The Green Book
Best Management Practice Guide

3. Soils

Best Management Practice (BMP) of soils on horticultural farms strives to maintain soil health and quality, and avoid the development of problems such as soil acidity, salinity and sodicity. The preservation of good soil structure to maximise plant growth and prevent soil erosion is also addressed by the BMPs recommended in this publication.

This section of *The Green Book* provides the key objectives of BMP for soil management and presents a list of management actions to help achieve those objectives. At the end of this section is a checklist of BMPs recommended for sustainable management of horticulture farms in the Murrumbidgee Irrigation Area (MIA).

The actions for BMP presented in this document are a summary of the key issues for environmentally sustainable horticulture in the MIA. Full details and references can be found in *The Green Book* companion chapter – Soils.

Contents

BMP objectives

Objective 1 – Protect horticultural soils from increases in salinity and acidity and manage sodic soils

The growth and yield of most plants is reduced in soils with a pH below 4 (acidic) or above 8 (alkaline) and where soil salinity is greater than 2 dS/m. Soil acidification and salinisation are gradual processes developing over many years and compounded by the use of some fertilisers and poor irrigation efficiency. Early intervention is essential for their effective management.

Appropriate management to prevent chemical degradation of the soil can be demonstrated on farm through the following actions:

- Test soil pH and salinity in the field every 2–5 years (or annually in sensitive crops or where indicated necessary by crop inspection).
- Confirm field tests with laboratory testing where soil pH is less than 5 or greater than 8 or soil salinity is greater than 2 dS/m.
- Apply lime to soils with pH less than 5 to prevent subsoil acidification and treat alkaline soils (pH greater than 8) with ammonium sulphate.
- Implement management strategies for saline land where soil salinity exceeds 2 dS/m (seek advice from NSW DPI).
- Measure groundwater salinity (from tile drain or test wells) at least quarterly.
- Minimise nutrient leaching with efficient irrigation and drainage management (see WATER section).
- Apply fertilisers in response to crop needs based on district recommendations (from NSW DPI or your adviser) and refined by monitoring actual leaf/soil nutrient levels.
- Use only the least acidic forms of nitrogen fertilisers (eg urea, ammonium nitrate) and avoid the use of ammonium sulphate except on alkaline soils (pH greater than 8).
- Keep records of fertiliser application including type, rate and mode of application.
- Use fertiliser records to identify efficiency of fertiliser when compared with nutrient analysis and yield/quality information.

Objective 2 – Prevent soil degradation from cultivation and compaction

Excessive cultivation and compaction, and long-term residual herbicide use are prime causes of soil structure decline. Structural collapse will result in reduced infiltration and water storage capacity, restricted root growth, a reduction in soil organisms, poor breakdown of organic material, waterlogging and potential for erosion.

Appropriate management to prevent physical degradation of the soil can be demonstrated on farm through the following actions:

- Avoid long-term use of residual herbicides.
- Minimise the number of cultivations and the need for cultivation by using knockdown herbicides and inter-row sod cultures.
- Reduce the area cultivated (eg only in the wheel tracks).

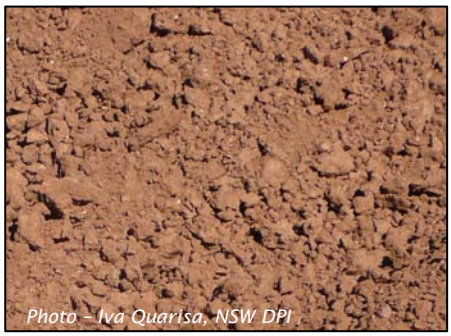

Photo – Iva Quarisa, NSW DPI

- Minimise the severity of the cultivation by using narrow tyned implements (unless discs are needed to break up weeds or trash), slow rotations and travel speeds.
- Avoid continual cultivation at the same depth.
- Test soil moisture content before cultivating by rapidly squeezing a small lump of soil into a ball and rolling it into a narrow (3 mm) rod.
- Cultivate only at optimum soil moisture conditions (ie if the soil makes a cohesive rod – too wet; crumbly rod – OK; no rod – clay OK, loam too dry).
- Confine farm traffic to set roadways.
- Keep tyre pressures low and use lighter machinery (eg ATVs) where possible.
- Restrict the use of farm machinery on wet soils to essential operations.
- Use a penetrometer to test for soil compaction and the existence of hard pans.
- Ameliorate compacted soils with deep ripping and gypsum application – change management to prevent reoccurrence.

Objective 3 – Minimise soil losses due to erosion

Soil erosion has a big effect on soil structure and fertility. Plant nutrients are usually concentrated in the clay soil particles, and nitrogen, phosphorus and organic matter are concentrated in the topsoil. Topsoil is most at risk from wind erosion and clay particles are easily dispersed and carried away with water run-off. Minimising soil erosion requires maintaining ground cover and managing run-off.

Appropriate management to prevent soil erosion can be demonstrated on farm through the following actions:

- Keep at least 70% of soil covered (includes crops and ground cover).
- Do NOT cultivate when heavy rain or high winds are forecast.
- Only cultivate at optimal soil moisture content.
- Use windbreaks to protect topsoil losses from prevailing winds.
- Consider the use of mulch or organic matter under trees/vines to provide ground cover.
- Allow some weed growth in channels (managed by use of knockdown herbicides and slightly over sizing channels) to reduce soil loss during irrigation/drainage and to maintain channel bank stability.
- Where slopes are greater than 3%:
  - shorten gentle or intermediate slopes with contour banks
  - cultivate across the slope to minimise run-off
  - plant at right angles to the direction of water flows and leave grass (or volunteer sod) on unplanted strips.
- Maintain grass (or volunteer sod) verges along channel banks to intercept silt and nutrients.
- Maintain a vegetated filter strip along river or stream banks to intercept silt and nutrients.


Photo – Iva Quarisa, NSW DPI

Objective 4 – Prevent environmental impacts from fertiliser mismanagement

Mismanagement of agricultural fertilisers is a major cause of groundwater and river pollution. Elevated levels of nitrogen and phosphorus can lead to algal blooms and eutrophication of river systems. Nitrogen is particularly mobile in the soil. Excess nitrate cannot be taken up by the plant roots and is leached rapidly down the soil profile to the watertable. Careless storage and handling of fertiliser also has direct impacts on the environment – particularly water quality.

Responsible fertiliser management to prevent groundwater and river pollution can be demonstrated on farm through the following actions:

- Store fertilisers in covered field bins or sheds that keep the product dry and prevent contact with the ground. Smaller amounts (in bags) should be protected from the weather and stored on an impermeable surface.
- Do NOT dump fertiliser on the ground before transferring to spreading equipment.
- Clean up spills immediately.
- Apply nutrients in response to crop needs; consider applying nitrogen in several smaller applications timed to meet crop demand.
- Irrigate efficiently to minimise nutrient leaching beyond the root zone (see WATER section).
- Apply fertiliser as accurately as possible and within reach of the crop root zone.
- Use slow release fertilisers where possible.
- Minimise soil loss to wind and water erosion by maintaining ground cover and managing surface run-off.
- Maintain grass verges or vegetated filter strips along channel and stream banks to trap silt and nutrients.

In focus - Sudden death of citrus

Sudden death of citrus is of particular concern in the Riverina with up to 10% of plantings dying in some areas. Poor water infiltration, soil compaction and temporary waterlogging have been identified as potential causes.

Wide spread and long term use of residual herbicides, combined with non tillage has been shown to result in crusting, compaction and water infiltration problems in citrus orchards.

Soil management in perennial plantings should focus on:

- correcting and minimising soil acidity
- maintaining and improving soil structure and drainage
- improving irrigation efficiency
- avoiding farm management practices that result in soil compaction
- aligning fertiliser applications with plant requirements
- replacing the use of residual herbicides with managed inter-row swards.

Source: NSW Agriculture "Soil Management Guide"1995

Photo – Riverina Citrus

Key legislation and codes of practice

- *Protection of the Environment Operations Act 1997* (NSW)

Acts, and amendments and regulations relating to acts, of the NSW Government can be found at www.legislation.nsw.gov.au/ and then easily found using the 'Browse' or 'Search' facilities at the site.

- Guidelines for determining a Nutrient Management Code of Practice. Fertiliser Industry Federation of Australia. www.fifa.asn.au then browse publication listing

More information

Key contacts

NSW Department of Primary Industries (Griffith) 02 6960 1300
NSW Department of Environment & Climate Change (Griffith) 02 6969 0700
NSW Department of Environment & Climate Change (general)..... 131 555
CSIRO Land & Water 02 6960 1500
Irrigation Research and Extension Committee..... 02 6960 1550
Murrumbidgee Landcare Incorporated 02 6925 7718
Greening Australia 02 9560 9144

Industry

Murrumbidgee Horticulture Council..... 02 6964 2420
Wine Grapes Marketing Board..... 02 6962 3944
Australian Prune Industry Association..... 03 5023 5174
Riverina Citrus 02 6964 4333

Web sites

Department of Agriculture, Fisheries & Forestry..... www.affa.gov.au
NSW Department of Primary Industries ..... www.dpi.nsw.gov.au
CSIRO Land & Water ..... www.clw.csiro.au
Cooperative Research Centre for Viticulture..... www.crcv.com.au
Department of Environment, Water, Heritage and the Arts ..... www.environment.gov.au
NSW Department of Environment and Climate Change..... www.environment.nsw.gov.au
Environment Protection and Heritage Council ..... www.ephc.gov.au
NSW Landcare ..... www.landcarensw.org
Land & Water Australia ..... www.lwa.gov.au
Land & Water Australia, River Landscapes..... www.rivers.gov.au
Nature Conservation Council of NSW ..... www.nccnsw.org.au
Natural Heritage Trust..... www.nht.gov.au

Best Management Practice checklist for soil management in the MIA

Use this checklist to assess how you are managing the soils on your farm. Depending on your answers, this list can form the basis of a plan for improving the sustainability of your farm management practices.

	Best Management Practice	Yes	Partly achieved	To do	N/A
1	Soil pH $_{(CaCl2)}$ is tested every 2–5 years (more frequently in sensitive crops) and maintained between 5 and 8 $_{(CaCl2)}$.	☐	☐	☐	☐
2	Fertilisers are applied in response to identified plant needs and only the least acidic forms of nitrogen fertilisers (eg urea, ammonium nitrate) are used unless soil tests indicate otherwise.	☐	☐	☐	☐
3	Nutrient leaching and impacts on watertable depth are managed through efficient water use and drainage management.	☐	☐	☐	☐
4	Soil salinity is monitored annually in lower lying areas or where crop productivity has declined. Guidelines for managing saline land are implemented where soil salinity exceeds 2 dS/m or in areas considered at risk.	☐	☐	☐	☐
5	The number and area of cultivations is kept to a minimum. Tyned implements are used where possible and cultivation only occurs at optimal soil moisture content.	☐	☐	☐	☐
6	Compaction due to heavy machinery and spray equipment is minimised by limiting farm traffic especially on wet soils.	☐	☐	☐	☐
7	Residual herbicides are **NOT** used to maintain a bare soil surface between plantings. Instead knockdown herbicides are used to control vegetation in plant rows and a permanent sod culture is maintained in the inter-row area.	☐	☐	☐	☐
8	At least 70% of the farm soil is covered (crops and ground cover) to reduce erosion due to wind. Windbreaks are used in areas of high prevailing winds.	☐	☐	☐	☐
9	The speed and direction of water run-off on sloping land is managed to reduce topsoil losses.	☐	☐	☐	☐
10	Chemicals (including fertilisers) and fuels are stored on an impermeable surface away from flood prone areas and waterways, and with ready access to spill or clean up kit (see CHEMICALS section).	☐	☐	☐	☐