

Soil management in orchards

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Good soil management is essential for sustainable production in orcharding. It is an issue that affects the flexibility, profitability and long-term sustainability of all North Coast properties. This publication aims to help North Coast orchardists protect their soil from the problems of erosion, compaction, and acidity.



REDUCING EROSION

To limit erosion in your orchard, you need to reduce both the amount of water travelling over the land surface and the speed at which this water moves. There are a number of ways to do this:

Mulching

A mulch is composed of organic matter deposited on the soil surface. It must be approximately 5–10 cm thick. Mulch is designed to protect your soil from erosion and moisture loss. Too much mulch is harmful as it can prevent water from entering the soil and the soil can take longer to warm up after winter.

As mulch decomposes, it will also:

- improve microbial activity,
- improve the nutrient-holding capacity of soil,
- increase plant-available water by increasing infiltration and water-holding capacity,
- add organic matter to the soil and improve soil structural stability.

Where possible, grasses and green matter beneath trees should be encouraged. This can then be slashed or mowed and left as mulch. In macadamia orchards, chopped-up macadamia leaves, waste husk material, and chipped prunings can be used as mulch.

The effectiveness of any mulch depends on its quality, indicated by its carbon:nitrogen ratio (C:N).

A good C:N ratio for mulch is 20:1. When this ratio is higher, nitrogen will be temporarily removed from the soil as the mulch decomposes.

C:N ratio of different mulch materials

Material	C:N ratio
Chicken litter	10:1
Mower clippings	20:1
Barnard grass	50:1
Soybean stubble	30:1
Bagasse	100:1
Straw	100:1
Sawdust	400:1

Nitrogen is used by micro-organisms as an energy source to help break down carbon-rich matter. When there is a lot of carbon-rich material, more nitrogen is needed, making it temporarily unavailable to plants. On the North Coast, a mulch must be coarse to resist rapid breakdown and allow good aeration. The mulch should cover the ground surface at all times.

How often you need to apply mulch depends on how quickly it decomposes.

Aim to apply your mulch when materials are available and when application does not interfere with other farm operations. Never apply mulch right up to the tree trunk as this encourages disease attack. The mulch should be no closer than 10 cm from the trunk. (For additional information, see NSW Agriculture Agfact H3.1.43 and H1.3.8 and Agnote 1/038.)



Mulch in an avocado orchard.



A mulch layer of prunings and grass with groundcover growing over it.



An avocado orchard showing excellent groundcover and moulding for better drainage.

Groundcovers

A groundcover is any plant or plant residue that covers the soil surface and which protects it from erosion and moisture loss.

Sowing a groundcover in autumn when there is less heavy rainfall means that there will be minimal soil disturbance as groundcover can be achieved with minimal soil disturbance.

Plant a groundcover before the orchard is planted (or when young) to ensure that the cover is well established by the time the trees are grown.

A groundcover can:

- decrease surface water velocity, thereby reducing its erosive power,
- add organic matter to the soil which will improve its structural stability and help resist erosion.

Use groundcover species that are:

- adapted to lower-light environments,

- ground-hugging,
- not overly-competitive with trees.

A grass-legume mixture will provide a persistent cover. Perennial grasses will last where annuals may not and legumes will supply nitrogen (see Figure 2 next page).



An example of good groundcover.

Groundcover and sowing rate	(kg/ha)	Qualities
Amarillo peanut	20–50 kg/ha	Compatible with grasses A legume Low-growing
Bahia grass	6–10>kg/ha	Low-growing Low light-adapted Slow to establish
Ryegrass	30 kg/ha	Establishes quickly Regrows after mowing Needs fertiliser application for bulk
Shaw creeping vigna	5 kg/ha	Establishes quickly Compatible with grasses
Sweet smothergrass		Vegetatively propagated Shade-tolerant

MACADAMIA ORCHARD RUN-OFF CONTROL

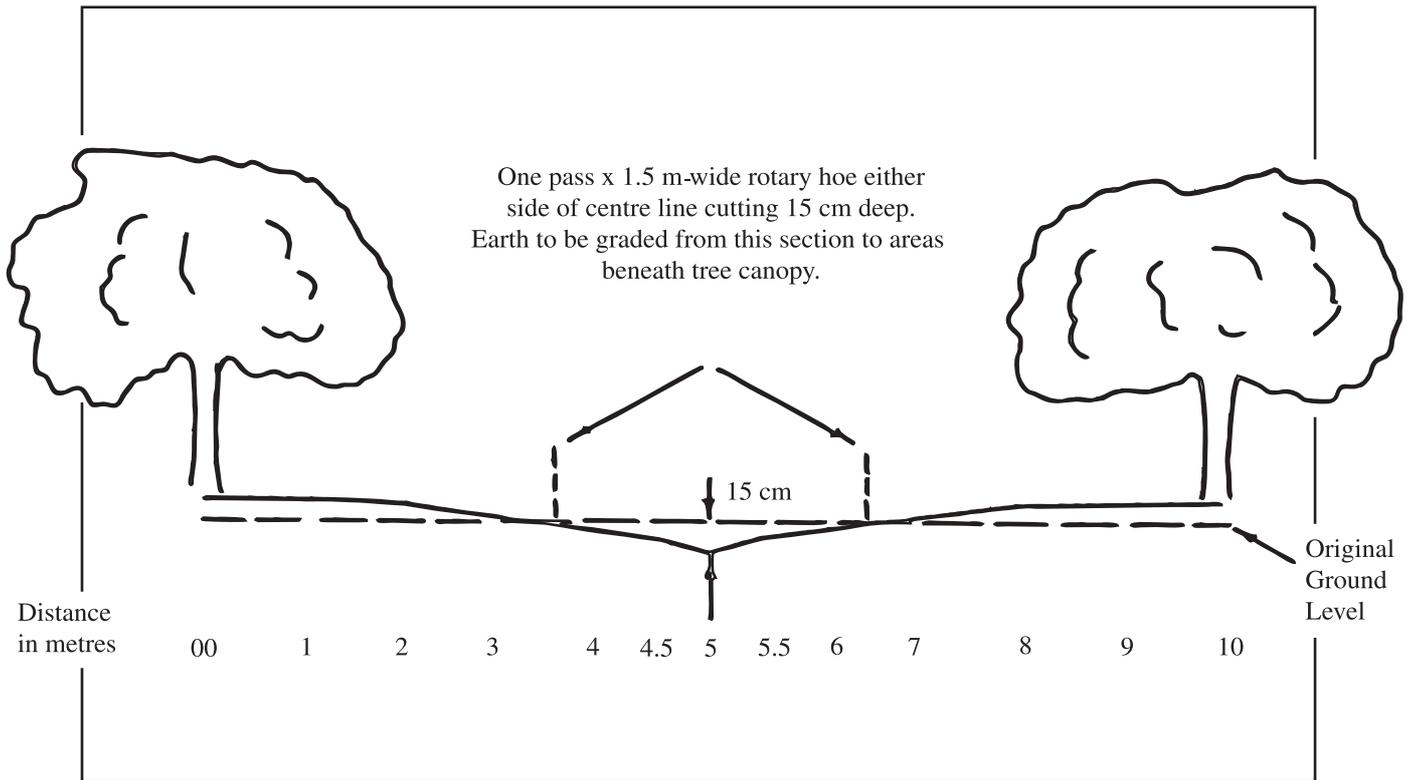


Figure 1. Cross section between rows running directly downhill.

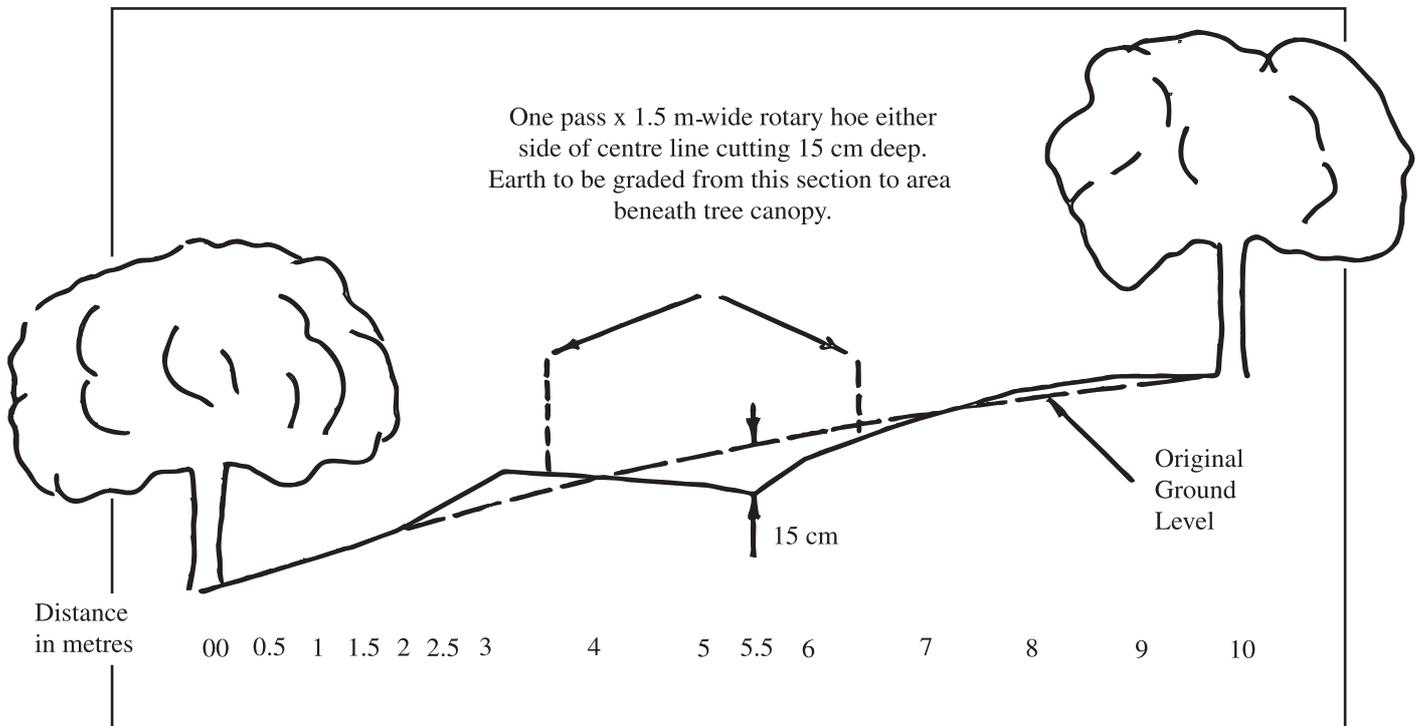


Figure 2. Cross section between rows across a 7° slope.

Note: Rows running directly downhill facilitate construction of mounded tree rows and associated drains.

Contour banks (mounds) and drains

A contour bank is an earth embankment with a shallow channel on one side. These banks run across the slope following the contour of the land with a drain on the upslope side. Build across slope drains with a slight gradient (1–3% only) so that water can drain slowly without causing erosion.

Using drains and banks together will slow the flow of water and divert excess water away from sensitive areas to natural waterways or grassed areas where erosion is minimised.

Where the land is too steep, drains should run downslope in the inter-row area — but a good groundcover must be established and maintained.

Inter-row drains running downslope must be broad and quite shallow (approximately 15–30 cm) and have regular diversion points so that the water is not channelled. The distance between diversion points will depend on the steepness of the slope (see Figure 1 previous page).

Banks should be constructed of soil removed from the drain area and should be approximately 30 cm above the lowest point in the inter-row.



Exposed tree roots caused by planting in a natural, shallow waterway.



Mounding prior to planting.

A cover crop must be sown immediately after construction to protect banks and drains from eroding. Drains and banks must always be covered (grassed) to prevent erosion.

In avocado orchards, make sure that mounds on contour banks drain well as saturated soil will encourage phytophthora (root rot).

Build across slope contour banks so that the downslope banks are not greater than 20%. This is essential for farm safety and to prevent the banks themselves eroding.

Remember that the steeper the land, the shorter the distance between banks. When using contour banks, ensure there are downslope drains at regular intervals to channel excess water into natural waterways or grassed areas where minimum damage can occur.

NOTE: Professional advice on the design and layout of graded banks, drains and waterways should be sought from the soil services section of the Department of Lands before your orchard is planted.

Natural waterways

Avoid planting trees in natural drainage areas.

During heavy rainfall, water flow is channelled to these areas with the bare areas beneath trees more readily eroded.

Grassed, natural drainage lines can be used to dispose of excess water from elsewhere in the paddock.

Planting on the contour

Planting on the contour is an option where land slope is less than 20%. On slopes greater than this percentage, it is unsafe to work rows planted on the contour.

Planting on the contour may be applied in conjunction with contour banks and drains for added soil protection. Most tree crops should not be planted on slopes greater than 15%.

— For further information, see Agnote 1/039 Agfact H6.3.10, Agnote 1/008 and 1/027, NSW Agriculture Advisory Bulletin No. 10 Feb 1992 and NSW Agriculture information sheet 230/28.



Well-constructed inter-row grassed drains.

REDUCING COMPACTION

How to check for compaction

To avoid compaction, try to minimise the time heavy machinery spends in your orchard, particularly when soil is wet. Driving machinery in your orchard will compact soil easily and, once compacted, it will not store water or drain well.

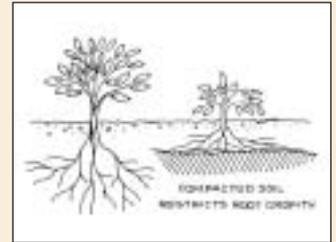
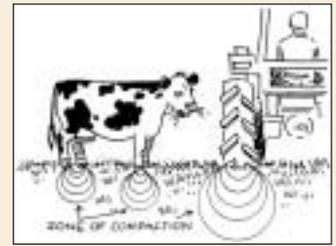
A compacted soil layer will also reduce plant growth because it reduces the root growth of plants.



There is a simple test to determine if soil is too wet to drive over (see figure at left). Ask your local Soil Advisory Officer for information on how to perform this test.

Ripping should only be carried out before an orchard is planted to break up compacted layers. However, this is not suitable for older orchards as tree roots may be harmed by rippers.

When ripping down a slope, alternate ripped lines with unripped areas because a continuous rip line down a slope will act as a channel for waterflow during rain and result in serious erosion.



AVOIDING ACIDIFICATION

When the pH level drops to pH4 (CaCl_2), soil has little ability to hold nutrients. That is, its CEC ('cation exchange capacity') is substantially reduced.

When too much nitrogen fertiliser is used, acidity becomes a problem. Some nitrogen fertilisers are more acidifying than others. The most acidifying fertilisers are ammonium sulfate and mono-ammonium phosphate.

Other causes of acidification include removal of agricultural produce and leaching of nutrients.

To improve the pH of your soil, use the finest and best quality lime available — finer lime maximises the contact between soil and lime particles so that results will occur faster.

HORTILIME has a greater ability to penetrate into soil and work more quickly because it is very fine.

Dolomite should only be added if both magnesium and calcium are deficient in the soil.

Farmers support sustainable soil management

Bonnie Walker has introduced a leguminous ground cover into her orchard and mulches the trees each year. This has provided a thick layer of humus full of nutrients and organic matter.

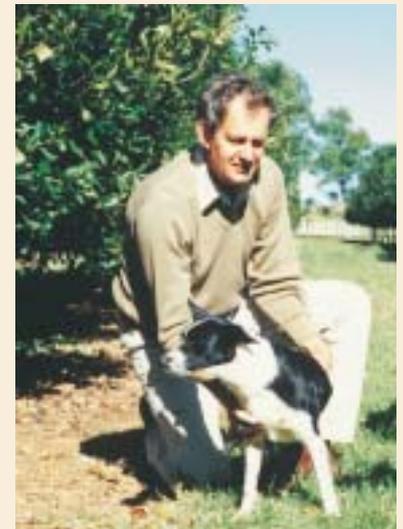


Bonnie Walker, avocado grower

'Mulching is an essential component of our orchard management program. The benefits to soil, root and tree health are measurable in fruit quality. Rewards such as weed suppression, moisture retention and fertiliser efficiency are a bonus,' she said.

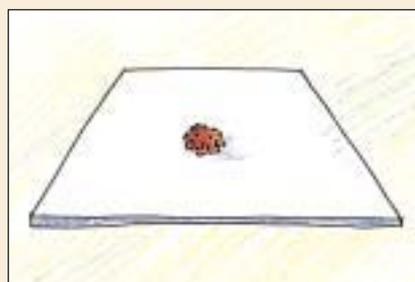
According to John Stock: 'To optimise the long-term productivity of our macadamia trees, orchard practices are specifically directed towards elevated soil organic matter levels and good stability of top soil.

'Ground covers are encouraged with minimal use of weedicides. These groundcovers, along with leaf fall and prunings, are chopped finely throughout the year using flail mowers. This provides a constant supply of organic matter and improves harvesting efficiency.'



John Stock, macadamia grower

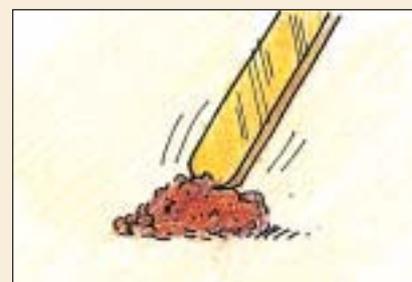
In all cases, pH should be tested regularly (at least every two years) to determine the correct lime application rate. Excess liming can cause iron deficiency (chlorosis).



1. Put a small lump of soil on a clean surface.



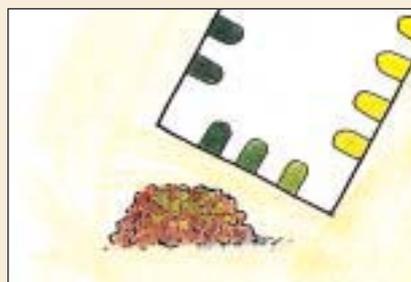
2. Add a couple of drops of universal indicator from the test kit.



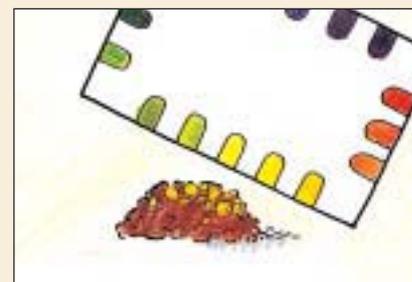
3. Mix the indicator with the soil.



4. Add some indicator powder.



5. Check the colour of the powder against the colour card. Green is the best colour because it shows the pH is near neutral.



6. A yellow colour indicates your soil is acid and needs lime added to it if you want plants to grow well.

Prolonged dolomite use upsets the soil Ca:Mg ratio which should be in the range of 3:1–6:1.

If you need magnesium, use dolomite alternating with plain lime, or mix the two. You can also use magnesium oxide (MgO). Lime acts very slowly, so apply the first lime application before planting to give the lime time to work.

Most subtropical orchard crops perform best in soil with a pH of 5 ± 0.5 depending on the soil type. Try to maintain pH at this level. Avoid coinciding lime application with fertiliser applications. Also, apply lime in winter around the root area and out to the drip line.

FURTHER INFORMATION

Soil Sense — *Soil Information for North Coast Farmers* (1995), available from NSW Department of Primary Industries, Wollongbar.

Soil Management: Bananas in *Soil Management for New South Wales Orchards and Vineyards*, NSW Agriculture & NSW Landcare. Available from NSW Department of Primary Industries.

'Soil Sense' leaflets available from NSW Department of Primary Industries.

Numerous Agnote and Agfact leaflets on specific aspects of subtropical orcharding are available from NSW Department of Primary Industries offices.

Contact: NSW Department of Primary Industries Inquiries Officers, Horticulturists, or Soil Advisory Officers.

ACKNOWLEDGMENTS

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DISCLAIMERS

The information contained in this publication is based on knowledge and understanding at the time of writing (July 2004). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date, and to check currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser.

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