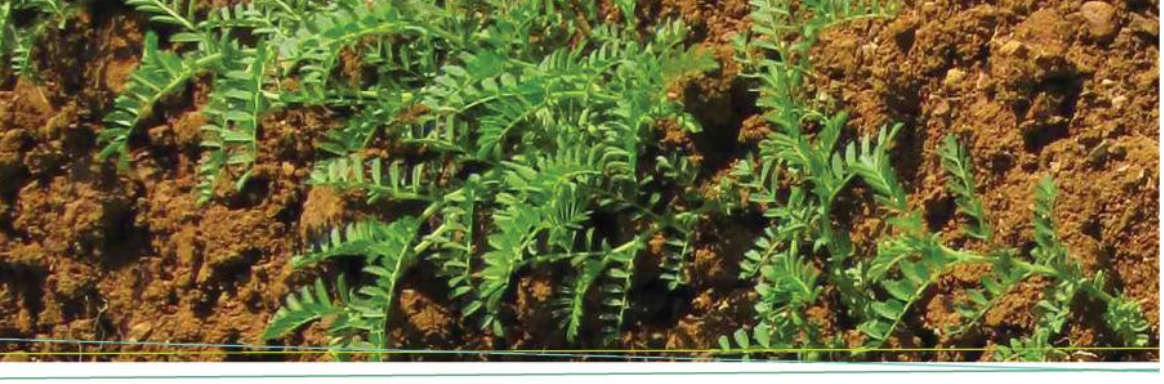

Minipaper

Water related aspects (Irrigation Aspects)

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1. Introduction

In the Mediterranean landscapes there is in most cases a clear, well defined line in the landscape: the line that divides the countryside in dry land and irrigated land. A huge difference exists in the agricultural development of such units concerning economy, yields, management, inputs and technology. In Mediterranean regions, irrigated areas are of outmost agricultural value and it is possible when high quality irrigation water is available. Different irrigated areas in Mediterranean regions supply a strategic amount of agricultural products both in terms of quality and quantity. The irrigated soils, mostly in fertile and productive zones have a large number of qualities that allow for good yields if regular irrigation water is provided.

Soil organic matter (SOM) is a recurrent topic in irrigated agricultural management (and in dry-land areas as well). In the case of irrigated land the SOM has a positive contribution to soil structure, soil infiltration, soil nutrient stock and supply, soil salinity and soil workability.

The water content of soil is directly related with the mineralization rate. During the mineralization process, organic forms of nitrogen (N) are converted to inorganic N, as ammonium N. The inorganic N may be indigenous to the soil or added as animal manures, crop residues or municipal wastes. This process is mediated by soil microorganisms, which use the energy derived from the oxidation of soil organic matter for metabolic activities and the N released during the decomposition to produce amino acids and proteins essential for population growth. Once mineralized, the ammonium N can be nitrified to nitrate N, and it can be involved in processes of nitrate leaching. The mineralization rate of the organic N from soil organic matter generally is higher with increasing moisture content in soil. In addition, temporal changes in soil water content (as cycles of drying and wetting) can affect to the rate of mineralization. The rewetting of dried soils produces a burst of microbial activity associated with an expansion of microbial populations involved in the process of mineralization.

The leaching of nitrates from irrigated areas is the main environmental problem that is related with the irrigation and fertilization management practices applied and with the SOM content of the soil (and the organic amendments applied). This environmental problem is directly related with the mineralization process. Some important agricultural irrigated areas of Europe have been designated "vulnerable zones to nitrate pollution from agricultural sources" by the EU Nitrate Directive 91/676/EEC. In these "vulnerable zones" it is mandatory to implement "Action Plans", which consists in the development of management practices of N fertilization and irrigation to reduce nitrate emissions to the environment. The amount of organic forms of N added to agricultural soils as manure applications has been limited by these "Action Plans". Manure applications have been done during the last decades to preserve the organic matter content in soils, especially in areas of the Mediterranean region in which the agricultural soils are poor in organic matter. The amount of manure applied to the soil is different depending on the crop and the agricultural system. In order to apply appropriate management practices it is necessary to know the expected rate of mineralization of the organic forms of N applied with organic amendments using manure or applying another organic amendment, and the effects that different irrigation systems and different irrigation management practices can produce on the rate of mineralization in the soil and in that way, on the rate of nitrates leached.

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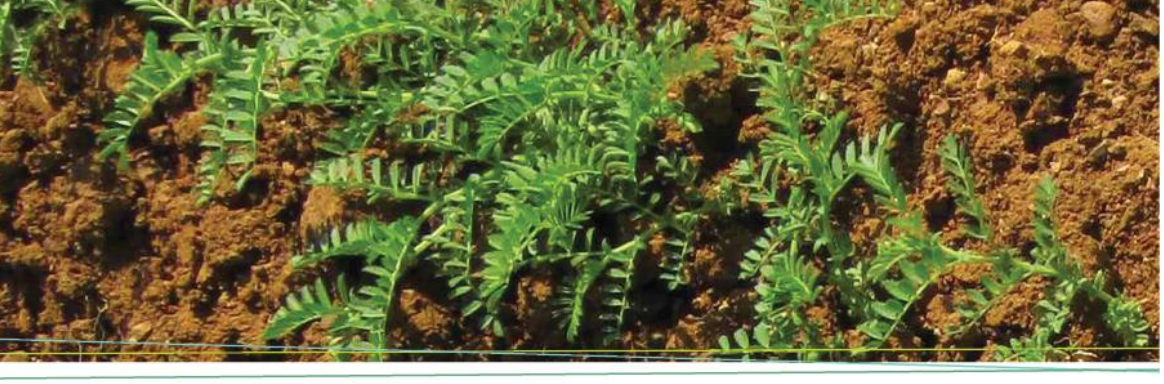

Some subjects stand out and probably should be better understood related water related aspects and SOM content in the soil:

ii) Which is the impact of irrigated agricultural management practices in SOM?

iii) Which are the practices farmers should implement for maintaining or improving SOM in irrigated areas?

COMMENT D.A.:

Comment: A discussion of the effects of good water management practices to SOM is of particular interest to the region, and the needs for further research and data collection.

The dissemination of information and education of farmers towards SOM and its importance in farming is a particularly important task, since it can transfer and apply to the field SOM conservation and enhancement measures.

2. Solutions/possibilities/opportunities

2. A. - Impact of agricultural practices in irrigated soils concerning SOM

Some agricultural practices are probably in the origin of low contents of SOM in irrigated soils. A non-exhaustive list of the origin of low SOM in the soils might be the following:

- Soil erosion due to a natural process

- Soil erosion due to leveling, land consolidation, routine agricultural practices

- Soil erosion due to abandonment of old soil conservation practices

- Soil erosion induced during irrigation

- Ploughing not adjusted to soil properties

- No restitution of plant residues to the soil

Key points

- From the SOM status of the soil to the evaluation of irrigation agricultural practices.

- How to supply to farmers an indicator of SOM, soil type related and according to soil agricultural system: fruit tree, cereal rotation, horticultural crops, fodder crops?

- How to translate to farmers the loss of soil quality through SOM indicators?

- Farmers should analyse their soils for SOM and take actions to increase it.

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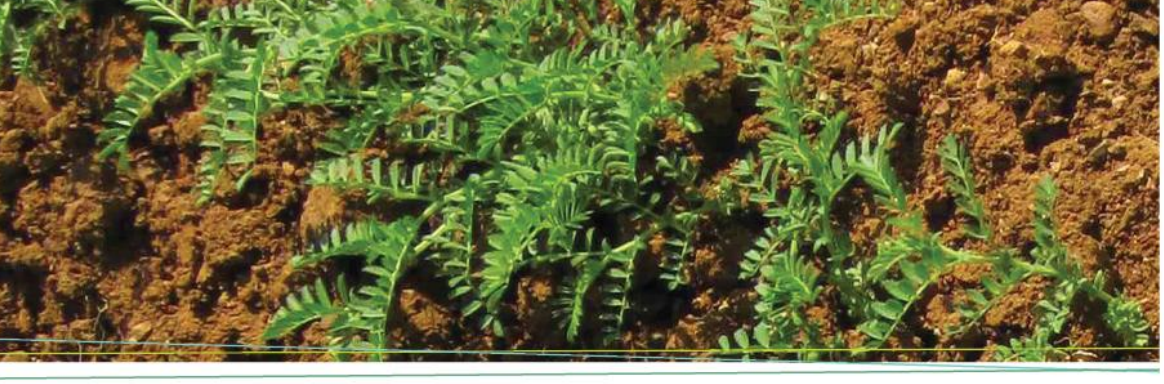

TO SUM UP: THE EVALUATION OF THE SOM AND ITS RELATION WITH AGRICULTURAL PRACTICES

2. B. - Maintaining or improving soil organic matter in irrigated areas

Farmers have the practical key for maintaining or improving SOM in the soil.

- Avoiding soil erosion: how to implement? In sloping areas/soils by performing ploughing according to isoheights and using proper irrigation system in order not to have surface water runoff which induces and accelerates erosion.

- Keeping old practices concerning soil conservation practices (how to do it in practice): One of the main old practices is terracing in sloping soils. This in our days is very expensive and it is not certain whether farmers can afford it. National or European subsidies might be the solution considering the value of soil in sloping areas and adjusting to farmer good practices.

- To avoid erosion (common point to dry land areas). Again terracing is the main answer in combination with proper ploughing or not till or minimum till. All this combined with proper crop management. Soil must be covered by crops or mulching during the autumn heavy rains.

- Keep soil cover (common point to dryland areas): this through proper crop rotation and mulching.

- Proper recycle system in managing plant residues (common point to dryland areas): No burning of plant residues, use them for covering soil after proper chopping and incorporation.

- Organic amendments based on the application of manure to soils in irrigated lands: it is necessary to review the amounts of manure (and the amounts of another organic residue) that are allowed to be applied in Vulnerable Zones to nitrate pollution in order to preserve and/or to increase the organic matter content of soil.

- The farmers have to consider the most compatible to its farm (for example in acid soil he must avoid acidified residues), also they have to consider the one with the lowest transportation and application cost.

Key points

- From the evaluation to the action. Which practices are advisable?

- Internal SOM supply or external:

  - Internal: crop practices within the farm. Evaluation through improvement of soil structure, workability, crop yield, but above overall through SOM analyses.
  - External: OM external supply. Evaluation of cost among the existing external sources and between internal sources. These by considering the existing external sources, their cost, their vicinity to the farm, the necessary processes, etc.

- How to translate to farmers the effective alternatives for increasing, if necessary, the SOM: Farmers in their majority are aware of the beneficial effects of SOM. What they may need is evidence that they will increase their income more than their expenses to increase the SOM, obviously in a long term approach.

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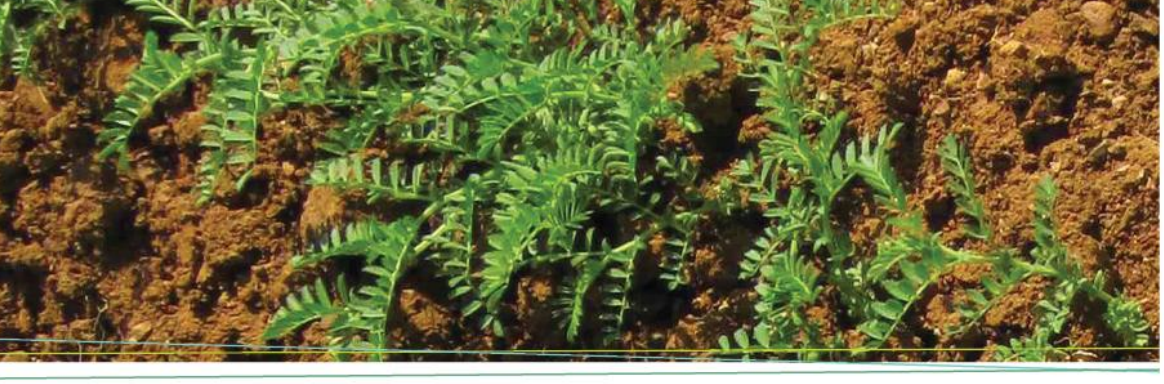

- How to translate to farmers the effective alternatives for increasing, if necessary, the SOM: Farmers in their majority are aware of the beneficial effects of SOM. What they may need is evidence that they will increase their income more than their expenses to increase the SOM, obviously in a long term approach.

- It is necessary to promote research studies to characterize the rate of mineralization of the organic N applied to agricultural soils with different organic amendments in different Mediterranean regions and with different cropping systems.

- The farmers have to consider the most compatible to their farm (for example in acid soil they must avoid acidified residues), also they have to consider the one with the lowest transportation and application cost.

- An important point in the irrigated agriculture in the Mediterranean regions, especially in areas where pumped water is used for irrigation, is the quality of water. Especially in areas close to the sea. Due to the water deficit which is enhanced by the warming up of the planet, more and more water is pumped and even from levels below the sea water level. This obviously favours sea water intrusion and irrigation water quality deterioration. In other words salt is added to the surface of the soil which induces desertification rather than SOM increase.

- It is also necessary to consider the farm and the agricultural plot general situation, especially in areas with high and short-distance soil variability and variability in crop management. This might be implemented by mapping the area and defining the subareas of high risk. In certain areas SOM increase scenarios could be proposed by local state or private advisors, in relation to the existing external sources (properties, cost of transportation, application etc.)

TO SUM UP: THE CORRECTION (IMPROVEMENT OR MAINTENANCE) OF THE SOM. ADVICE ON BEST PRACTICES

3. EXAMPLES, PRACTICES TO WORK OUT

3.1. - Case A

- Rotation maize-wheat-alfalfa under irrigation (sprinkler)

- Yields: on the top considering the averages in the area

- SOM: more than1%

- Evaluation of the SOM

- Actions to proceed

Case resolution:

- *The level of SOM is not well defined in this case "more than 1%". Soil analysis should be implemented.*

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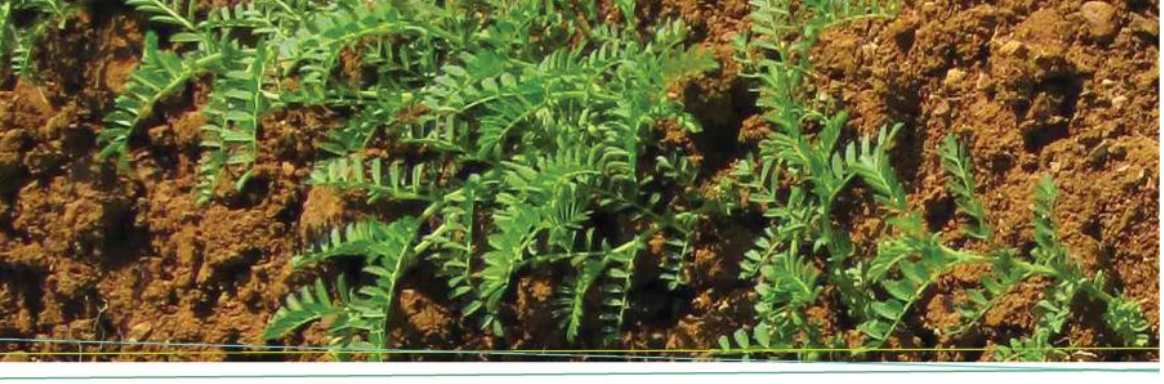

- *Yield levels are on top of the area and no problems are mentioned.*
- *The rotation has the potential of supplying a large quantity of plant residues.*
- *In this case we should await for soil analytical results before a decision is taken.*
- *External supply of residues should be wait for a proper status definition. A proper definition of the expected residue is necessary. Not all residues supply significant amounts of OM to reinforce soil status.*
- *Field visit should supply an in situ diagnostic for proposing specific practices: soil erosion, soil depth, visual assessment…*

3.2. - Case B

- Recently irrigated group of agricultural plots. Old plot margins have been eliminated in the process of land consolidations. The slope of the plot is about 2% and sprinkler irrigation is envisaged. Yields are expected to increase drastically thanks to irrigation.

- Farmer has the soil characterization including SOM measurements. SOM is 1,4%. The farmer has in mind the "improvement" of the SOM and it has the offer of and external supply of residues from agro industrial origin. The cost of the external OM supply is zero.

- Which could be the advice for farmer objectives concerning the increase of SOM?

Case resolution

- *Current SOM is measured. SOM < 1,6% is considered to be low.*
- *Land consolidation and levelling has implied a loss of properties of top layer, horizon Ap.*
- *Land ploughing according to isoheights is important although the risk of soil erosion depends upon a number of soil characteristics including rainfall intensity, infiltration, cover…so a field diagnostic is compulsory.*
- *A real and quite realistic option to apply could be the implementation of minimum tillage.*
- *The most suitable organic residue in view of the increase of organic matter could be farm manure. Cattle manure might be a good option considering the content of organic matter in relation to the total amount of residue. Slurry (pig) could not be adjusted to the needs of the farm considering its low content in organic matter. The supply of agro-industrial residues should be analysed with care considering: content of OM, content of nutrients, presence of potential pollutants.*

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