PLANT AND SOIL NEMATODES

TOWARDS MORE SUSTAINABLE VEGETABLE PRODUCTION SYSTEMS

Sustainable agriculture is a type of agriculture that satisfies our current requirements for food but does so in a way that preserves the environment and ensures that food production is able to continue in the long term. This fact sheet challenges vegetable growers to consider whether their production system is sustainable.

WHAT IS SUSTAINABLE AGRICULTURE?

There are many definitions of sustainable agriculture but it is generally accepted that it is an integrated system of plant and animal production which promotes biodiversity, improves soil health, reduces the need for fertilisers and pesticides, conserves water, sustains the quality of the wider environment, and ensures that farm operations remain economically viable in the long-term.

As soil is a non-renewable resource, maintaining and improving the health of the soil is an important component of sustainable agriculture. When a production system is sustainable, many different practices are incorporated into the system so that soil carbon levels increase, biodiversity improves, and the soil begins to function effectively because a range of other benefits are obtained.

- The physical structure of the soil improves because microbes produce glues that bind soil particles into aggregates and earthworms and other burrowing animals create a network of large and small pores. The end result is that roots grow more readily because the soil is well aerated and easier for roots to penetrate, water infiltrates more rapidly, and the soil's water-holding capacity increases.
- Plants produce more biomass because the soil's chemical fertility has improved. Organic matter contains all the nutrients required by plants and when it is decomposed by the microbial biomass, these nutrients are released in soluble inorganic forms and can be used by plants. Inclusion of nitrogen-fixing legumes in the rotation also means that the nitrogen requirements of the following crop are markedly reduced.
- Pest and disease problems generally decline as soil health improves. A much wider range of organisms will be living in the soil, including the parasites and predators that regulate or suppress populations of nematodes and other soilborne pests and pathogens.

KEY PRACTICES TO IMPROVE SOIL HEALTH AND SUSTAINABILITY

If an agricultural soil is to remain productive in the long-term, there are three key practices that must be included in the farming system: minimum tillage, cover cropping, and maintenance of a permanent layer of crop residues on the soil surface.

Minimum tillage. The main reason agricultural soils are badly degraded is that they have been cultivated excessively for many years. Minimum tillage (sometimes referred to as conservation tillage) is the only sustainable tillage option and it has many different forms, including no-till, strip till, ridge till, and mulch till systems. When these techniques are used, some plant residues are retained on the soil surface throughout the year, thereby reducing wind and water erosion and lessening nutrient losses. These organic inputs also enhance soil aggregation, promote biological activity, increase water infiltration rates, and improve the soil's water holding capacity. This leads to greater available soil moisture, improved soil tilth, and higher levels of soil organic matter. Reducing tillage is also economically advantageous for farmers because it saves time, conserves fuel, limits machinery wear and reduces labour costs.

Cover cropping. The increased focus on soil quality in recent years has meant that vegetable growers are now much more likely to include cover crops in their production system. There are many reasons why cover cropping should be integrated into a crop management regime and they include reducing erosion, improving soil health, enhancing water infiltration, smothering weeds, controlling pests and diseases, and increasing biodiversity. If legumes can be used as a cover crop or included in a multi-species mix, another benefit is the introduction of substantial quantities of plant-available nitrogen into the soil.

As with any agricultural practice, there are challenges growers must face when introducing a cover or rotation crop into their farming system. In most environments, additional irrigation will be required to

grow these crops, while the costs of seed and soil preparation also need to be considered. Although cover cropping can reduce the impact of specific pests such as nematodes, it is important to check that they do not act as reservoirs for other pests (e.g. insects and rodents) or diseases. Another issue that needs to be considered is whether the cover crop will persist as a weed in the subsequent crop. This can occur if the cover crop is improperly selected or poorly managed.

Maintaining permanent ground cover. One of the key methods of improving the health of a soil is to maintain a permanent cover of organic materials on the soil surface, as this reduces losses to erosion, minimises moisture losses and provides an ideal habitat for beneficial soil organisms. Thus, when cover and rotation crops are used in a vegetable production system, the residues should be retained on the soil surface as mulch.

OTHER SOIL IMPROVEMENT PRACTICES

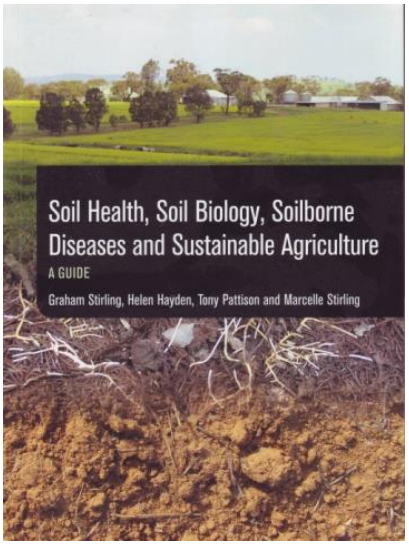
Once the above practices are integrated into a farming system, it may be possible to make incremental improvements by 1) incorporating organic amendments and mulches into the system to further increase soil carbon levels; 2) introducing plant species with different rooting habits to penetrate compacted layers or improve soil structure; 3) using multi-species mixes to increase biomass production and enhance biodiversity; and 4) establishing permanent traffic lanes so that the amount of soil compacted by farm machinery is reduced.

HOW DO VEGETABLE GROWERS MOVE FORWARD?

Although the practices listed above provide growers with a range of management options, the actual practices integrated into a farming system will be influenced by climatic factors, cash crops being grown, production goals, and the economic realities of farming. Thus, best-practice farming systems will vary to some extent from farm to farm. Many potentially useful technologies and practices are available, and it is up to the land manager to adapt them to local conditions and constraints.

FURTHER INFORMATION

This 280-page book (ISBN 9781486303045) can be purchased from CSIRO Publishing, Melbourne. It provides growers and their consultants with holistic solutions for building an active and diverse soil biological community capable of improving soil structure, enhancing plant nutrient uptake, and suppressing root pests and pathogens. All major crops in Australia are covered, but Chapter 10 is particularly relevant to vegetable growers. It is entitled 'Vegetable farming systems: the challenge of improving soil health and sustainability in an industry that demands high levels of productivity'.



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