Resilient Cropping

Resilient Soils

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FAR

Horticulture New Zealand

Tāhuri Whenua
National Māori Vegetable Growers Collective

Ministry for Primary Industries
Manatū Ahu Matua

LandWISE INCORPORATED

About Resilient Cropping

Resilience is the ability to bounce back from adverse events.

When we are generally happy and healthy we can handle most things nature (or life) throws at us. If we are run down, tired and sick, the slightest thing seems to knock us for six.

Farms are very much the same. They handle adverse events better if the soil is healthy, water available, and infrastructure (and capital) in place. And the reverse is true too. Beaten up soils, lack of water, inadequate or poorly maintained infrastructure and high gearing leaves a farm (and its people) at higher risk when bad things happen.

The “Resilient Cropping” initiative aims to build resilience into crop farming. It is a joint venture between LandWISE, the Foundation for Arable Research, Horticulture NZ and Tahuri Whenua the Maori Vegetable Growers Collective. The work is funded by the Ministry for Primary Industries.

Events

The main focus of “Resilient Cropping” is preparing for adversity such as extreme weather events, fuel cost spikes and restricted access to irrigation water.

In-field workshops across the country allow local growers to share experience and ideas and propose local solutions for local conditions. Among the topics are soil quality, irrigation efficiency, nutrient management and energy use.

A common question is, “How can we best prepare for uncertainty?”

An alternative is, “How should we farm knowing with certainty that adverse events will happen, and possibly more often?”

Resilient Soil

Resilient soils have the capacity to recover well when subjected to stresses, either natural or man-made.

Two keys to resilience are inherent soil strength and good porosity, both closely related to soil structure. Strength means soil can hold together even when very wet. Porosity means water and gases can get in, through and out of the root zone, and plant roots can explore the full soil volume.

Despite what is thrown at them, resilient soils:

- cope well in heavy rain
- are less prone to washing away
- cope better with floods or droughts
- hold together in wind
- resist collapsing and compaction
- carry traffic better
- withstand cultivation
- grow good crops

Understanding soil quality is a step toward better productivity and profit

Soil Quality

Soil quality is a relative measure of fitness for purpose. It is not a fixed, one-answer-fits-all issue. We generally talk of indicators which help build an overall assessment of quality.

What may be acceptable for one farming system may not be suitable for another. In fact, what is good quality in one part of a paddock may be poor in another – think controlled traffic farming, where we deliberately compact wheel tracks, but preserve un-compacted soil in gardens.

Assessing Soil Condition

How do I assess soil quality?

Scientists use a range of soil quality tests, many requiring detailed sampling and expensive laboratory testing. Farmers want a cheap and easy alternative.

Soil quality indicators are often broken into three categories:

- physical
- chemical and
- biological.

Observing uncultivated soil from
1. under a fence
2. the cultivated part of the paddock and
3. the wheel track.

Physical indicators

The physical indicators describe, for example, how well and how strongly the particles are bound together and how easily air and water can move through pores.

One of the key physical indicators is **soil structure**. Structure refers to how soil particles are bound together into aggregates – the lumps we find when we dig soil over.

For best plant growth, well-structured soil has mid-range aggregates which hold together well, even when wet, but can be broken into a seed bed tilth. A poorly structured soil may collapse into individual silt and sand grains or form large, impenetrable lumps.

Physical qualities change. A wet soil is weaker than a dry soil and does not carry traffic as well. And the longer the soil has been wet, the weaker it may become. Because of this, well drained soils are often more resilient than poorly drained soils.

Chemical indicators

Most people are familiar with soil chemical testing for fertility and nutrient planning. As well as the main nutrients (N, P, K and S) there are other macro and micro nutrients required for healthy plants and animals.

Soil acidity (pH) and cation exchange capacity (CEC) are also important. pH affects nutrient availability. CEC affects nutrient holding and release.

Biological indicators

There are many biological indicators, including organic matter content and worm numbers.

Counting and recording worm numbers while assessing soil quality

Soil physical quality and soil biology are closely related. Worms and other species recycle material and create pores and the glues that hold soil aggregates together are particularly important. Good soil physical conditions are better for worms, which find compacted, water logged or droughty soils hard work.

Visual Soil Assessment (VSA) Method

Growers often want to know if soil quality is improving or not. To have real use, a method should be scoreable for recording to compare results between areas and over time.

Visual assessment of soil condition is a good way to follow change, as paddocks can be monitored and scored each year.

The tests must be recorded, so they can be repeated over time, scores compared, and significant changes in soil quality detected. This gives growers the opportunity to monitor how practices like cover cropping, reduced cultivation or controlled traffic improve soil quality.

Actions

On-farm actions can moderate the effects of adverse climate and reduce negative impact on crops. Three factors under grower control are:

- returning organic matter
- drainage
- cultivation, and
- compaction (includes stock as well as vehicles).

Organic matter is a critical component of healthy soil. Burned off by cultivation, it is replaced by growing plants. About half of plant matter is below ground. Returning plant residues such as stubble can add to the amount of organic matter returned and increase soil health. Cover crops also protect soil and add valuable organic matter.

Drainage can have immediate effect on crop production and is critical in preserving soil resilience by protecting soil structure. Surface and internal drainage are both important. Ensuring water can soak in or move away in a managed fashion is essential. Slowing water helps stop erosion.

Cultivation damages soil. It can be beneficial in addressing compaction, can incorporate residues and can manage weeds. But it breaks up natural soil structures and burns off the organic glues that give soil its natural strength. And by reducing porosity it reduces drainage, increasing water logging and ponding. Cultivation should be a last resort.

Compaction physically deforms soil structure. Unnecessary compaction reduces crops and makes them more at risk during adverse climatic events. Compaction prevents roots exploring the soil so makes plants more at risk in dry periods. Compaction reduces internal drainage putting plants at risk during heavy rains or prolonged wet periods.

Further information

Managing the quality of the soil resource is a key to profitable and sustainable cropping systems.

Visual soil assessment allows growers to benchmark where their soil quality is currently at and offers a structured approach to follow changes in soil quality over time.

For a copy of the VSA booklet and a full description on how to perform a VSA of your paddocks, check:

- Landcare Research (www.landcareresearch.co.nz),
- BioAgrinomics site (www.bioagrinomics.com)
- or your regional council.

Other resources

Available as downloads www.landwise.org.nz/projects/resilience

- Resilient Cropping Fact Sheets:
    - Managing Soil Impacts – drainage
    - Managing Soil Impacts – cultivation
    - Managing Soil Impacts – compaction
- Visual Quality Assessment by Graham Shepherd
- LandWISE Fact Sheet: Assessing Soil Quality on Farm
- LandWISE Fact Sheet: Visual Soil Assessment – a simplified look
- LandWISE Fact Sheet: Visual Soil Assessment – test process

Practical steps to protect soil are given in fact sheets from the SFF project "*Holding it Together"* are available from http://www.landwise.org.nz/projects/hit/hit-fact-sheets/

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Web Resources

www.landwise.org.nz/projects/resilience

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