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Different agroecosytem managments affects diffirently soil fertility by long term organic amendement: case study of sandy soil in southwestern of Morocco

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Different crop managments affects diffirently soil fertility by long term organic amendement: case study of sandy soil in southwestern of Morocco

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Abstract

This experiment is intended to study organic amendments effect on fertility status within different horizons of an alluvial soil under different crop managments (banana, tomato and grass). Three organic amendments were performed for twelf successive years in comparison with a fellow soil as control. Organic amendments decreased soil degradation and increased total organic matter. Soil amended with manure and plant residues is better in terms of structure and physicochemical fertility (1.7% organic matter, 0.1% total nitrogen, 28.9 ppm phosphorus), followed by soil amended with compost and soil covered by grass. At the level of pedogenesis, the studied soils can be evolved, whereas organic amendments have moderately low effect on sandy soil pedogenesis.

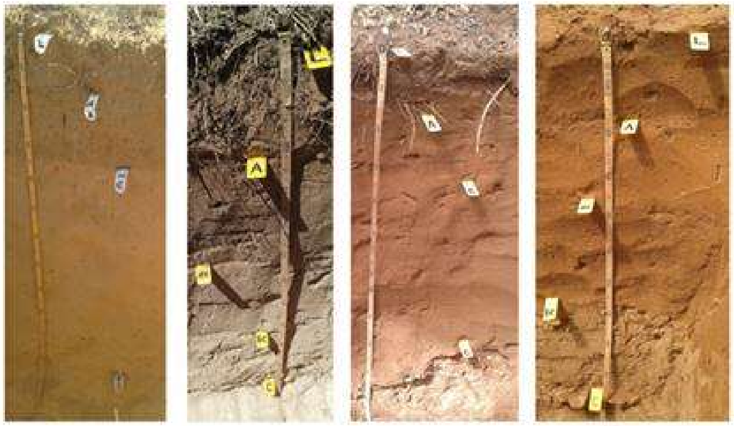
Keywords: Sandy soil, organic amendement, fertility, soil pedogenesis.

Introdcution

Soil erosion and organic matter reduction are major threats that play important role (Chenu et al 2011). organic amendement is a common practice to handle problems related to the soil physical structure. The lastest defines how soil is organized in space (Dexter, 1988) and over time (Roger-Estrade, 1995). Fertilization is the contribution of mineral nutrients that are necessary for the development of the plant in the form of fertilizer, compost or manure. It is based on the supply of organic matter, which in addition to its role as a reservoir of nutrients, has a major role in the physical fertility of soils, their aeration and in their resistance to degradation and erosion (Domburg *et al* 2000). In this context, the present work will focus on the study of the effect of organic amendments on the structure and physico-chemical fertility of alluvial soil horizons as affected by different crops (banana, tomato and grass).

Materiels and methods

The overall objective of this study is to evaluate the effects of organic amendments (composts, manure, plant residues) on the physico-chemical fertility and soil structure of the study area. Four sites were investigated by sampling soil samples at different depths (Figure 1) in the Experimental Farm of INRA-Agadir at 40Km south of Agadir (southwetern of Morocco). The soil samples were weighted for moisture content after its drying at 105°C during 48 hours in the oven prior to laboratory analysis through sieving at 2 mm diameter.



A B C D

Figure 1. Schematic presentation of the studied soils [A: Control soil (without amendment); B: Soil covered by grass; C: Soil amended by manure and plant residues; D: soil amended by compost]

Physicochemical analyzes were performed as well as particle size analyzes on the Robinson pipette method. Oven dried samples were subjected to pH analysis in 1:10 soil/water (w/v) suspensions using a glass electrode pH-meter (BioBlock pH-meter Microprocessor 99621) at room temperature (Rhoades, 1982). Electrical conductivity (EC) (µS/cm) was measured using an electrical conductivity meter (WTW Inolab-Cond Level-2P, Germany) in 1:5 soil/water (w/w) solutions (Rhoades, 1982). Soil organic matter (OM) was analyzed by the method of Walkley and Black (Jakson, 1973). Total nitrogen content (NTK) analysis was performed using standard Kjeldahl procedure (Gerhardt: Kjeldatherm-Vapodest 20, Germany) as described by (Jackson, 1973). Nitrates was analyzed by the chromotropic acid method; Olsen's method for assimilable phosphorus and Wiklander's method for exchangeable potassium; and finally Calcium and Magnesium were determined by extraction with sodium acetate and reading on the atomic absorption spectrophotometer.

Results and discussion

Pedogenesis status of studied soils

The studied soils are located in the same experimental area, which is part of the plain of Souss. This area offers a fairly varied range of favorable soils for agricultural productivity thanks to their morphology. The observation of the profiles shows the effect of organic amendments on soil evolution (Figure 2).

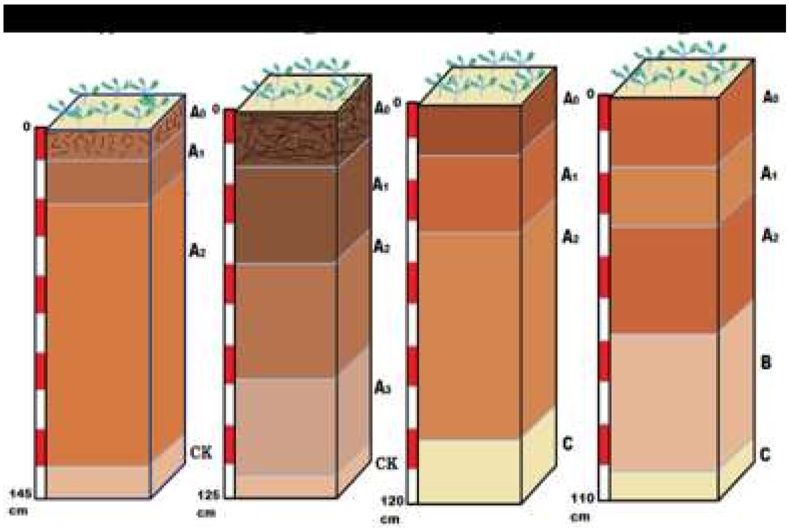


Figure 2. Schematic presentation and comparison profile of studied soils A, B, C and D

Soil evolution is mainly related to water and temperature, both going hand in hand. In addition, the temperature is relatively high (T°>20°C) for five months without any rain. The runoff is very active over the whole extent of the plain, the vegetation cover is weak or absent. The upper horizons of the majority of soils have a beating structure, so water penetrates weakly into the soil. In this context we can explain the difference between the soil profiles after the addition of the organic amendments.

Impact of organic amendement of soil profiles

<u>A-Control soil (permanent fellow):</u> Macroscopic observations of color, sandy texture, and the presence of carbonates allow us to assume that the soil is of quaternary deposit deposited on the dolomitic limestone of Adoudounian. The depth of 145 cm can be explained without having the bedrock and the presence of shell debris by layer deposits after each erosion of the sands. The accumulation of carbonates in deep horizons, is related to their leaching in the superficial horizons.

B-Soil covered by grass: The significant change in the color level and the development of the roots is linked to the strong rooting of the grass cultivation, as well as the contribution of debris from the grass after each remodeling of the garden during 30 years, which favors the storage of organic matter in the upper horizons. The erosion of the soil each year by the wind improves the thickness of the sandy layer, which explains the absence of the bedrock at the level of 125 cm.

C-Soil amended by sheep manure and plant residues: The addition of plant debris from banana crop to the soil surface decreases aeration of the soil, thus the degradation of the organic matter (manure) that explains the dark brown color of the top horizon. The low evolution of the profile may be related to the low degradation of the organic matter, as well as the fertilization of the banana crop.

D-Soil amended with compost: The absence of root debris is linked to the uprooting of tomato crops at the end of the growing season and tillage. The small thickness of the sandy layer (65 cm) can be related to the slope and the bedrock emergance to the south, the use of chemical fertilizers including nitric and phosphoric acids explain the degradation of the bedrock.

Effect of organic amendments on soil physico-chemical parameters

For remediation of soils altered by intensive agricutlure, organic amendments are essential for fertilization in organic agriculture and the pillar method for organic practices in order to improve soils at the structural, chemical and biological level. The physicochemical analyzes of the samples are shown in Table 1:

Table 1. Soil physico-chemical parameters

Sites	**CEC**	**N total**	**MO**	**P_2O_5**	**K^+**	**Ca_2^+**	**Na^+**
	meq/100g	g/100g	%	ppm	meq/100g	meq/100g	meq/100g
A	7.79	0.056	0.77	37.87	0.44	0.013	0.14
B	43.62	0.22	4.32	131.43	1.49	3.76	0.93

C	11.32	0.105	1.7	29.87	0.36	4.37	0.22
D	11.19	0.105	2.01	20.14	0.53	5.21	0.33

The physical characterization revealed that the soils of the studied site have an essentially sandy texture (fine sand) in the upper horizons. According to Table 1, the control soil shows the lowest levels while all the amended soils contain higher levels and especially soil amended by manure and plant residues. Active limestone has high levels in the control soil but not in the other soils. These factors show a low fertility of the control soil, especially for vegetbales which requires high levels of nutrients availability.

Effect of organic amendments on soil pedogensis

The results show that the contribution of organic amendments to sandy soil has a relatively weak effect on soil evolution. On the other hand, the use of chemical fertilizers in the soil amended by the compost, has known a significant evolution such as in the deep horizons. While the studied soils are of the same soil genesis of control soil that is of Sierozem type. The evolution characteristics of these soils are rather weak thanks to their sandy texture and the dominance of fine sands on coarse sand.

Conclusion

The low chemical and biological fertility combined with the low water retention potential greatly restricts agricultural production of soils. Thus the strong aeration that promotes the incubation of organic carbon. These soils require appropriate management techniques to raise their chemical fertility to the optimum level, and to increase agricultural production. In general, soil amended by manure and plant residues seems to have a higher level of fertility than the others, although these soils have the same morphological characteristics. Clay amendement could be an interesting solution to built the humic-clay complex and favorize reclacitrant carbon rather than labile carbon.

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