

Soil health in the Mediterranean region: Development and consolidation of a multifactor index to characterize the health of agricultural lands

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The link among between soil health, soil conservation, and food security, resilience, and function under a wide range of agricultural uses and different environmental systems, is at the heart of many ecofriendly research studies worldwide. We consider the health of soil as a function of its ability to provide ecosystem services, including agricultural production (provisional services); regulating natural cycles (regulation services) and as a habitat for plants (support services).

Soil health is affected by a wide range of soil properties (biotic and abiotic) that maintain complex interactions among themselves. The decline in soil health includes degradation in its physical properties (e.g., deterioration of soil structure, compaction and sealing, water-repellency, soil erosion by water and wind), chemical properties (e.g., salinization, depletion of nutrients and organic matter content, accumulation of pollutants and reduction of the soils' ion exchange capacity) and biological properties (e.g., vulnerable populations of microflora, microfauna, and mesofauna, leading to a breach of ecological balance and biodiversity and, as a result, destruction of beneficial populations and pathogen outbreaks). Numerous studies show that agricultural practices have a major impact on soil functioning. Substituting longstanding tillage with no-till cropping and the amalgamation of cover crops in crop rotations were found to improve soil properties. Such changes contributed to the enhancement of the agronomical performance of the soil. On the other hand, these practices may result in lessened effectiveness of controlling perennial weeds. The evaluation of soil-health status in the Mediterranean region is very limited. Moreover, existing approaches for evaluation that have been used (such as the Cornell and Hany tests) do not give sufficient weight to important agronomic processes, such as soil erosion, salinization, sodification, spread of weeds in the fields (in particular, weeds that are difficult to control), soil-borne diseases, and pesticide fixation and release.

We, a group of more than ten Israeli scientists, have recently started a multidisciplinary study aimed at developing and consolidating a multiparameter soil-health index to characterize the health of agricultural soils in Mediterranean regions. Such an index will enable us to quantitatively evaluate the contribution of different cultivation managements and reclamation activities. In order to achieve our goal, a three steps approach was adopted: 1) acquiring a multivariate component database (about 42 variables) that will be quantified in the laboratory and in the fields in two soil types of the most important agricultural region of Israel, at three different soil usage: orchard, field crops and "native" as a reference. The acquired biological, physical, and chemical variables comprise basic quantitative values in the soil health of agricultural land; (2) developing a multivariate soil-health index based on a multivariate correlation, in addition to conducting meetings with farmers and panel discussions with other scientists in the field. The whole study angled to evaluate the relative contribution of each of the biotic and abiotic parameters in order to develop a model related to soil health; and (3) to validate the efficiency of the developed index for characterizing and assessing soil-health state at the various agricultural regions in Israel where conservation and reclamation activities took place. We are open to extend our study to other areas with a Mediterranean climate and look forward to establishing cooperative activities with other research groups.