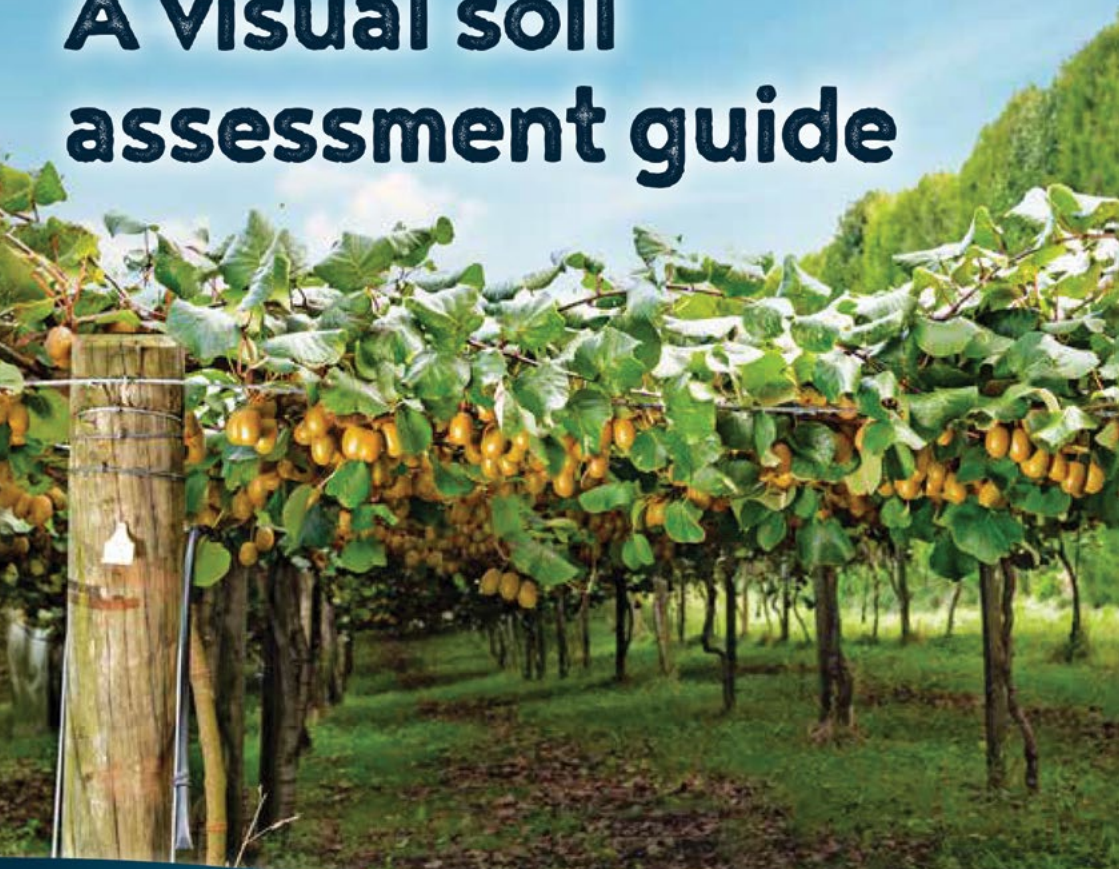
Ballance agri-nutrients

A visual soil assessment guide



Your easy guide to assessing the health of orchard soils

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Version 1

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Visual Soil Assessment

Visual Soil Assessment (VSA) is a tool you can use to assess soil physical quality of a block quickly, easily and reliably, without special training or equipment.

The physical condition of your soil is vital to its sustainable use. Even with good nutrient levels, poor physical condition can affect the movement of air, water and plant roots, reducing plant growth and making the soil vulnerable to further damage. Repairing soil damage takes a long time, and can be very expensive. Visual Soil Assessment allows you to identify issues so you can address them and minimise soil damage.

When to assess

Sample in late winter or early spring.

Check soil moisture before sampling. Try to roll a piece of soil into a 50 mm long by 3 mm thick worm. If you:

- can't do it or if it cracks, then you're good to sample.
- can make the worm easily and/or can make it even thinner than 3 mm, then the soil is too wet.

Sample at the same time annually (as long as the soil moisture levels are adequate), so results are comparable from year to year.

What you need

- Spade
- Square plastic basin (about 35 cm square x 20 cm deep)
- Hard, square board which fits flat into the bottom of the basin
- Heavy duty plastic bag (about 75 x 50 cm)
- Tape measure
- Indicator photos and scorecards from this guide

Select sites

- Choose one to three representative sites per management block. Select individual sites within a block that best capture the block's key features. In some blocks, more than one site may be needed e.g. when comparing damaged and undamaged areas.
- Avoid areas which may get heavier traffic than the rest of the block, such as loading areas, tracks and entry points.
- Record the location of your sites well (e.g. using GPS), so you can return to them each year.

Collect and assess samples

At each site, follow these steps to dig and assess your sample. It should take about 20 minutes per site.

1. Place the basin with the board in it next to the site. Spread out and anchor the plastic bag next to the basin.
2. Complete the site information section at the top of the scorecard.
3. Record any special aspects in the notes section (e.g. significant history like major flooding or erosion in previous seasons).
4. Dig out a 20 cm cube of soil. If the topsoil is less than 20 cm, trim off the subsoil.
5. Drop the soil sample from waist height onto the board in the basin. If large clods break away after the first (or second) drop, gather them up and drop again, but do not drop any clod more than three times.
6. Transfer the shattered sample onto the plastic bag, arranging clods from coarser at one end to finer at the other. If applicable, separate samples, and separate clods from roots.
7. For each indicator on the scorecard, compare the sample to the photos, and give it a score. If your sample falls somewhere between two indicator pictures, give it a half score.

Indicators

Soil structure and consistency

Structure provides pore spaces, which are important for water movement and storage, air for organisms and root growth. Looking at the shattered sample on the plastic bag, use the photos and descriptions below to assess the soil structure and consistency.

Sample has lots of fine, easily crumbled pieces throughout with no/few larger pieces.

Good condition

Sample has a mixture of coarse, firm pieces and smaller, easily crumbled pieces.

Moderate condition

Most of the sample is very coarse, firm pieces, with few small, easily crumbled pieces.

Poor condition

Soil porosity

Look closely at a number of clods from the sample, or you can take another slice of soil from the side of the site sample hole.

Sample has lots of readily visible spaces/cavities within it.

Good condition

Sample has some spaces/ cavities but you may have to look harder to see them.

Moderate condition

Sample is compact and smooth, with few cracks or holes and may have sharp angles.

Poor condition

Soil colour

Colour indicates how much organic matter is in soil, and provides an indication of soil drainage and aeration. Take a spade-depth soil sample from within the tree/vine row - this is your reference sample. Compare the colour of a handful of soil from the site sample to the tree/vine row sample and the photos to determine the score.

Sample is dark-coloured and not too different from the tree/vine row soil.

Good condition

Visual score = 2

Sample is a little paler than the tree/vine row soil.

Moderate condition

Visual score = 1

Sample is much paler than the tree/vine row soil.

Poor condition

Visual score = 0

Number and colour of soil mottles

If air can't move freely through the soil due to compaction or waterlogging, areas lacking in oxygen turn orange, then grey. Looking at the side of the site sample hole or a number of clods from the sample, use the photos and chart to assess the colour and percentage of orange and grey mottles.

Indication of mottle abundance

No mottles readily visible.

Good condition

Visual score = 2

About 10-25% of the sample has fine/ medium sized orange and grey mottles.

Moderate condition

Visual score = 1

About 10-25% of the sample has fine/ medium sized orange and grey mottles.

Poor condition

Visual score = 0

Earthworm count

Earthworms burrowing, feeding and casting help all the processes that boost soil health. Sort carefully through the sample in the basin for 5 minutes and count the number of worms you find.

More than 20 worms
Good condition
Visual score = 2

10 - 20 worms
Moderate condition
Visual score = 1

Less than 10 worms
Poor condition
Visual score = 0

Surface crusting

Little or no surface crusting; OR Vegetative surface cover is >70%.

Good condition

Surface crusting forming and is 2-3 mm thick. Some cracking; OR Vegetative surface cover is >30% and <70%.

Moderate condition

Surface crusting is well formed and is >5 mm thick. Significant cracking; OR Vegetative surface cover is <30%.

Poor condition

Completing the scorecard and next steps

While all indicators reveal something about your soil's physical condition, some have more of an impact than others and therefore have a higher weighting on the scorecard.

1. Multiply the visual score by the weighting to get the weighted score for each indicator.
2. Add the weighted scores to get your total VSA score.
3. Your total VSA score tells you whether the overall physical condition of the soil is good, moderate or poor. If your score is moderate or poor, you can consider applying management techniques to address/improve the situation.

Visual Soil Assessment scorecard

Date

Block / site name / location

Soil type

Texture	☐ sandy	☐ loamy	☐ clayey		
Moisture	☐ dry	☐ slightly moist	☐ moist	☐ wet	
Weather conditions	☐ dry	☐ wet	☐ cold	☐ warm	☐ average

Indicator	Visual score			Weighting	Weighted score (visual score x weighting)
	2	1	0		
Soil structure and consistency				x3	
Soil porosity				x3	
Soil colour				x2	
Mottling				x2	
Earthworm count				x3	
Surface crusting weighting				x2	
				Total VSA score	

Total VSA score			
Score	Less than 10	10 to 20	More than 20
Overall physical condition	**Poor**	**Moderate**	**Good**

Notes

Menu of practices to improve soil health

This menu provides guidance on implementing practices to improve soil health on orchards. Impacts of these practices on your orchard business and on soil health status are also shown.

Using the menu

The menu shows a range of land management options for improving the health of your soil. To help your decision making, indicative relative costs and benefits are provided. Options are grouped according to the main soil indicator they are likely to benefit.

Any additional soil health benefits a practice provides are also listed.

Generally, if a soil health parameter is:

- within the optimal range, continuing the current long term land management practices should retain the soil health at a similar level
- gradually declining (as evident from regular soil monitoring), then applying advice from the menu should elevate the parameter to within the optimal range.

Meanings of the cost and benefit scores

Each practice's cost and economic benefit to the business, and benefit to soil health, are rated using a relative score of low / medium / high.

Red indicates a likely negative cost.

Green indicates a positive cost (saving)/profitability benefit.

Cost impact on business					
Negative			Positive (saving)		
Low $	Medium $$	High $$$	Low $	Medium $$	High $$$
Input of grower time and expenditure, and practice change required is:			Saving in input of grower time or expenditure is:		
limited	moderate	significant	limited	moderate	significant

Soil health benefit			Profitability benefit		
Low ●	Medium ●●	High ●●●	Low $	Medium $$	High $$$
Limited changes to soil health and/or slow response time (decades)	Moderate changes to soil health and/ or moderate response time (within a decade)	High changes to soil health and/or quick response time (within years)	Little change to orchard profit as a result of this practice or may require small changes to orchard infrastructure	Practice likely to result in a moderate increase in profitability or improved management	Very profitable practice or results in improved management or orchard operational costs

Select a soil health parameter you'd like to improve, then choose and review the on orchard practices appropriate to the system.

Soil health parameter and status	On orchard practice	Cost impact on orchard business	Profitability benefit	Soil health benefit
Soil pH				
Below optimum	A capital lime application may be required to raise the pH.	$ $	$ $	● ● ●
At optimum	Maintenance lime will be required to remain within the range due to the slight acidification of soils over time resulting from a range of soil processes.	$	$	● ●
Above optimum	Avoid applying lime until soil pH is within range as agricultural soils will slowly acidify over time due to a range of soil processes.	$	$ $	● ● ●
	If immediate adjustment is required, elemental sulphur can be applied.	$ $	$ $	● ● ●
Olsen P				
Below optimum	A capital phosphorus (P) fertiliser application may be required to raise the soil to the target range.	$ - $ $	$ $ $	● ● ●
At optimum	Continue to budget nutrient applications annually to ensure trees/vines are getting adequate P without applying excess P fertiliser. Maintenance P may also be delivered via other P inputs, or via composts etc.	$	$ $	● ●
Above optimum	Avoid or reduce fertiliser P applications until it is within range. Depending on the crop grown and system type, Olsen P will slowly decrease over time if P is withheld.	$ - $ $	$ $ $	● ● ●

Soil health parameter and status	On orchard practice	Cost impact on orchard business	Profitability benefit	Soil health benefit
Total carbon (C) (organic matter) *N.B. Organic matter is calculated from the Total C, so any management change aimed at increasing Total C will also increase organic matter.*				
Below optimum	Incorporate materials with a high C:N ratio (C rich materials) as the system allows e.g. crops grown specifically for the purpose (green manures), plant residues or waste organic material such as chicken manure. *(The accumulation of C in soils is very slow process and only a small amount of the C applied in this manner will be stabilised. Expect that multiple additions will be required to increase the Total C, unless starting at a very low, depleted condition.)*	$ - $$	$$	●●
	Increase natural accumulation processes by retaining interrow plant cover and increasing plant productivity.	$	$	●
	Maintain constant cover of vegetation or cover crop if practicable. this will minimise erosion losses, plus biology and living roots will increase C inputs.	$	$$	●●
	Retain residues following harvest of a crop. These can help minimise erosion losses as well as being a high C:N ratio input.	$	$	●
At optimum	It is important to maintain Total C within this optimum range, so continue to apply the practices above.	$	$$	●●
Above optimum	There is no upper limit for Total C in soils, the more the better. Continue to apply the practices above.	$	$$	●●

Soil health parameter and status	On orchard practice	Cost impact on orchard business	Profitability benefit	Soil health benefit
Total nitrogen (N)				
Below optimum	Add low C:N ratio (N rich) organic matter to the soil incrementally. Typical examples of suitable organic matter sources include legume crops or manure (e.g. chicken) if available.	$ - $$	$ - $$	● ●
	A period under a legume crop or grass-clover sward can be used to build up organic matter levels and N reserves if practicable.	$ - $$	$	●
At optimum	Continue to assess nutrient applications annually to ensure vines / trees are getting adequate N without applying excess N fertiliser.	$ - $$	$ - $$	● ● ●
Above optimum	Carefully evaluate N fertiliser efficiency on these areas and consider targeting application to areas with lower Total N. Additionally, lowering (or stopping) the incorporation of low C:N ratio material (such as manure) will help to reduce this over time. Although an indicator for soil health, consideration of the impact of high soil N content on the environment is required.	$ - $$	$ - $$	● ●

Soil health parameter and status	On orchard practice	Cost impact on orchard business	Profitability benefit	Soil health benefit

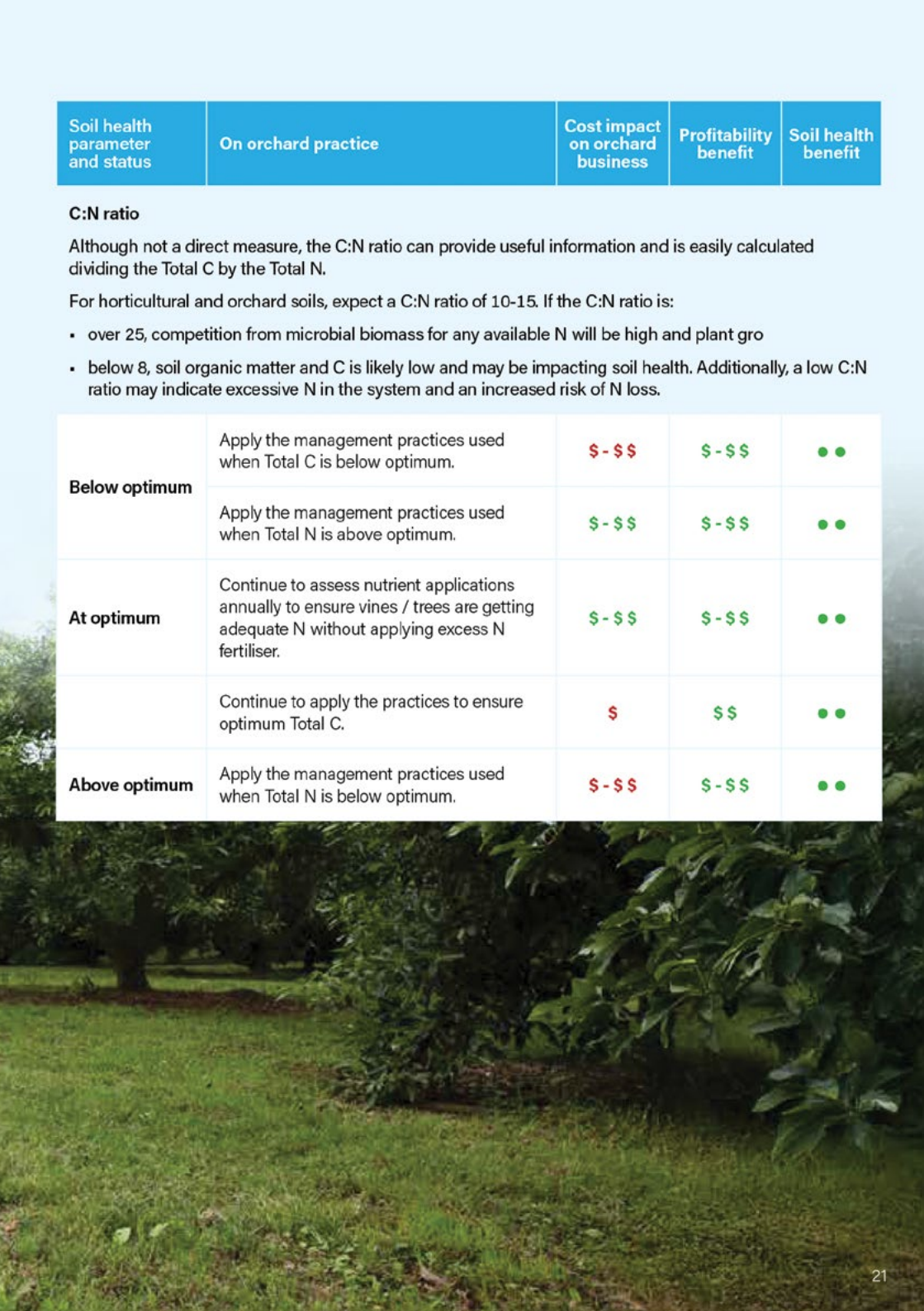
C:N ratio

Although not a direct measure, the C:N ratio can provide useful information and is easily calculated dividing the Total C by the Total N.

For horticultural and orchard soils, expect a C:N ratio of 10-15. If the C:N ratio is:

- over 25, competition from microbial biomass for any available N will be high and plant gro
- below 8, soil organic matter and C is likely low and may be impacting soil health. Additionally, a low C:N ratio may indicate excessive N in the system and an increased risk of N loss.

Below optimum	Apply the management practices used when Total C is below optimum.	$-$$	$-$$	●●
	Apply the management practices used when Total N is above optimum.	$-$$	$-$$	●●
At optimum	Continue to assess nutrient applications annually to ensure vines / trees are getting adequate N without applying excess N fertiliser.	$-$$	$-$$	●●
	Continue to apply the practices to ensure optimum Total C.	$	$$	●●
Above optimum	Apply the management practices used when Total N is below optimum.	$-$$	$-$$	●●



Soil health parameter and status	On orchard practice	Cost impact on orchard business	Profitability benefit	Soil health benefit
Anaerobically mineralisable nitrogen (AMN)				
A consequence of using AMN as a biological proxy is that the impact of high soil N content on the environment also needs to be considered.				
Below optimum	Increase organic matter levels, providing good habitat for soil microbes and other soil biota (e.g. worms).	$ - $ $	$ $	● ●
	Ensure soil pH is in the optimum range.	$ - $ $	$	●
	Maintain living roots by ensuring constant cover with growing plants if possible. Roots exude organic acids that supply an energy source for microbes.	$	$	● ●
	If possible, use irrigation and drainage to manage soil moisture so that soils are not moisture limited or waterlogged. Microbes require sufficient moisture for survival but still require a good supply of oxygen.	$ - $ $	$ $	● ●
At optimum	It is important to maintain AMN within the optimum range, so continue to apply the practices above.	$ - $ $	$ $	● ●
Above optimum	Minimise N inputs from short term sources such as fertiliser otherwise N will be in excess of demand and the risk of loss high.	$ - $ $	$ $	● ● ●
Air-filled porosity (soil compaction)				
Below optimum	Minimise machinery passes	$	$	● ●
	Avoid heavy machinery on wet soils.	$	$ $ $	● ● ●
At optimum	It is important to maintain air-filled porosity within the optimum range, so continue to apply the practices above.	$ - $ $ $	$ - $ $ $	● ● ●
Above optimum	Maintain vegetation cover (e.g. cover crop) to minimise the time the soil is bare and potential soil loss.	$	$	● ●

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