture is the act of application organic fertilizer and reduce chemical fertilizer, can be one of the best way to overcome these problems. The influence of soil quality on plant growth and sustainable agriculture is important (Lal, Mokma, & Lowery, 1998). The favorable of soil quality not only

improve plant growth but also increase crop yield and improve the quality of environmental protection. The application of imbalance chemical fertility leads to reduce soil quality. Recently, the application of organic materials on soil quality was investigated. Organic fertilizer improved soil physical, chemical and biological properties (Marinari, Masciandaro, Ceccanti, & Grego, 2000).these materials reduce soil bulk density and Increase the total of porosity in soil (Aggelides & Londra, 2000). Organic materials are the best way to supply plant' nutrients and reducing the ecological risk

of chemical fertility and toxic component (Hatfield & Stewart, 1997). The positive effect of organic materials and diversified crop rotations on soil quality aspects was investigated (Schjønning, Elmholt, Munkholm, & Deboz, 2002). A healthy soil is defined as a balanced system with high diversity and high rate of microbial biomass (Van Bruggen & Semenov, 2000). Farming soil often have lower microbial diversity which is a real threat for food security and soil quality (Buckley & Schmidt, 2001). Organic materials improved the soil chemical properties include: increase soil's PH and soil macro and micro elements (Courtney & Mullen, 2008). Organic materials can also encourage plant health and increase yield crop. The impact of organic materials on soil properties depends on the rate of composition (Unsal & Ok, 2001). The high amount of organic materials in soil can be useful to restore soil fertility and support plant growth (Diacono & Montemurro, 2010). organic materials have multiple functions in soil from short time provide most of the plant nutrient to long term increase soil organic materials (Bhattacharyya et al., 2010). The use of low quality organic materials which immobilizes soil nutrients after release in the soil and plant cannot access to these elements (Palm, Myers, & Nandwa, 1997). Organic materials may also have option uses that are more important to the farmers than in corporation them into the soil. For example, the application of crop residues as a fuel (biomass energy) are common in Ethiopia (Taddese, 2001). The combined application of organic materials and nitrogen (N) fertilizer on maize (*Zea mays* L.) leads to improved yield productivity and soil fertility (Srivastava et al., 2012). The addition of organic materials to soil is an issue that recently suggested as a way to improve soil water holding capacity (Busch, Kammann, Grünhage, & Müller, 2012). Soil quality includes the interaction of soil properties and growing plant. An evaluation of soil

fertility is one of the most important factors to optimize the production of agronomic crops. Compost and bio compost contains a large number of micro-organisms. Thus the use of the compost and bio compost adds the plant nutrients, organic matter and living organisms (Beffa et al., 1996). There is a positive relation between soil enzymatic activity and soil microbial population size (Pagliai, La Marca, Lucamante, & Genovese, 1984). The nutrient release from mineralization of soil organic matter supply the main nutrients plant growth in organic farming. This process generally is slowly in the soil (Chang, Chung, & Tsai, 2007). Therefore, to establish soil organic matter Content to a certain level usage of compost and bio compost are important in organic farming. Soil microbial biomass has been used as a sign of soil fertility. The biological part of the soils usually responds more rapidly to different condition n of soil than physical and chemical properties (Anderson & Gray, 1990).the addition of different amount of compost and bio compost to agricultural soils has favorable effects on plant growth and crop yield by improving soil physical, chemical and biological (specially soil respiration) properties (Zheljazkov, Craker, & Xing, 2006). The application of compost and bio compost in order to improve soil fertility and microbial biomass has received little attention. The aim of this study was to evaluate the effect of compost and bio compost enriched with chemical fertilizer on soil biological properties.

Materials and Methods

To study of evaluating the quality characteristics of compost and bio compost on soil biology and fertility was conducted in Iran, Gilan province. The mean annual precipitin of 1980 mm y^{-1} has a distinct seasonal pattern, with 85% falling from October to March and

25% from April to May. The mean daily temperature is 15.9 degrees centigrade, the highest monthly temperature is in July (30 degrees centigrade) and the lowest monthly temperature is in January (3 degrees centigrade). (these data obtained from Horticulture Research Institute, Agriculture Research Center, Ministry of Agriculture, Gilan, Iran). This experiment was carry out for two years. In order to study soil biology, we cultivated maize for three years. Compost was composed of pig manure and soybean meal and bio compost is manufactured by composting press plant residues received from sugar beet. This experiment was carry out as a Split-plot with randomize complete and three replications. The main plot involved six levels of fertilizer including: 30 and 50 tons of compost ($C_{30} F_{50}$) and ($C_{50} F_{50}$), 30 and 50 tone of bio compost ($bio_{30} F_{50}$) and ($bio_{50} F_{50}$) $ton ha^{-1}$ that enriched with 50 % chemical fertilizer. Chemical treat is (F) and all plot were irrigated when necessary. The control plot was without chemical and organic fertilizer.

Soil analyses

Soil texture was established using the hydrometer method. For soil chemical analyses, soil organic carbon was established following Walkley-Black method and phosphor available was measured using Olsen method and sodium adsorption ratio was measured by film photometry and nitrogen was measured by kjeldahl method. the potassium was measured by ammonium acetate method and soil electrical conductivity was measured by the conductivity meter device (RICHARDS, 1954).

Chemical fertilizer includes: nitrogen, potassium and phosphor as superphosphate, potassium sulphate. The soil type was Silty loam.

Statistical analyses

Analyses was performed following the SPSS. The compare mean test- Duncan were calculated at $p < 0.05$ confidence level.

Result and Discussion:

Organic Carbon

The maximum contain of organic carbon is showed in treat ($C_{50} F_{50}$), (3 .24%)(Fig1). In the other plots there is a significant difference with control plot. But there is no significant difference in control plot. In fact, the minimum contain of organic carbon is showed in control plot and then chemical fertilizer (Fig 1). Furthermore, there is a positive relation between application of compost and bio compost and organic carbon. It means that we have maximum contain of organic carbon in T2 (Fig1). As a reported (Oliveira, Mattiazzo, Marciano, & Rosseto, 2002) by the use of compost and bio compost the amount of organic carbon in soil will be increase. The amount of compost after added to soil was decomposed and it cause an increase in soil organic matter. as a reported Beffa (1996) compost and bio compost contain a lot of organism that was useful to improve soil organic matter.

Soil respiration

The soil respiration in control plot ($6.12mg k^{-1}$) and ($C_{50} F_{50}$) ($19.8mg k^{-1}$) are minimum and maximum in respectively (TABLE 2). The result showed that there is a good correlation between additions compose and bio compose to soil and soil respiration. in other words, by increasing organic materials such as compost and bio compost in soil we also have maximum respiration in soil

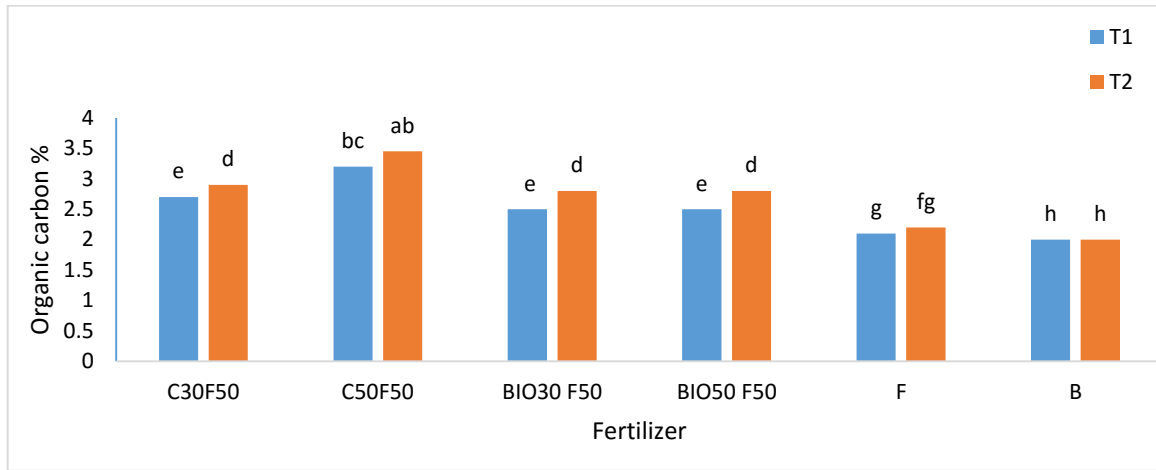


Figure 1. the effect of different amount and period application of compost and bio compost on soil organic carbon; T1: two years application (2011, 2012) - T2: three years application (2011, 2012, and 2013); C30F50= 30 ton compost + 50% chemical fertilizer; C50F50=50 ton compost + 50% chemical fertilizer; Bio30F50=30 ton bio compost + 50% chemical fertilizer; Bio50+ F50=50 ton bio compost + 50% chemical fertilizer; F= Chemical fertilizer; B= control; * Values with the same letter are not significant different ($p \leq 0.05$).

Table 1. Major physical and chemical properties of the compost and bio compost and soil used in the experiment

TOTAL OF Potassium (mg kg ⁻¹)	TOTAL OF PHOSPHOR (mg kg ⁻¹)	ELECTRICAL CONDUCTIVITY Ds m ⁻¹	P H	Total of nitrogen %	Organic carbon %	Soil texture	
321.78	20.57	1.84	7.8	0.16	1.9	SILTY LOAM	soil
2552.6	3789.4	2.5	7.4	1.51	18.6	-	compost
1523.3	4297.15	2.13	7.1	1.62	24.6	-	Bio compost

(Fig 2).

The T2 has more soil respiration than T1. The quality of organic materials has important effect on decomposition rate. Chemical fertilizer treat has minimum respiration after control plot. Zhong & Cai, (2007) as a reported organic fertilizer has directly effect on soil biological factors such as soil respiration. As a reported Zheljzkov (2006) the addition of large number of compost and bio compost to soil has benefit response and it cause to improve soil physical chemical and biological properties. Maybe the difference in soil organic carbon and soil respiration between compost and bio compost is in resulting of enzyme and growth hormones that are in compost. The maximum rate of CO₂ evaluation in the soil

is showed by increasing compost and bio compost in soil (Fig 2). There is a positive correlation between CO₂ respiration and soil organic matter that is recorded ($r=0.98^{**}$). This means the organic components such as compost and bio compost supply nutrients for microorganisms.

Conclusion

The result of this study showed that organic materials leads to improve soil physical, chemical and biological. Furthermore, different amount of organic materials has the most influence on soil quality and plant growth also they supply plant nutrient and plant growth. As a

Table 2. Effect of Different Amount of Compost and Bio compost on biological properties(compare means of soil respiration)

T2	T1	treat
6.12 ^h	6.65 ^h	B
14.60 ^{cd}	11.6 ^e	C30 F50
19.80 ^b	14 ^{cd}	C50 F50
10.07 ^{ef}	8.35 ^{fg}	BIO30 F50
11.30 ^e	9.4 ^{ef}	BIO50 F50
10.41 ^{ef}	9.90 ^{ef}	F

T1: two years' application (2011, 2012) - T2: three years application (2011, 2012, and 2013); C30F50= 30-ton compost + 50% chemical fertilizer; C50F50=50-ton compost + 50% chemical fertilizer; Bio30F50=30-ton bio compost + 50% chemical fertilizer; Bio50+ F50=50-ton bio compost + 50% chemical fertilizer; F= Chemical fertilizer; B= control

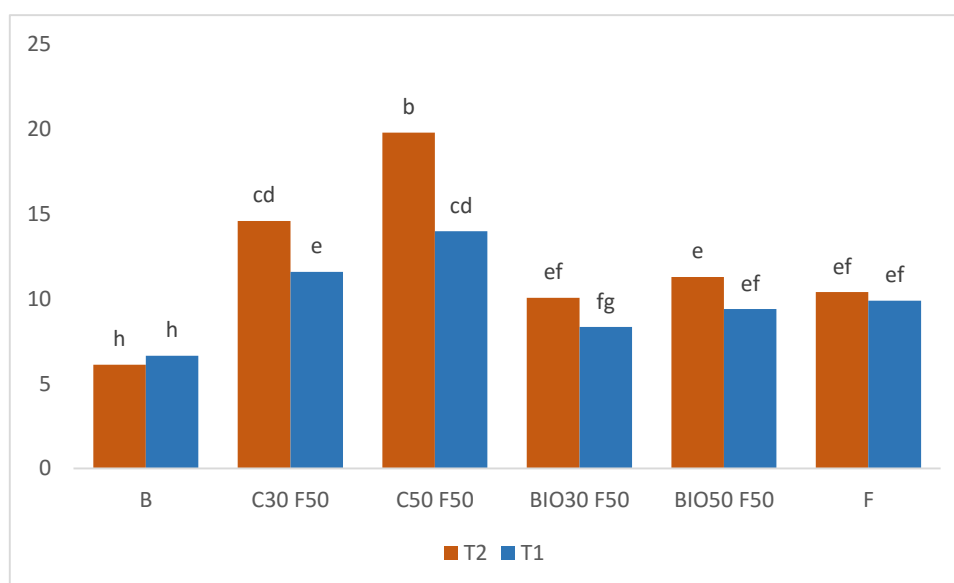


Figure 2. The effect of different amount and period application of compost and bio compost on soil respiration; ^x Values with the same letter are not significant different ($p \leq 0.05$).

reported, compost and bio compost has an important role to supply energy for microorganisms and increase microbial biomass in soil. The maximum respiration was recorded in (C₅₀ F₅₀) and the application of different amount of compost and bio compost leads to increase soil organic carbon and soil respiration compare with chemical fertilizer.

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