

## **KEY PLANT AND SOIL MANAGEMENT PRACTICES TO IMPROVE SOIL HEALTH AND ENHANCE SUSTAINABILITY**

Many of the practices used in modern agriculture are degrading our soils and are detrimental to the environment. Consequently, a huge amount of research has been undertaken in the last 20-30 years to assess the impact of various crop management practices on the health of agricultural soils. There is now general agreement that if an agricultural soil is to provide a full range of ecosystem services (i.e. sustain plant productivity; maintain soil structure; produce, store and release nutrients; sequester carbon; detoxify pollutants; suppress soilborne pests and diseases; and maintain environmental quality), a diverse range of soil management practices must be integrated into the farming system. The key practices and a range of second-tier practices are listed below.

### **KEY REQUIREMENTS**

- **Continuous inputs of organic matter from plants**
- **A permanent cover of plant residue on the soil surface**
- **A diverse rotation sequence**
- **Minimum tillage**
- **Avoidance of compaction through traffic control**

### **SECOND-TIER PRACTICES**

Once the farming system has been modified and all key requirements have been implemented, incremental improvements in soil health can be made by incorporating a range of second-tier practices into the farming system

- **Biomass-producing cover crops**
- **Inclusion of legumes in the rotation**
- **Integration of crop and livestock production**
- **Organic mulches**
- **Organic amendments**
- **Improved nutrient-use efficiency**
- **Optimised water management**
- **Site-specific management of inputs**
- **Integrated pest management**

The challenge facing land managers is to understand why each of the above practices play a role in improving the health of the soil, and then find a way to integrate many of these practices into their farming system. This is not a simple task, as there are many potentially useful options, and the way they are incorporated will be influenced by climatic factors, production goals and the economic realities of farming.

Given the complexities involved in modifying a farming system, it is impossible to cover the soil improvement process in a single fact sheet. Consequently, anyone interested in establishing a soil improvement program should consult a book by Stirling et al. (2016). All available options are discussed in detail and there are also case studies showing how Australian grain growers, sugarcane farmers, vegetable growers and horticulturists have improved the health of their soils.

### **Further reading**

A huge number of books, reviews, research papers, and extension publications describe the practices required to improve the health of agricultural soils. Some of these publications are listed below. Anyone requiring confirmation that the above practices should be included in a soil health improvement program should consult those publications.

- Bonanomi G, Lorito M, Vinale F, Woo SL (2018) Organic amendments, beneficial microbes, and soil microbiota: towards a unified framework for disease suppression. *Annual Review of Phytopathology* 56, 1-20.
- Bunemann EK, Bongiorno G, Bai Z, Creamer RE, et al. (2018) Soil quality. A critical review. *Soil Biology and Biochemistry* 120, 105-125.
- Lal R (ed.) (2022) *Soil organic matter and feeding the future. Environmental and agronomic aspects*. CRC Press. ISBN: 9780367609702
- Larkin RP (2015) Soil health paradigms and implications for disease management. *Annual Review of Phytopathology* 53, 199-221.
- Lehmann J, Bossio DA, Kogel-Knabner I, Rillig MC (2020) The concepts and future prospects of soil health. *Nature Reviews Earth & Environment* 1, 544-553.
- Lehman RM, Cambardella CA, Stott DE, Acosta-Martinez V et al. (2015) Understanding and enhancing soil biological health: the solution for reversing soil degradation. *Sustainability* 7, 988-1027.
- Magdoff F, Weil RR (2004) (eds.) *Soil organic matter in sustainable agriculture*. CRC Press, Boca Raton. 398 pp.
- Moebius-Clune BN, Moebius-Clune DJ, Gugino BK, Idowu OJ et al. (2017) Comprehensive assessment of soil health. The Cornell framework. 3<sup>rd</sup> edition. Cornell University, Ithaca, NY. 123 pp.
- Norris CE, Congreves KA (2018) Alternative management practices improve soil health indices in intensive vegetable cropping systems. A review. *Frontiers in Environmental Science Volume* 8, article 50, 1-18.
- Wezel A, Casagrande M, Celette F, Vian J-F et al. (2014) Agroecological practices for sustainable agriculture. A review. *Agronomy for Sustainable Development* 34, 1-20.

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