DETERMINATION OF ORGANIC MATTER AND PH OF GLASSHOUSES SOILS

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Abstract

Organic matter plays different and essential functions. By an agronomic point of view it is important for two main reasons: serve as a nutrient deposit and as a remedial agent for soil structure (Izaurralde, R.C. & Cerri, C.C. 2002). As it is formed mainly by plant residues and contains the entire nutrients needed for plants growths and these nutrients are released at the most appropriate forms for plant. pH of the soil can help us isolate the existent and possible problems so we can manage better the vegetables growth. pH of the soil has effects on the quantity of nutrients dissolved in soil as some of them can be more available on acid conditions and some others on alkalinity conditions. These two indicators were determined in an existent glasshouse soil placed in Durres city on three parcels planted each with tomato, cucumber and pepper. Organic matter was determined by combustion and pH by pH-meter on a soil water extract. Organic matter was within the limits of 4 – 8 % that are considered as an average containment of it (Bauer, A. & Black, A.L. 1994) so it can provide all the necessary nutrients nedeed for a normal growth of planted vegetables. Soil pH, was clasified as slightly acid, neutral and slightly alkaline within the values of 6.1 - 7.5 (Brady,N.C dhe R.R.Weil, 1999). These values are optimal for vegetable growth. Organic matter and soil pH haven't changed their normal values beside the long period of years that organic and inorganic fertilizers have been used in this glasshouse.

Keywords: Organic matter, pH, soil, vegetable, nutrient

INTRODUCTION

Soil organic matter is any material produced originally by living organisms (plant or animal) that is returned to the soil and goes through the decomposition process. At any given time, it consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixture of materials known as humus (Bauer, A. & Black, A.L. 1994). Most soil organic matter originates from plant tissue. Plant residues contain 60-90 percent moisture. The remaining dry matter consists of carbon (C), oxygen (O), hydrogen (H) and small amounts of sulphur (S), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg). Although present in small amounts, these nutrients are very important from the viewpoint of soil fertility management (Duxbury, J.M., Smith, M.S. & Doran, J.W. 1989). Organic matter within the soil serves several functions. From a practical agricultural standpoint, it is important for two main reasons: (i) as a "revolving nutrient fund"; and (ii) as an agent to improve soil structure, maintain tilth and minimize erosion (Izaurralde, R.C. & Cerri, C.C. 2002). As a revolving nutrient fund, organic matter serves two main functions: As soil organic matter is derived mainly from plant residues, it contains all of the essential plant nutrients. Therefore, accumulated organic matter is a storehouse of plant nutrients. The stable organic fraction (humus) adsorbs and holds nutrients in a plant-available form. Organic matter releases nutrients in a plant-available form upon decomposition. In order to maintain this nutrient cycling system, the rate of organic matter addition from crop residues, manure and any other sources must equal the rate of decomposition, and take into account the rate of uptake by plants and losses by leaching and erosion. (Bauer, A. & Black, A.L. 1994)

Table 1. Functions of organic matter (Hudson, B.D. 1994)

Physic functions	**Chemical functions**	**Biological functions**
• Connects soil's particles into stable aggregates • Affects water retentions and air flow • Affects soil's temperature	• Big source of cation exchange • Creates a buffer medium • Creates connections between heavy metals and pesticides	• Food source for microorganisms • Major nutrients reservoir for plants

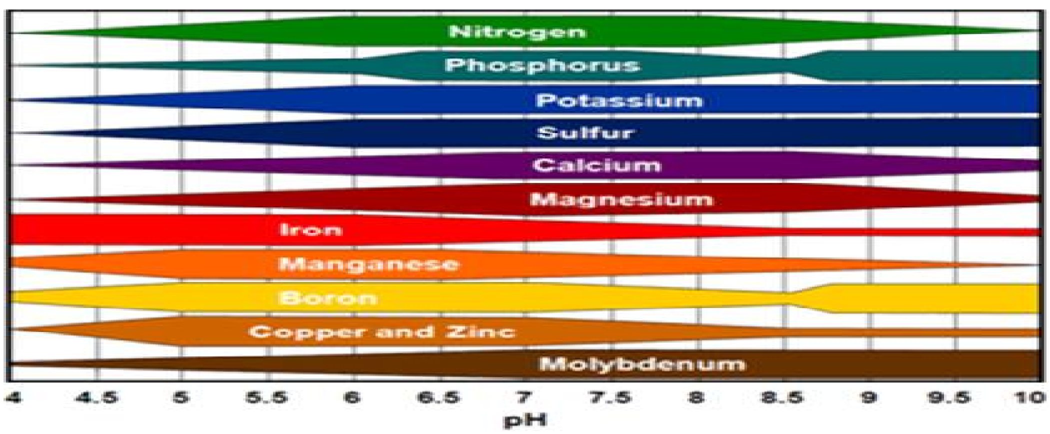
Soils can be acid or alkaline according to pH values which in fact are indicators of hydrogen ions concentrations. For having a health growth of vegetables it is important to know the exact value of soil pH. Evaluating soil pH can help us isolate existent or possible problems and then manage in better way the plant growth. According to soil pH we can make a classification of soil as shown on table 2 (Brady,N.C and R.R.Weil, 1999).

Table 2. Soil Clasification according to pH

pH	Soil Classification
>9	Very strongly alkaline
9 – 8.5	Strongly alkaline
8.4 – 7.9	Moderately alkaline
7.8 – 7.4	Slightly alkaline
7.3 – 6.6	Neutral
6.5 – 6.1	Slightly acid
6.0 – 5.6	Moderately acid
5.5 – 5.1	Strongly acid
5.0 – 4.5	Very strongly acid

Optimal pH values of soil to assimilate all the micro and macro nutrients are of 6 -6,5 because pH of the soil affect the amount of nutrients dissolved in it and so on the amount of available nutrients for vegetables growth. Some nutrients can be more available on acidity conditions and some others on alkalinity conditions as shown on the figure below.

Figure 1. Available nutrients at different pH



Based on the great importance that pH and organic matter have on plant growth and development, as well as in making a qualitative agricultural production, this study sought to determine the levels of them content in a glasshouse (placed on Durres) and evaluation of their levels and compare them with some older data on these two soil indicators taken during 2004 - 2005 on some greenhouses placed on Durres and Fushe-Kruja areas.

MATERIALS AND METHODS

The method of the relevant guidance given in QTTB (Land Departament) Fushe-Kruje , was used in soil analyses. A greenhouses belonging to a farmer in area of Durres have been the object of our study. Appropriate samples of land were taken from this greenhouse. Each soil sample has emerged as the mixture of 5 individual samples taken over an area of 100 m^2 in the range 0-30 cm depth. Their further treatment mixture, cleaning of plant roots and reducing, has enabled the delivery of appropriate samples in the laboratory. The samples were dried in natural conditions in the shade for several days in laboratory and then milled in dimension about 2mm. 40g soil samples prepared as above were placed in a 500 ml erlenmajer and treated with 200ml of distilled water. The content was shacked for about 15 minutes and then filtered with a compressed filter. pH was determined with pH-meter and organic matter was determined by combustion on 600^0C.

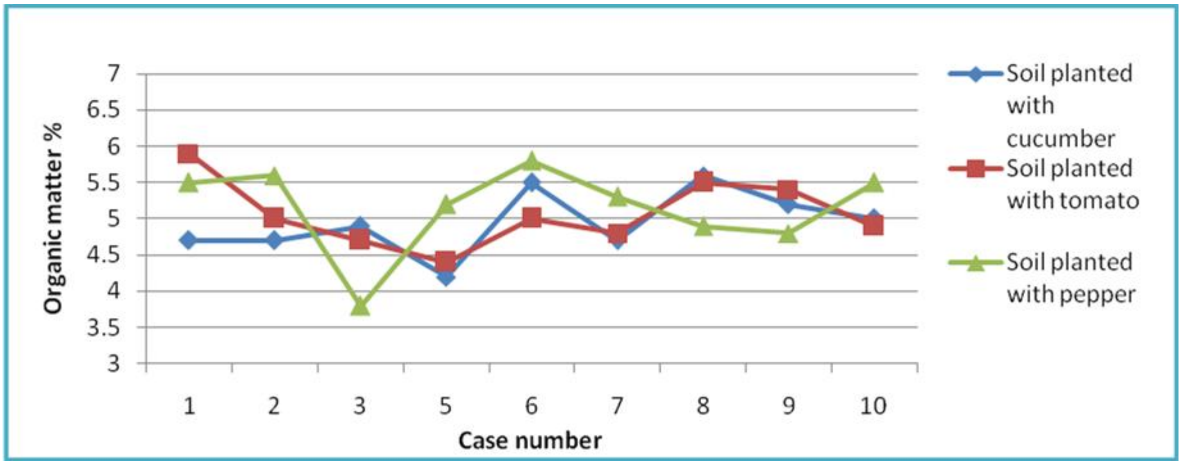
Results and discussions

The glasshouse that was part of our study constantly cultivates three types of vegetables: tomatoes, cucumber and pepper. Part of our study was determination of soil's organic matter and pH on three plots seeded with three cultivars. In table 3 are shown the results obtained from the assessments done in this glasshouse over the organic matter containment. We can notice that both three plots have organic matter containment within the levels of 4.2 – 5.9 %. According to the literature content of organic matter within the levels of 4 – 8 % is evaluated as an average content of it soil (Bauer, A. & Black, A.L. 1994).

Table 3. Organic matter in % of glasshouse soil

Case number	Soil planted with cucumber	Soil planted with tomato	Soil planted with pepper
1	4.7	5.9	5.5
2	4.7	5	5.6
3	4.9	4.7	3.8
4	4.6	4.3	5.2
5	4.2	4.4	5.2
6	5.5	5	5.8
7	4.7	4.8	5.3
8	5.6	5.5	4.9
9	5.2	5.4	4.8
10	5	4.9	5.5

Through graph 2 below we can understand that all the three glasshouse plots present a sustainability of this indicator within average limits of its content (4 – 8 %).



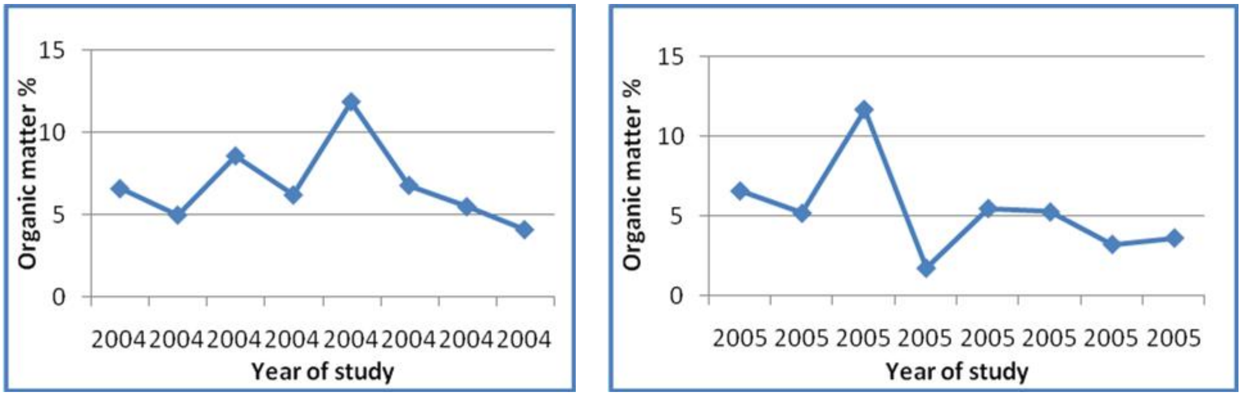
Graph 2. Organic matter in % of glasshouse soil

Despite mineralization of organic fertilizers (as a result of glasshouses conditions) is faster than in open plots soils, thus providing more plants nutrients, in our case there are not prospectively effects that must have been present on organic matter data, as a high content of it.

On table 4 and graphs 3 and 4 are presented data of organic matter content of some other older glasshouses soil (of Durres and Fushe-Kruja areas) collected during the years 2004 – 2005.

Table 4. Organic matter of some glasshouses studied during the years 2004 and 2005

Year of study	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**
Place	Durrës	Durrës	Durrës	Rreth, Shijak	Durrës	Durrës	Krujë	Krujë
Organic matter %	6.6	4.99	8.6	6.22	11.9	6.8	5.5	4.1
Year of the study	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**
Place	Krujë	Krujë	Krujë	Nikël, Krujë	Nikël, Krujë	Nikël, Krujë	Nikël, Krujë	Krujë
Organic matter %	6.6	5.2	11.7	1.76	5.5	5.28	3.25	3.65



Graph 3 &4. Organic matter of some glasshouses studied during the years 2004 and 2005

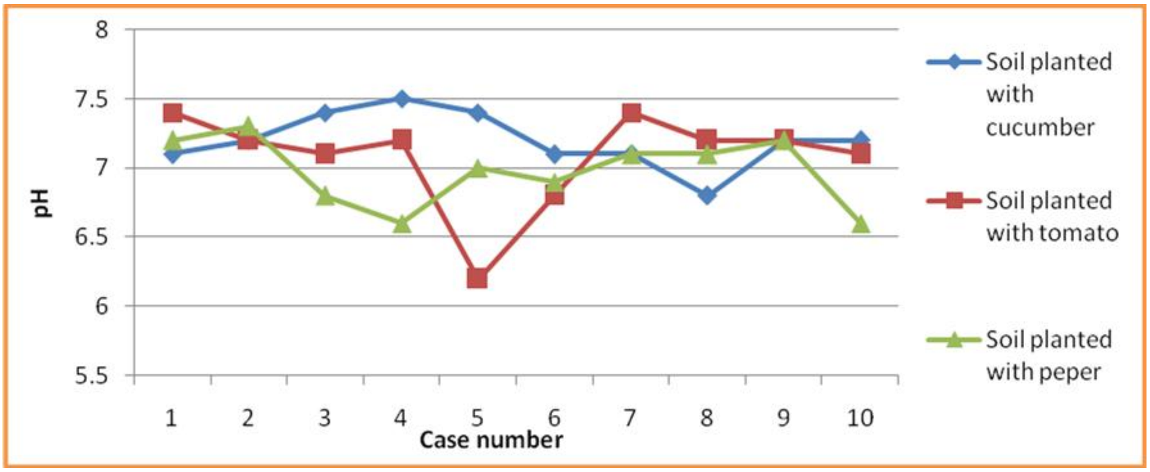
As we can see soils of the glasshouses studied during 2004 organic matter is within its average limits of evaluation 4-8%, while the soils of glasshouses studied during 2005 bedside the cases of average organic matter content, cases of high content (above 8%) and lower content (below 4%) are also observed.

Importance of soil pH stands at mineral and plants nutrient solubility. Most of these nutrients dissolve better on acid soil then on neutral and slightly alkaline soils. pH role in soil is also connected to bacteria and microorganisms, that decompose organic material, which perform better their function on acid soils.

Table 5. Soil pH of the glasshouse studied

Case number	Soil planted with cucumber	Soil planted with tomato	Soil planted with pepper
1	7.1	7.4	7.2
2	7.2	7.2	7.3
3	7.4	7.1	6.8
4	7.5	7.2	6.6
5	7.4	6.2	7.0
6	7.1	6.8	6.9
7	7.1	7.4	7.1
8	6.8	7.2	7.1
9	7.2	7.2	7.2
10	7.2	7.1	6.6

Even through table 5 but also through graph 5 we can say that at the glasshouse studied its soil can be evaluated (Brady,N.C dhe R.R.Weil, 1999, table 2) mainly as slightly acid (pH 6.1 – 6.5) and neutral (pH 6.6 – 7.3). Only in few cases soil can be evaluated as slightly alkaline with pH values within 7.4 and 7.5.

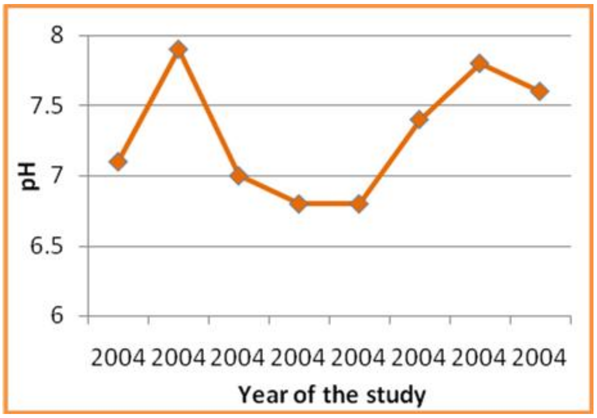


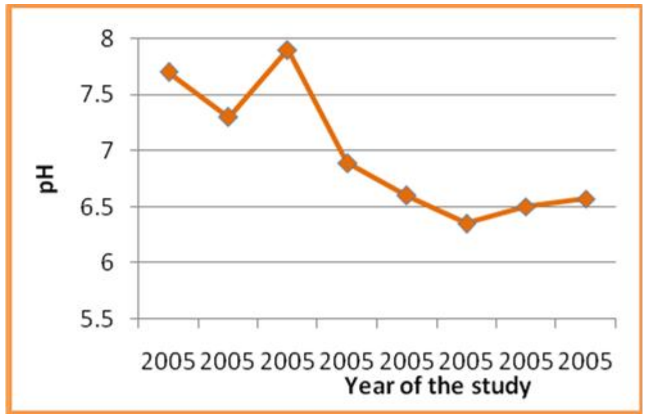
Graph 5. Soil pH of the glasshouse studied

Both the three plots of glasshouse studied show a sustainability of pH values as of minimal and maximal values that demonstrate the special care token to keep pH of soil water extract within cultivated vegetables needs. On table 6 and graphs 6 and 7 are presented the pH values obtained from glasshouse's soils studied during the years 2004 and 2005.

Table 6. Soil pH of the glasshouses studied during the years 2004 and 2005

Year of study	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**	**2004**
Place	Durrës	Durrës	Durrës	Rreth, Shijak	Durrës	Durrës	Krujë	Krujë
pH	7.1	7.9	7	6.8	6.8	7.4	7.8	7.6
Year of the study	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**	**2005**
Place	Krujë	Krujë	Krujë	Nikël, Krujë	Nikël, Krujë	Nikël, Krujë	Nikël, Krujë	Krujë
pH	7.7	7.3	7.9	6.89	6.6	6.35	6.5	6.57





Graph 6 & 7. Soil pH of the glasshouses studied during the years 2004 and 2005

As we can see soils analyzed during the years 2004 – 2005 have pH values that vary from 6.8, that make these soils be evaluated as slightly acids, up to 7.8 and 7.9 that make the soil be evaluated as slightly alkaline (Brady,N.C dhe R.R.Weil, 1999). Soils presenting pH values between 6.5 – 7, are soils that can provide to plant a good growth because nutrient absorption and microorganisms activity is in its optimal levels (Scherer and Werner 1996).

Results and discussion

Analyzed glasshouses soils have a pH of water extract varying in the limits of 7.0 – 7.2, that is optimal for normal development of most vegetables.

Long time and systematic use of mineral and organic fertilizers had no effect in changing the soil pH.

Organic matter is in average or low content. This requires a controlled use of mineral fertilization. Control must be done through intermediate soil assessment during vegetation period of a given culture.

Uses of organic fertilizer didn't change organic matter content in soil. That's why organic fertilization must be used especially as a plant food with short time effects on glasshouses soil.

References

1. Alexandra Bot FAO Consultant and José Benites FAO Land and Plant Nutrition Management Service FAO SOILS BULLETIN 80 The importance of soil organic matter Key to drought-resistant soil and sustained food production
2. Bauer, A. & Black, A.L. 1994. Quantification of the effect of soil organic matter content on soil productivity. *Am. J. Soil Sci. Soc.*, 5: 185–193.
3. Brady,N.C and R.R.Weil, 1999. The nature and property of soil, 2^{-nd} ed; 462 -465
4. Duxbury, J.M., Smith, M.S. & Doran, J.W. 1989. Soil organic matter as a source and sink of plant nutrients. *In* D.C. Coleman, J.M. Oades & G. Uehara, eds. *Dynamics of soil organic matter in tropical ecosystem,* pp. 33–67. USA, University of Hawaii Press.
5. Hudson, B.D. 1994. Soil organic matter and available water capacity. *J. Soil Wat. Con.*, 49(2):189–194.

6. Izaurralde, R.C. & Cerri, C.C. 2002. Organic matter management. *In: Encyclopedia of soil science*, pp. 910–916. New York, USA, Marcel Dekker Inc.
7. Mengel K, Kirbky.E.A 2001, Principle of plant nutrition, Text
8. Udhëzuesi i analizave të QTTB, Fushë - Krujë
9. Scherer, H.W, and Werner, W. 1996, Singificance of soil microorganisms for the mobilization of nonexchangeable ammonium. Biol.Feritl.Soils 22, 248 – 251