Summary and Conclusions

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The Symposium, 'Advances in Soil Quality for Land Management: Science, Practice and Policy', brought together a wide cross-section of scientists, land managers, and those involved with the agricultural industry. The ordered structure or sequence of the Symposium from 'Science of Soil Quality' to 'Industry Practice and Grower Perspectives', and concluding with 'Programs for Soil and Land Quality' reflected the natural progression, or scaling up, from soil to land quality. The latter includes 'soil' as a component, along with vegetation and water.

The impetus to define and assess soil quality is in many ways derived from outside the scientific community, being related to the concern of society with the overall quality or health of the environment. Thus, the onus is placed on the soil scientist or land manager to characterise and define soil quality. However, this can pose a major difficulty in that while water and air quality can be readily defined in regard to human and animal consumption, a similar scenario does not apply to soil. Soil, as a living system, is a fundamental resource with various functions and only indirectly influences human or animal health.

Some general impressions and conclusions from the Symposium are given below.

1. Soil quality is not a new topic, but one undergoing development in response to the idea that soils are part of land or terrestrial ecosystems. Thus, soil quality brings together old and new ideas about soil and land.

2. Ecosystem concepts such as function, processes, attributes, and indicators, proved to be a useful framework to describe soil quality. However, a precise definition of soil quality proved to be elusive. This is probably related to the innate difficulty in defining soil itself, and the multi-faceted nature (i.e. scientific, personal, social) of environmental concerns.

3. Overall, it was recognised that although soil quality describes an objective state or condition of the soil, it also is subject or evaluated partly on the basis of personal and social determinations. The framework (i.e. function, process, attributes, indicators) of soil quality has utility when it is directed or focused towards the manipulation, engineering, and/or management of the soil resource. Thus, soil quality is a technology, an applied science, directed towards problem solving (e.g. better soil management) and involves social and economic aspects. In this context, soil quality is seen as a key to sustainable land management.

4. The basic idea of 'fitness for use' in regard to agricultural and/or industrial use of soil, which is reflected in early and ongoing attempts at classification of 'soil suitability' or 'land capability', was seen as a basic premise of soil quality. If a soil is not suitable for a specific use then it is not appropriate to attempt to assign or describe quality for that specific use or function. In many cases, however, it is not possible to make a perfect match between the soil and its intended use. Under these circumstances, quality must be built into the system using best management scenarios.

5. There are a large range of attributes, such as chemical, physical, and biological properties, that can be used to describe soil quality. Generally, soil quality attributes need to be characterised for specific soil and situations, or soil uses. However, there are some attributes or groups of attributes (i.e. common data sets) that have a wide utility and can serve a wide range of purposes. Thus, in many situations a 'minimum data set', composed of a limited number of key attributes, can be readily assembled. Except for some singular situations (e.g. disturbed hydrology), where a dominate soil response can be characterised by a single attribute, a set of attributes or indicators are usually required to evaluate soil quality.

6. It was recognised that there is a need for adequate methodology to easily and efficiently characterise soil quality attributes, and a need to better understand how attributes are measured and characterised. The need for standardisation, in regard to both methodology and 'critical limits', was identified as a major impediment to the evaluation of soil quality. Soil quality standards are required to ensure that soil sampling, description, and analysis procedures can set the limits for a quality soil and detect adverse changes in soil quality.

7. Soil science and principles of land management are poorly understood both in the agricultural and wider society. Thus, there is a need to educate all aspects of society about soil and transfer knowledge of the same, especially to the land manager. For soil quality concerns, there is a special need for close interaction among

scientists, technologists, and land managers, especially as the perceived function or purpose ascribed to soil often varies within a community.

8. Industry and grower presentations and perspectives emphasised the importance of characterising soil quality as part of their common concern with sustainable land management. The need to identify and select key indicators of soil quality for specific soil situations, climates and cropping systems was considered to be of prime importance. Also, the close involvement of the research community with these endeavours was emphasised, especially in the area of indicator scale and variability, and the relation of indicators to animal and human health. The drivers behind these concerns were economics/profit, need for better management skills, need for greater understanding of soil processes, and the need for long-term sustainability of agricultural systems.

9. Assessment of soil and land management programs underlined the importance of soil and land quality indicators. In this context a need was identified to provide soil quality guidelines to local government bodies, to incorporate more soil indicators in the 'Top Crop' program, and to implement soil quality programs on the basis of specific industry needs. In regard to the latter, some agricultural industries (e.g. cotton) already provide useful approaches or models.