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The Umbrisol problem

Michele E. D'Amico[1]*, Emanuele Pintaldi[2]

[1] *Department of Agricultural and Environmental Sciences, University of Milano, Italy*

[2] *Department of Agricultural, Forest and Food Science, University of Torino, Italy*

*michele.damico@unimi.it

ABSTRACT

According to the WRB concept, Umbrisols are characterized by the presence of deep, dark and organic-matter rich Umbric topsoil diagnostic horizons, the acidic counterpart of soils with Mollic horizons such as Phaeozems, Chernozems and Kastanozems. Their high C stocks make them particularly important for C sequestration in terrestrial environments. They mostly develop in humid mountain areas, both temperate and tropical, usually on silicatic or volcanic bedrocks, and only rarely on limestone or dolostone. However, their known distribution is underestimated, as older classification systems referred to them in different ways, often associating them with soil types corresponding to Cambisols, Luvisols or Regosols. For example, Umbrisol distribution maps at the global and European scales do not show their extensive presence in the southern European Alps, where they are the most common soil type on south-facing slopes on silicatic bedrocks and sometimes even on limestone or dolostone.

Despite their similarities to non-acidic Phaeozems, the genesis of Umbrisols is very different, as is the vegetation under which they are often found. In fact, soils with Mollic horizons are usually associated wih grasslands, with which they are genetically linked, whereas soils with Umbric horizons are often found under broadleaf forests.

Also today, however, many different views exist regarding their genesis and classification. Many soils usually classified as Umbrisols have andic or protoandic properties, and they have been sometimes classified by different soil scientists also as Andisols (e.g. in NW Spain). In other cases (Southern Switzerland and NW Spain), the increasing root density and the darker colour of subsurface horizons compared to the uppermost Ah has been interpreted as evidence of podzolization, and these soils have been termed "cryptopodzols". The widespread black lower part of the Umbric horizon has also been interpreted as a buried Ah (e.g. NW Spain). The presence of charcoal fragments derived from anthropic forest clearing has also been often observed and considered as one of the main factors controlling the stable organic matter and the dark colour. Large quantities of amorphous Fe and Al oxyhydroxides, however, characterize Umbrisols, and they usually grade into Podzols at higher elevations or on colder northward slopes. In many cases, the deep black section of the Umbric horizon below the roots does not show visible biological activity (coarse blocky subangular aggregation, very scarce pellets and monomorphic organic matter in thin section). These properties and the gradual lower boundary, which often seems to follow water percolation pathways, could be related to illuviation of organic acids, although definitive evidence is still lacking.