The study of Mediterranean soils : a difficult task

Mancini F.

in

Zdruli P. (ed.), Steduto P. (ed.), Kapur S. (ed.).
7. International meeting on Soils with Mediterranean Type of Climate (selected papers)

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 50

2002
pages 3-9

INTRODUCTORY PAPERS

THE STUDY OF MEDITERRANEAN SOILS: A DIFFICULT TASK

FIORENZO MANCINI

Accademia Italiana di Scienze Forestali Piazza Edison 11, 50133 Firenze, Italy
Tel. 0039-055-570348, Fax 0039-055-575724, E-mail info@aisf.it

Why this study is a difficult and often a very difficult task? Because strong variations in space and time are not an exception but the common rule in the Mediterranean regions.

Thirty-five years ago at the congress of the Mediterranean soils in Madrid, Spain, I proposed the elimination of the term "Mediterranean" in soil classification. It was evident, in my opinion, that according to the 7th approximation of the U.S. Soil Classification (the Soil Taxonomy will appear ten years later) in the Mediterranean areas, at least 7 or 8 orders were and are present (Entisols, Vertisols, Inceptisols, Mollisols, Alfisols, Ultisols, Aridisols and Hisosols).

Detailed information on soil surveys in the Mediterranean at that time (1966) was not high. Today the situation at least in Italy, is quite different. The surveys have clearly demonstrated the variations of soil panorama.

Let' s now discuss why this study is rather difficult.

We may begin with the situation that at first look can be considered as the simplest one: the alluvial soils. They are of recent origin and profiles are not differentiated. Many properties are notably related with the mechanical composition of the parent material. Which are then the complications?

Some alluvial soils contain transported soil materials eroded elsewhere and having different properties due to various origin and evolution. This is especially the case when two or three orders of old fluviatile or marine terraces somewhat eroded are near. Another contribution may be due to wind.

This phenomenon is often underestimated. The transported materials can be of quite different origin. In Sicily for instance, abundant fine, and mainly quartz sandy deposits of African origin are common and influence the texture of the first horizons. Ashes and cinders deposits can be found in many localities of Southern Italy due to a long and intensive volcanic activity during Pleistocene.

The phenomenon is still going on due to the volcanic activity of Etna, Stromboli and Vulcano. Maybe we should remember that the Vesuvius had a tremendous eruption in 1906 and the last one in 1944 during the war. Here in Apulia, Italy, the Vulture (1363 m high) distributed ashes till to the Gargano area.

In the Foggia plain (northern Apulia), some vertic alluvial soils have a certain content of those ashes directly deposited or deriving from the upper catchments that arrived as recent alluvial sediments. So also for these alluvial soils, the simplest that we have, a

mineralogical research both for the sandy and the clayey fractions is in many cases necessary and will be very useful for future rational soil management. Of course, also the initial weathering and the organic matter of these young soils must be studied to understand the trend of the soil evolution.

Let's see now what happens in the older soils. Here the differences may be very large, in some cases almost enormous. It is a matter of fact that we may find soils 1,000 years old and near by others of 400 or 600,000 years having lived many of the climatic fluctuations of the Pleistocene and its direct and indirect consequences.

In the old soils, several phenomena may be distinguished. Some are going on since ancient times perhaps with different intensity, others are no more active but in the profile there are clear indications of their past action. Interpretation of the two cases is often difficult.

We probably underestimate the recent climatic modifications. Two examples: an eminent historian, Alessandro Clementi, told me that in the winters of 1602 and 1603 tremendous snow falls occurred at l'Aquila, the principal town of Abruzzi. Many roofs were destroyed and the archbishop opened immediately churches and monasteries for hosting the population. In the nearby Gran Sasso d'Italia (2,912 m high) exists a little glacier, the Calderone, the most meridional of Europe. E. Giraudo writes “during the little Ice Age the glacier reached the maximum expansion of the last 4,000 years”. This happened only 400 years ago.

Variations in rainfall not only in the amount but especially in the distribution may influence notably the pedogenesis. More rain in May and in June, for example, means that high temperatures and water are in the same time present in the soils and so many phenomena are not blocked by aridity in the first weeks of summer.

Evidence of an increase of rainfall are known at least for Italy and for the last part of Holocene during Neolithic, the Bronze Age and around the birth of Christ. So also the Holocene is complicating our itinerary. I think that collaboration with palaeoclimatologists and prehistorians is surely very useful.

Going back to more ancient times, we know that in the last interglacial period, a milder climate was prevailing with luxuriant vegetation like that we may observe today in the gulf of Trabsund in the oriental southern coast of the Black Sea. We have a Mediterranean climate with rainy summers originating Alfisols and Ultisols. Some of these soils in other regions are still preserved on old surfaces often severely eroded or under forest with the superficial horizons now influenced by the species that at present form the vegetation cover. Therefore, it is not always easy to distinguish old and recent pedogenetic features.

The permanent snow limit in the Mediterranean mountains in the last glaciations (the Würmian of the Alps with its maximum around 16 to 17,000 years BP) was at 1,600 - 1,800 m o.s.l. and rising to 2,000 in the southern slopes. This means that periglacial phenomena occurred over at 1,000 meters or a little higher. At lower altitudes, the pedogenesis was active and in some cases more intense, due to an increase in the amount of precipitation and a better or different distribution during the year.

To solve some of our problems the help of palebotanists may be important. Be sure that also

they did not have an easy life! In some cases, for instance in Calabria, the forest has components of quite different origin and ecology like *Quercus ilex*, typical of the Mediterranean Silva mixed with beech (*Fagus*) species present in central Europe till Scandinavia. Some elements probably raised during the interglacial or other warm periods while others descended in the colder times.

What are the interpretation and the influence in pedogenesis of one evergreen tree and a deciduous one? Pollen analysis may give good results allowing a rather precise chronological scale but in red Mediterranean soils pollens in general are not preserved.

Having the luck of finding buried soils a detailed investigation can solve some of our incertitudes. We need to know that very impermeable layers lying above securely seal these soils. If not, trans located materials (carbonates, oxides, and organic matter) can be found and great difficulties immediately arise. Absolute dates (C14 dating or others methods) will of course give an excellent support to our interpretations.

In very old soils, formed for instance in the great interglacial period (the Mindel - Riss of the Alps) or previous periods, some tropical features appear that are still preserved till today. For instance, the presence of gibbsite or the dominance of monosiallitisation (C. Bini and other authors) could be mentioned. Many profiles are truncated, but still very deep. Weathering is high and when cobbles and pebbles constitute parent material they can easily be cut with a knife.

Desaturation is strong, and acidity very high. Due to their lower fertility, they are often still under forest vegetation, which in various localities is more mesophile than elsewhere, due to the important volume of the soil and the consequent high water retention capacity. They pertain in general to the Ultisol order and sometimes, oxic characters appear. The situation may be worst where fragipans or cemented and impermeable layers are present, so the roots cannot go deeper.

Leaving the old soils it may be of some interest to note what is going on recently in the Mediterranean area. My experience is of course limited to Italy. In other countries, I only participated in Spain, Portugal, France, Greece and in the other coast, the African, in Egypt, Morocco and Libya to field excursions, short surveys and of course meetings, congresses but never handled long and detailed studies. Personally, I have very limited experience of the more arid environments.

In my opinion, in Italy we have to distinguish what happens in the litoral flat plains and in the mountains both at the coast and behind some tens of kilometres. At the coast rainfall can be limited to 350-400 mm/y or a little more. We do not have localities with less than 300 mm. In the mountains the situation is in general rather different. An increase of 500 mm in the total amount in 20 km distance from the littoral is common.

In Campania and in Calabria, where the rains are abundant, we may have stronger differences. Let's look the pluviothermic diagram for Montevergine (Fig.1), an old monastery at 1,270 m/ a.s.l. immerged in a splendid *Fagus* forest over Avellino some 30 km from the Tirrenian sea. It rains more than 2,000 mm/y but pay attention; the distribution is still Mediterranean with arid summer months while in winter abundant snowfalls are the rule.

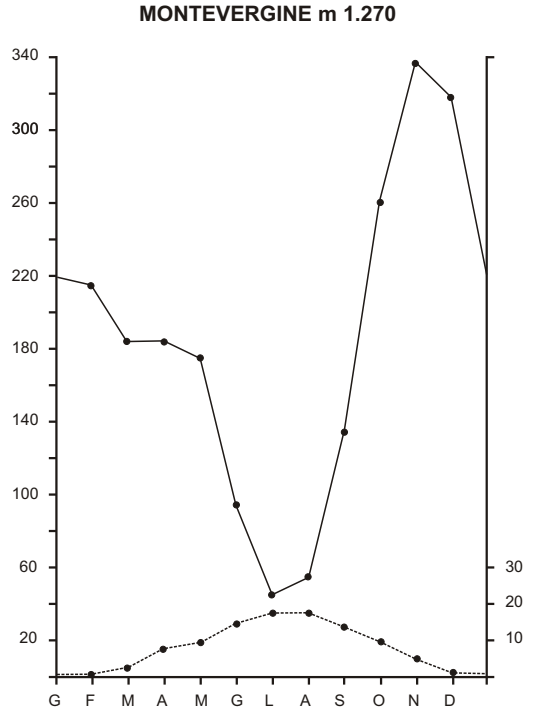

Figure 1. Pluviothermic diagram.
Mean annual rainfall 2,215mm in 118 days. Mean annual temperature 7,8°C

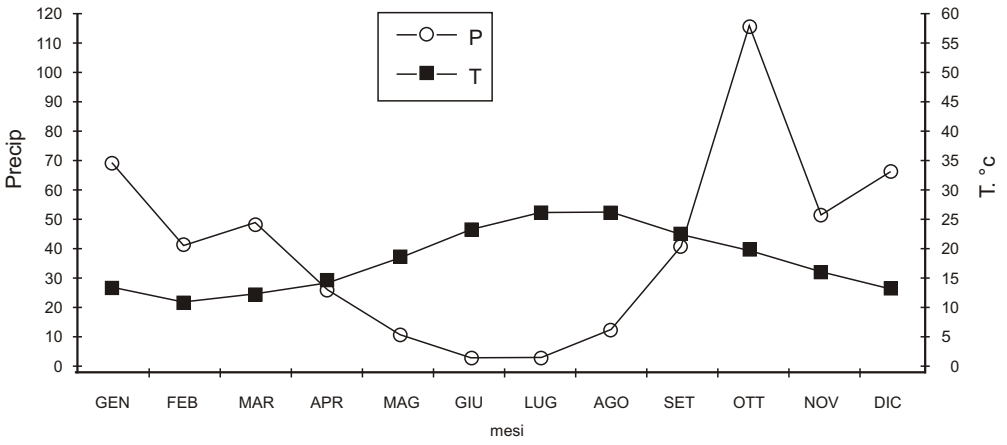

Figure 2. Pluviothermic diagram for Siracusa (Sicily). (From G. Fierotti).

These examples demonstrate that large areas with a Xeric Soil Moisture Regime (SMR) could include some localities, especially in the mountains, having an udic SMR.

Infidelity is another peculiar problem. You can never forecast when and how much it will rain and this of course influence notably the pedogenesis, consequently the work of the farmers and the quality of their products. Very rainy summers will certainly give not excellent wines. The irregular rainfall distribution pattern provokes a rather strange situation in many of our soils that may have a Xeric SMR in one year but an Udic one in the next year.

It is also interesting to examine which is the thermal regime. We have "frost free zones" at the coast or a little behind it, but in the immediate interior, especially in narrow river valleys, temperatures lower than 0°C are frequent in winter times and a sudden recrudescence in spring is not rare with severe damages in agriculture (*i.e.* the 15th of April 2001). In the mountains, especially at high altitudes, the winter can be severe and low temperatures could last as long as March or April.

In the more humid mountains of Abruzzi, for instance Maiella, the snow can cover the ground, at 2,000 - 2,200 m for six months. The Table for Monte Scuro at 1,710 m in Calabria, prepared by Brunetti and its collaborators, shows clearly that not only in winter but also late in March we may have very low temperatures and also snowfall could be abundant and frequent. Note that the two seas, Tirrenian and Ionian are few tens of kilometres far away from this locality.

Table 1. Late spring and early fall frosts for Monte Scuro, 1,710 m o.s.l. (Calabria) (from Brunetti *et al*).

LATE SPRING FROSTS: frequencies, (%) of occurrence of minimum temperatures equal or less than specific thresholds

Month decade		thermal threshold								years of observation
		-10°	-8°	-6°	-4°	-2°	0°	2°	4°	
	I	65	88	97	100	100	100	100	100	34
January	II	59	85	97	100	100	100	100	100	34
	III	56	82	94	100	100	100	100	100	34
	I	50	79	91	100	100	100	100	100	34
February	II	50	68	82	100	100	100	100	100	34
	III	38	56	74	94	100	100	100	100	34
	I	29	41	65	82	100	100	100	100	34
March	II	21	26	56	79	97	100	100	100	34
	III	3	6	26	62	91	100	100	100	34
	I	3	3	15	48	82	100	100	100	33
April	II	0	0	9	36	76	97	100	100	33
	III	0	0	0	18	61	91	100	100	33
	I	0	0	0	6	18	58	97	100	33
May	II	0	0	0		03	21	73	100	33
	III	0		0	0	03	9	52	76	33
	I	0	0	0	0	0	6	24	61	33
June	II	0	0	0	0	0	0	06	33	33
	III	0	0	0	0	0	0	0	9	32

EARLY AUTUMN FROSTS: frequencies, (%) of occurrence of minimum temperatures equal or less than specific thresholds

Month decade		thermal threshold								years of observation
		-10°	-8°	-6°	-4°	-2°	0°	2°	4°	
	I	0	0	0	0	0	0	0	6	33
July	II	0	0	0	0	0	0	0	15	33
	III	0	0	0	0	0	0	0	15	33
	I	0	0	0	0	0	0	0	18	33
August	II	0	0	0	0	0	0	0	23	33
	III	0	0	0	0	0	0	0	24	33
	I	0	0	0	0	0	0	6	29	34
September	II	0	0	0	0	0	3	12	35	34
	III	0	0	0	0	0	9	32	68	34
	I	0	0	0	3	9	18	47	76	34
October	II	0	0	0	3	15	38	48	97	34
	III	0	0	0	9	32	62	91	100	34
	I	0	0	6	18	41	74	97	100	34
November	II	0	3	9	26	59	88	97	100	34
	III	0	9	29	62	88	97	100	100	34
	I	6	18	47	82	97	100	100	100	34
December	II	9	24	62	85	97	100	100	100	34
	III	12	32	79	94	100	100	100	100	34

The late frosts in spring in the hills create more damages for agriculture and less for the natural vegetation.

Trying to simplify the tremendous variability concerning pedogenesis in the Mediterranean environments, we may have in Italy three typical situations of certain reliability.

The first one relates to the fact of the long or very long arid period occurring from late spring to the entire summer season. Therefore, most of the pedogenesis activity occurs in fall, winter and the first part of spring. Later, the rising of capillary water to the soil surface is common and brings to efflorescenses formation. In summer there is absence of water, cracking occurs in clayey soils but not much more than that.

The second situation includes the areas with much more abundant rainfall and a better distribution. In several localities, the month of May, at least 5 years over 10, has more rain than April, which in turn is rainier than March. After the arid summer, we may have rain late in August or at beginning of September, bringing to the so-called "Rinfrescata" (Refreshment).

Pedogenesis may be almost blocked in some winter months by rather low temperatures especially in some hills. In those cases, the process lasts some months in spring until the first weeks of summer and early in autumn when the temperature in the air but especially in the soils is still rather high. Therefore, the summer interruption for lack of water is shorter.

In the more humid periods, leaching is an important phenomenon with the tendency of an argillic horizon formation. This phenomenon was clearly stressed by Mediterranean soil scientists, especially by José Cardoso, who already many years ago proposed also for that horizon the term "*argilluviado*", which in my opinion, makes me much happier and I find it more eloquent that the "*argillic*".

The third environments are the mountainous regions with a long blocking of soil formation from the middle of fall to full spring by low temperatures. They have a very short arid period in summer. Pedogenesis is very active late in spring and also in summer with a decrease of intensity, different every year, late in July and August and a restarting for few months in September and October.

It is evident that the three situations shortly illustrated are quite different from one another and those differences may change every year.

Let's go to the conclusions. These are remarks of a rather rusky and somewhat rustic old soil scientist with a long field experience in pedology and geomorphology and much less a laboratory one.

I believe that we may convene that the study of Mediterranean soils is a difficult task but in the same time one of the most fascinating. Young scientists or middle age ones, that have in front 20 or 30 years of investigations have to form, in my opinion, large working teams with specialists of other disciplines and an important overlapping in their language and understanding.

In these teams an important place must be reserved to humanists not only historians, prehistorians and archaeologists but also to students able to find in the very rich archives that we have in Italy and in other Mediterranean countries important documents rich of information useful for improving our interpretation.

Excellent results will come but pay attention, pay much attention dear friends, field study, detailed, deep, and precise observations in front of the soils that Nature and Man have created are of paramount importance. Without these field observations we will certainly never obtain good results.

Amen, have a great success in your work and thank you very much for your kind attention.