

## From Health to Wealth

### Looking after soils for vegetable production

#### Key messages

- Soil health refers to the fitness of the soil to achieve its potential, within natural or managed limitations, and be productive under the intended land use
- A healthy soil is sustainable, productive and profitable
- Soil constraints (e.g. salinity, compaction) will limit plant growth and therefore the potential yield and quality of crops
- Soil health can be assessed using a combination of chemical, biological and physical indicators – refer to the **SOIL WEALTH CHECK**
- Soil organic matter content and rootzone depth are good indicators of soil health

#### What is soil health?

Soil health refers to the fitness of the soil to achieve its potential, within natural or managed limitations, and be productive under the intended land use. Healthy soils have physical, chemical and biological properties that sustain biological functioning, maintain environmental quality and promote plant, animal and human health.

For productive vegetables, a healthy soil is one that is fit for the profitable and sustainable production of crops for decades.

#### Why is it important?

Compared to soils in poor condition, healthy soils require fewer inputs, have less wear on machinery, have better water relations and nutrient cycling, offer improved disease control, have increased biodiversity and produce more resilient crop with higher yields and good product quality. This usually leads to economic benefits.

#### Characteristics of healthy soils and how to get there

Soil type and texture cannot be changed - a heavy clay soil cannot be made into a sandy loam, or vice versa. Healthy soils tend to have a range of desirable characteristics in common and there are ways to improve soils:

WHAT?	WHY?	WHAT TO DO ABOUT IT?
High organic matter (OM) content for the climate and soil type	Improves and stabilises soil structure, provides, nutrients, water holding capacity, air and a home for soil biology, it increases root growth and buffering against sudden changes and toxic elements.	Growing of cover crops and high biomass vegetable crops, retention of crop residues, amendments of manures, composts and mulches, minimum tillage, controlled traffic,, good groundcover, no or minimum fallow periods.
Loose, friable structure	Important for root growth, movement of air and water, crop establishment.	All of the above, gypsum or lime, improve organic matter, strategic ripping together with the above to stabilise structure.
Good water relations	Store water and supply water to the plant. Prevent waterlogging, anaerobic conditions leaching and groundwater recharge.	All of the above, raised beds and good drainage.
Active soil microbes	Needed for nutrient cycling, organic matter decomposition, soil structure, and soil-borne disease control.	All of the above, lime to pH 5-7.
No erosion	No loss of nutrients, OM and fine soil particles.	All of the above plus contour drains.
Cycling and availability of nutrients	Needed for plant growth and healthy soil biology.	All of the above, RRRR Fertiliser programs: right products, right times, right amounts, right placement.
No or low soil-borne pests and disease pressure	Ensure plant health and productivity.	All of the above, good rotation and weed management, integrated crop protection (ICP).

Document SW2/046/1611

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## The main soil health issues and potential solutions

“Unhealthy soils” have properties that restrict plant growth, negatively impacting on the sustainability and profitability of vegetable farms.

There are a number of common soil constraints that cause declines in crop production:

CONSTRAINT	SOLUTION
Loss of organic carbon (OC)	Growing of cover crops and high biomass vegetable crops, retention of crop residues, amendments of manures, composts and mulches, minimum tillage, controlled traffic principles, good groundcover, no or minimum fallow periods, balanced nutrition.
Soil biology (decline, imbalance)	All of the above, plus biofumigation crops, lime to pH 6-7.
Soil borne pest and disease pressure	Apply all of the above plus good irrigation management;
Weed pressure (seed bank)	In some cases deep ripping may be required together with soil stabilisation via lime, a deep rooting cover crop, an organic soil amendment, subsoil manuring (if economically feasible).
Soil structure decline: <ul style="list-style-type: none"> <li>• Compaction</li> <li>• Poor drainage / infiltration</li> <li>• Reduced water holding capacity</li> </ul>	
• Rootzone restriction	Identify reason(s) e.g. compaction, salinity, change in soil texture (duplex soil), low pH, and address these.
Soil loss <ul style="list-style-type: none"> <li>• Wind erosion</li> <li>• Water erosion / run-off / flooding</li> </ul>	Maintain soil cover, especially avoid bare soil on slopes during times when high or intense rainfall is expected, maintain good soil structure to aid infiltration, use minimum tillage and controlled traffic principles, use subsurface or surface drains to quickly get water off paddocks (and not on adjacent paddocks).
Nutrient issues <ul style="list-style-type: none"> <li>• Low nutrient levels</li> <li>• Low nutrient use efficiency / uptake / root access</li> <li>• Nutrient imbalances</li> <li>• Nutrient losses (leaching, runoff)</li> </ul>	Maintain overall soil health, use soil testing & site specific nutrient management plans, monitoring and good irrigation management.
Acidification (pH drop)	Liming.
High pH	Use of acidifying fertilisers unless soil are high in sodium, if they are, use sodicity control e.g. gypsum or other calcium products, monitor and adjust nutrition program e.g. N, P K, Ca, trace elements.
Salinity	All of the above, drainage and special attention to phosphorus, calcium and potassium nutrition.
Sodicity	

Many constrains are due to excessive tillage, tight rotations, unbalanced nutrient programs, including use of amendments, poor liming practice, bare or fallow ground for long periods, poor site selection, inadequate irrigation systems or management, poor weed, pest and disease control, often as a result of continuous cropping and tillage or spray application methods and products used.

These constraints can lead to reduced crop growth and yields and excessive money spent on inputs (fertilisers, pesticides, water, labour) and land management.



Example of unhealthy (left) and healthy (right) soil.

Source: Steve Culman, Cornell University