

Soil & Water Best Management Practices for **NSW Banana Growers**

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NSW Department of Primary Industries



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NSW DEPARTMENT OF
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About this guide

These guidelines have been developed by NSW DPI in consultation with NSW banana growers and the Northern Rivers Catchment Management Authority. Other related publications include *Banana Growing Basics for NSW* and *Banana Growing Guide – Cavendish Bananas*, both published by NSW DPI are available from the NSW DPI website www.dpi.nsw.gov.au. Updated versions of this document and other publications covering pest and disease management will also be found at this web address.

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Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (June 2008). 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 DPI or the users independent adviser.

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The guidelines were developed by staff of NSW Department of Primary Industries at Alstonville, Coffs Harbour and Murwillumbah, in consultation with banana growers and industry representatives. It is written for growers and land managers in northern NSW. Its focus is primarily on natural resource management (NRM) issues in relation to soil and water resources.

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INTRODUCTION

This publication focuses on banana plantations on steep lands on the NSW north coast where high seasonal rainfall is a regular event. Land managers on similar landscapes are encouraged to consider the on and off farm effects of their management decisions. The aim of this publication is to provide practical guidelines to help growers and land managers develop whole farm practices that lead to a stable, productive and sustainable system. These practices will also have off farm benefits to the wider community such as clean waterways and improved soil health and biodiversity. However the general principles will apply equally to other horticultural enterprises with similar intensive systems.

Apart from the on and off farm effects of soil loss on the steep lands of the north coast, improvement of soil health is critical to maintenance of healthy and productive banana plantations. Use of organic mulches (including banana trash), composts and cover crops are more commonplace these days in north coast banana production. There is also some evidence to suggest that maintaining a biologically diverse soil through use of various forms of organic matter and maintenance of a well aerated, well structured soil, can help suppress soil-borne diseases of bananas.

A comprehensive approach to natural resource management on horticultural farms extends further to consider issues of water and air quality, weed management, impacts of pesticide use, management and retention of remnant vegetation, recognition of protected species and biodiversity. However, the purpose of this document is to provide guidance to industry on current best practice to protect and improve the quality of soils on banana plantations and to manage water flows within and through the plantation to minimise erosion and off site transport of soil, nutrients and organic matter.

Some of the best practices described in this publication add to the cost of growing bananas. However, with most it is a one-off investment which not only adds value to the farm, but can enhance productivity. So, if attempting large scale changes involving big investment dollars is not feasible, a gradual approach over a number of years can spread the cost, and the workload.



A double row system at Ian Simpson's allows extra light penetration, access for machinery and a buildup of mulch around the plants.

INTRODUCTION

Industry background

The NSW banana industry is confined to the coastal strip from the Queensland border south to the Kempsey Shire. Bananas are grown on hillsides to enable them to be above the frost line. This creates many problems for the growers, making the work backbreaking and limiting the amount of machinery that can be used. It also limits banana production to sloping sites which are highly prone to erosion. Prior to the advent of four wheel drive vehicles, elaborate flying fox systems were used to deliver the bunches from the plantations to the packing sheds.

The introduction of four wheel drive vehicles necessitated the construction of road systems throughout the plantations. These road systems created new challenges for growers as they can concentrate water which may cause extensive soil erosion. Roads therefore need to be planned and constructed correctly. Road batters can also create erosion problems and need to be well planned and constructed to minimise erosion risk.

Early in the history of banana production it was mandatory to keep the banana plantation free of weeds and other vegetation. This was necessary to permit Banana Bunchy Top Virus inspectors access to the plantation and inspect each plant for possible infection with the virus. This regulation has now been relaxed and vegetation within one metre of the base of banana plants must be kept below 30 centimetres. This now permits growers to grow low growing cover crops in the inter-row area.

These days growers are able to manage their plantation to minimise the risks of erosion and maximise the benefits of organic material on the soil surface. Table 1 below summarises the best management practices outlined in this publication.

Table 1. Natural Resource Management summary

MANAGEMENT AREA	GOAL	PROCESS	GROWERS CAN
Planning	Minimise on and off farm impacts of erosion and runoff water	Use a whole farm planning approach to water management	Involve specialists at the design phase
Plantation layout and design	Catch and divert run-on water and manage on farm drainage	Design roads, drains and culverts to control water	Ensure roads are effectively diverting water to drains
Good land preparation	Minimise soil disturbance	Maintain ground covers where possible to mitigate erosion	Supervise all aspects (e.g. contract dozer operations)
Using cover crops	Minimising soil loss and improving soil health	Establish crops early	Manage the cover crop for maximum soil coverage
Managing fertilisers	Minimise nutrient run-off	Match applications to plant nutrient demands	Use regular soil, leaf and water tests. Apply regular small doses of fertiliser
Effective irrigation	Apply water to satisfy crop needs	Schedule irrigation to match water use	Monitor soil moisture and apply the correct amount
Infrastructure maintenance	Maintain water diversion and control structures	Incorporate maintenance into farm management routine	Conduct regular inspections of all structures

PLANNING

Site selection

The ideal site has a gentle slope facing north to north east, above frost level and protected from prevailing winds. Very seldom will ideal conditions be available over the entire property and normally a compromise will have to be made. Variations within the property can assist in spreading the farm operations out and help spread the work load.

Slope

The slope of the plantation will affect productivity. If a section of the property is obviously too steep, serious consideration should be made not to plant the area and if it is planted already then maybe the area should be retired and revegetated. Clearing of land on slopes in excess of 18 degrees is restricted under State regulations, and such land should also be avoided for banana cultivation.

Steep land will have many disadvantages:

- erosion will be more difficult to control
- water flows will be more damaging
- all operations will be harder to undertake
- the cost of production will be higher
- roads will be steeper which will impact on safety for farm workers
- road batters will be higher
- fruit is more liable to be damaged during harvesting
- overall bunch yield may be lower
- plants may be more susceptible to falling over.

Aspect

The aspect of the plantation will affect winter temperatures and exposure to cold winds. North east to north slopes are ideal. Flat land is suitable provided it is sheltered from strong winds.

However sites exposed to cold winds, with temperatures regularly falling below 12 °C cycle more slowly and produce inferior fruit.

Areas that are open to cold winds, are too low or have the wrong aspect will be too cold and less viable. It will be found that:

- fruit will have a higher incidence of *Deightoniella* and other skin blemishes
- fruit will be a dull grey in winter/spring

- fruit will be slower ratooning
- more frequent treatment for fruit pests and diseases may be required
- the plantation will have lower production
- less leaf mulch will be produced resulting in less soil protection
- leaves will become shredded and less efficient
- some varieties will 'choke' in winter.

Gullies, watercourses and ridgelines

Any gullies and watercourses on the block should not be disturbed and vegetation along ridge lines should be kept as windbreaks.



Bananas in NSW are grown on hillsides, requiring growers to implement steps to reduce soil erosion.

PLANTATION LAYOUT/DESIGN CONSIDERATIONS

If a section of an existing plantation is being replanted the option to start re-roading the plantation should be considered. When the plantation roads were originally constructed, it is possible the plantation was already established and the roads were constructed between existing banana rows. This may have resulted in a road system that was a compromise between the ideal design and not losing too many plants or opening the plantation up to damaging winds.

Roads

When replanting, the option to completely redesign the road system should be considered. A good road system will:

- allow efficient movement throughout the plantation
- collect and divert drainage water into natural or constructed waterways
- be designed to permit harvesting of fruit with the minimum of walking up and down the slope
- have roads spaced so there is a minimum of walking back to the vehicle to refill during fertiliser applications

- have roads spaced to enable the use of large spray equipment if these are to be used for leaf spraying
- be designed to provide safe access to the plantation for vehicles, equipment and people
- be designed for roads to run across the slope or up and down the slope.

Roads across the slope:

- must be well designed and maintained otherwise they can concentrate water which could cause severe soil erosion
- may have steep batters on the uphill side which can make farm operations difficult
- need to be grassed or protected with rocks on the banks to prevent erosion
- can be constructed as in-sloping roads with a 3% gradient to collect and divert water to natural or constructed drains
- can be constructed as out-sloping roads which will allow rainfall to continue down the slope – provided they are well maintained; however, maintenance is difficult as even the smallest wheel rut will concentrate water.

Roads running up and down the slope:

- permit vehicles to be parked where harvested bunches and fertiliser can be carried across the slope
- permit rows to be planted up and down the slope where appropriate utilising tram-line configuration and permitting the use of machinery for farm operations such as weed control, fertilising
- have been known to allow damaging winds into the plantation
- can be grassed if they can be slashed
- will concentrate some water in the wheel ruts or between the concrete tracks
- can be sealed or concreted to protect against soil erosion
- depending on the plantation, cross drains may be required to divert water out of the plantation.

Good road design and maintenance is critical to minimise erosion as well as reduce fruit damage during harvest operations.

PLANTATION LAYOUT/DESIGN CONSIDERATIONS

Sealed roadways in the plantation:

- provide added safety for farm vehicles
- are ideal on corners
- improve vehicular access in all weather conditions
- help prevent the spread of panama disease
- require a minimum of maintenance
- should be well planned and constructed to minimise concentration of high velocity water flows. Concrete strips with diversion drains can slow and spread water before it becomes damaging.

Plantation design

Cavendish bananas are usually planted to have one plant per seven square metres, while ladyfingers are planted at about twelve square metres each. Consideration should be given to choosing a plantation design that incorporates ease of access for harvest and farm operations with favourable conditions for cover crop establishment. One system which provides such benefits is use of double rows with grassed inter-rows, or 'tram lining'. This system can be used where slopes are gentle and has the following advantages:

- trash can be concentrated between the rows, allowing nutrient recycling, and a build up of soil organic matter
- grassed inter-rows enable easy access for harvest aids and machinery

- wider spacing of the inter-rows allows better air circulation to allow the plantation to dry out quickly after rain, minimises leaf disease and maximises light penetration
- grassed rows and mulch beds running across the slope slow down water movement, resulting in minimal soil losses.

Drains

A well designed drainage system is essential if soil erosion is to be controlled. Water from above the plantation should be diverted if possible and water that collects within the plantation needs to be controlled.

- drainage water from above the plantation (run-on water) needs to be directed away from the plantation or into natural or constructed drains
- water that collects within a plantation needs to be controlled and slowed by a well designed and maintained road and drainage system
- ideally drains should be vegetated or protected with rocks to reduce soil erosion.

Gully lines should not be disturbed, and can be protected with vegetation or rocks if needed.



Grassed inter-rows help to slow water movement through internal drains. Banana trash also remains undisturbed enabling nutrient recycling, and soil protection.

LAND PREPARATION

Clearing the land

Bananas will normally be established into one of three situations:

- newly cleared land which is to be planted to bananas for the first time
- planting into former banana plantations where the bananas have been removed and significant regrowth has occurred
- replanting an existing plantation.

A soil test should be taken before land preparation starts so that soil amendments such as lime can be spread mechanically if possible. Consider using compost or mulch to improve soil physical, chemical and biological fertility.

Depending on the situation there are a range of land preparation options. These include the use of heavy machinery, the use of hand held machinery, i.e. brush cutters and spray equipment, and the injection of existing banana plants with herbicide.

Fire has been used in the past to prepare sites, but it is not a recommended practice because it

- destroys all vegetation which would have protected the soil from erosion
- destroys soil organic matter
- can escape, damaging neighbouring properties.

When using heavy machinery to clear the site

Where the site has never been cleared, or has significant re-growth vegetation requiring large scale dozer operations, consider:

- Soil that is left bare is prone to severe erosion.
- Remnant vegetation should be retained along natural drainage lines and gullies running through the plantation.
- Timing should avoid periods of heavy rainfall (June to October is the best time to avoid heavy storms).
- May–June is the best time to start site preparation. This allows time for a cover crop to establish prior to planting bananas in the spring.

- Logs and rocks can be removed which can later interfere with plantation operations and harbour rats.
- Roads and drains should be constructed at this stage.
- Immediate establishment of a cover crop will save the soil from erosion and build up the soil.

Having a clear plan for the dozer is critical. The plan should show where roadways, drainage lines and run-on water diversion structures are to go.

When using brush cutters and herbicide

- if the regrowth vegetation is low growing it may be possible to clear with brush-cutters and herbicides if it is economical. This method will minimise soil disturbance and is preferable to using machinery.
- the cover crop should be established as soon as possible after the land is cleared. This will reduce the possibility of soil erosion prior to the cover crop establishing.

Clearing native vegetation is highly regulated in NSW. Consult with the regional CMA and local government prior to clearing existing vegetation. For clearing of exotic or dead native trees on slopes over 18 degrees DECC must also be consulted.

LAND PREPARATION

Panama disease management

Panama disease is a fungal disease *Fusarium oxysporum* that is spread in water, soil and planting material. Once Panama gets established in a plantation it is there for ever. At present there is no chemical control available. The only control is to plant resistant varieties.

To keep Panama out of a plantation and limit its spread in a plantation growers need to:

- control the access of visitors
- use a footbath before entering the plantation
- limit vehicle access to the plantation during wet weather
- wash farm vehicles with a truck wash containing quaternary ammonia compound
- only use contract machinery as a last resort
- if contractors are used, ensure their machinery is thoroughly cleaned before entry
- use your own planting material or tissue cultured plants
- use cover crops in the plantation to limit the movement of soil
- ensure drainage water from bananas does not enter the irrigation dam
- have the foot-valve of the irrigation pump as close to the water surface as possible
- seal roads with gravel or concrete
- don't return bunch stalks to the plantation.



Young bananas in molasses grass mulch at Jim Voisey's plantation. The molasses grass was planted three years ago, when the previous plants were destroyed, and sprayed off a few months before these young bananas were planted.

LAND PREPARATION

Re-planting an existing plantation

Planning for replanting commences before the original bananas are destroyed.

- Prior to killing the old bananas a cover crop should be planted. This can then establish as the banana plants are dying.
- The best method of killing the banana plants is to inject them with a systemic herbicide. Do not cut down plants before injecting them with herbicide as the leaves need to remain on the stool for the herbicide to work. This will clear the old crop while causing a minimum of soil disturbance.
- The banana plants can also be slashed with a heavy duty slasher or trampled with a dozer. Both methods will rid the area of bananas but will cause considerable soil disturbance making the area prone to soil erosion. Bringing any machinery into a plantation also runs the risk of introducing panama into the plantation.
- The existing plants need to be removed at least six months BUT preferably 24 months before the new planting. This ensures the elimination of banana weevil borer and nematodes, which can persist in the needed corms of plants for many months. This time out of bananas ensures that all plants and suckers are dead and that bunchy top will not be carried over to the next crop.
- A dozer may then be brought in to re-design or repair roads. Banana planting lines can be ripped at this stage, limiting the rip line to a single tyne along banana rows. Under no circumstances rip up and down the hill.

Under no circumstances should the plants be pushed out with a dozer and piled into windrows because this will:

- **loosen the soil and make it prone to erosion**
- **result in a heap of banana plants that will be hard to kill at a later date**
- **remove large quantities of top soil containing organic matter and nutrients.**

COVER CROPS

Use of grasses or legumes in bananas as cover crops have been shown to provide a range of benefits, including

- reducing the effect of raindrop impacts on soil
- slowing water movement through the plantation and minimising soil erosion
- provision of root channels in the soil which improve water infiltration and air movement into the soil
- consolidation of the soil surface to allow easy access of machinery into the plantation.

The requirements of an ideal cover crop include:

- adapted to lower light environments
- ground hugging
- not too invasive or competitive with plants
- do not harbour nematodes
- persistent and doesn't require re-seeding.

Planting bananas into a cover crop

Regardless of whether the bananas are being established into newly cleared land or former banana plantations where significant regrowth has occurred, or re-planting an existing plantation, it is recommended that a cover crop is established prior to planting the bananas.

Once a cover crop is established, the management procedures around planting time are as follows:

- 4 – 8 weeks before planting the bananas, spray out a 1 m wide circle at each planting site or 1 m wide strip along the row. If using molasses grass spray out the entire block in May, before it flowers.
- After planting backfill the hole and pull mulch back around the plant.

Managing cover crops in young plantations

- Spot spray around plants with a non-systemic herbicide for weed control if required.
- No inter-row weed control should be needed for at least six months if the cover crop is well established.
- Progressively increase the width of the sprayed strips; by 12 months there should be about a metre strip of cover crop left along the middle of each row. Allow this to re-seed to keep the cover growing back into sprayed area. Spray back after late autumn.



Haifa white clover established in two year old bananas.

COVER CROPS

Managing cover crops in established plantations

- The use of a non-systemic herbicide to reduce competition for water from grass strips may be necessary in spring and summer if the plantation is not irrigated.

An alternative is to spray out the cover crop and weeds and then broadcast low growing turf varieties of ryegrass in late summer. These grow well through the winter and will last through until the following season. This reduces herbicide applications and improves soil health.

Cover crop options for banana plantations

OPTION 1
Turf varieties of ryegrass (<i>Lolium perenne</i>)
• Turf varieties of ryegrass are low growing and do not run to seed as readily as pasture varieties. • They establish best in autumn. • Broadcast the ryegrass seed after any weeds in the plantation have been sprayed out. • When planted thickly the ryegrass will block the light and inhibit germination of other weeds.

Cover crops protect soil against erosion, protect waterways and help keep weeds down without constant spraying.

OPTION 2
Broadleaf paspalum (<i>Paspalum dilatatum</i>)
• Takes two years to get a full establishment so plan ahead and plant in summer. • No inter-row weed control needed for at least six months. • Spot spray around plants for weed control if required. • Spray back after late autumn seeding. • Excessive growth of weeds or paspalum can be sprayed with a light spray of a non-systemic herbicide without killing the paspalum. If paspalum is being used for replant areas: • Plant the cover crop before the old bananas are destroyed. • Annual weeds in the first year will be smothered next winter.

OPTION 3
Molasses grass (<i>Melinis minutiflora</i>)
• While molasses grass is similar to broadleaf paspalum up to early crop establishment, it won't persist in long term plantations in the same way that paspalum does. Therefore molasses grass is good for establishment but not as good for a long term cover crop. • Molasses grass planted into a patch that is to be spelled will provide a good mulch layer when sprayed out for planting the new crop. • It takes two years to get a full establishment – plan ahead and plant in summer. • It will harbour burrowing nematodes so it is not the best choice in areas where these nematodes are a problem. If in doubt about burrowing nematodes use a different cover crop. • Spray out the entire block in May prior to planting the bananas. (After it seeds it is uncomfortable to work in.) • Annual weeds from the first year will be smothered in winter.

OPTION 4
Other cover crops
There are undoubtedly other cover crops that are not excessively competitive or unmanageable. Check what your fellow growers are doing. Some other crops that have been used are listed below: Spring: • Millet is cheap and easy to establish and manage, or better still a mixture of millet and paspalum. Autumn: • Oats is cheap and easy to establish and manage. • Follow up the autumn cover crop with planting of paspalum; however it is better to sow oats and paspalum together in autumn. • Some growers have also successfully used Namoi woolly pod vetch. • Smothergrass (<i>Dactyloctenium australe</i>) has been successfully used in macadamia plantations on the north coast, and is well adapted to a medium shaded environment. It is suitable for protecting road batters and within plantations that can be mown. • Haifa white clover (<i>Trifolium repens</i>) can be established in young bananas and will persist within the plantation.

SOIL MANAGEMENT

Once the plantation is established, the soil should be managed to provide the best environment for the plant roots. This will involve the application of fertilisers and soil additives aimed at improving the physical, chemical and biological properties of the soil to benefit crop growth.

Managing nutrients

A well managed nutritional program will help keep the soil healthy and the plantation growing vigorously. A soil test should be taken to establish an effective, economical fertiliser program. Bananas perform best in soils with a pH of 5.0 (calcium chloride) or above. The table below provides a guide to preferred levels for bananas from a typical soil test.

RECOMMENDED MINIMUM NUTRIENT LEVELS
Phosphorous (P) – 80 ppm
Potassium (K) – 0.5 meq/100 g
Calcium (Ca) – 4 to 10 meq/100 g
Magnesium (Mg) – 1 to 3 meq/100 g
Electrical conductivity (EC) – < 0.15 ds/m

Zinc and boron levels are likely to be low in north coast soils so these should also be checked when the soil test is done.

Excessive application of fertilisers, particularly during the storm season, can result in massive nutrient losses in runoff water, or with topsoil during severe erosion events. Leaching losses through the soil profile should also be avoided. These nutrient losses waste inputs and pollute the surrounding environment. Cover crops also need to be fertilised to maintain good ground cover.

Managing soil pH

Increased soil acidity reduces the cation exchange capacity of the soil, which can result in deficiencies of calcium and magnesium, leading to poor productivity. Regular use of ammonium based nitrogen fertilisers can increase soil acidity, so consider switching to alternatives such as calcium nitrate if soil tests indicate decreasing pH (increasing acidity). Lime or dolomite are also used to increase pH if acidity is becoming limiting to plant growth.

Deciding when to apply fertilisers

The preferred approach is to apply a little fertiliser often. Once you have a recommendation for the amount of fertiliser needed, calculate how much you need to apply in five or six applications per year to reach the annual target. Do not apply fertiliser in a few big applications as fertiliser applications are prone to being washed away if a storm occurs, and more liable to losses through volatilisation.

Generally, for banana crops, the application rates for major nutrients should be in the region of: Nitrogen: 100 kg/ha, Phosphorous: 60 – 90 kg/ha and Potassium: 220 kg/ha. This will replace the nutrients used by the crop over a year. If manures are being used as an alternative to chemical fertiliser, soil and leaf testing should also be used to determine if additional nutrients are required.

Fertilising young plants

Apply the fertiliser within a circle less than 15 cm from the plant (keep away from the funnel leaf to avoid burns).

Continue applying fertiliser each month, widening the circle out each time to keep slightly ahead of root growth until you start broadcasting over all the inter-row area from 6 months onwards.

Aim to apply small doses every warm month but remember, it can take up to 30 mm of rain for fertiliser to be washed in. So in practice you would apply 5 or 6 applications per year.

Fertigation is an ideal method of applying precise amounts of nutrients. Automated systems deliver nutrient at the correct time and match the crop needs, and allows for the little and often approach. However, the distribution uniformity of the irrigation system must be high (85% plus) to ensure even application across the block.

Fertilising established crops

Take soil and leaf samples for analysis in April/May each year once the plantation is in production. This will allow for the annual fertiliser requirements to be calculated and allow time for any lime or dolomite applications to be applied during winter before the fertiliser program commences in the next spring. It is best to broadcast fertiliser over the whole inter-row in established bananas.

SOIL MANAGEMENT

Irrigation

Bananas grow more consistently and cycle faster if they are well irrigated. Bananas have a relatively high water use in the heat of summer but only have a shallow root system, with most of the roots in the top 30 cm. At the peak of the season bananas can use up to 50 mm a week. This means soil moisture reserves are used up very quickly, particularly in light or gravelly soils. An actively growing cover crop will require additional irrigation, otherwise it will compete with the banana crop.

To get the best performance, irrigation may need to be applied at 30 mm a time twice a week in November and December in soils with low water holding capacity. An irrigation system should be designed to allow for an irrigation schedule which can achieve this.

Irrigations should be scheduled to apply enough water to re-fill the root zone as regularly as possible. These decisions are best made after checking either evaporation data or soil moisture levels. A range of soil moisture monitoring devices are available from simple tensiometers to high-tech computerised systems. (All of these tools are more accurate than kicking the soil!)



Tensiometers give an easy indication of soil moisture in the root zone. These two show wet soil at both 300 mm (12") and 450 mm (18") after 50 mm of rain.

SOIL MANAGEMENT

Managing soil biology

Bananas will grow better where the soil is well structured and has a build up of organic matter. A well structured soil will have better aeration at depth which gives roots a greater volume of soil to grow into. Soil structure is improved by increased levels of organic matter which is known to encourage soil dwelling organisms, which in turn help retain and recycle plant nutrients.

Use of mulches

A mulch is organic matter applied to the soil surface in a layer up to 10 cm thick, and designed to:

- protect soil from raindrop impact
- reduce erosion
- improve soil microbial and soil invertebrate (i.e. worms) activity and diversity
- reduce soil temperature variations
- increase root growth, which helps to counteract nematode damage
- improve the nutrient holding capacity of the soil
- improve the structural stability of the soil by adding organic matter
- improve infiltration and water holding capacity of the soil
- suppress weed growth
- reduce moisture loss from the soil.

Banana trash is an ideal mulch for banana plantations, allowing re-cycling of nutrients, and reducing the reliance on applied fertilisers. Cover crops that are either slashed routinely or sprayed off can also act as an effective mulch and are a good source of organic matter.



Concreted roadways stop the formation of erosion ruts and make the plantation more storm proof.

As the plantation matures, the trash from harvested plants, de-suckering and deleafing will provide additional soil protection, and increase soil organic matter.

INFRASTRUCTURE MAINTENANCE

Road maintenance

Even well designed roads need adequate maintenance to prevent water being concentrated which can then break out and cause erosion. Well maintained roads are also important to reduce damage to fruit during harvest.

- Ensure road batters have cover crops planted to minimise soil erosion.
- Check that drainage water is directed to natural or constructed drains.
- Check that drains are not eroding.
- Ensure diversion banks, also known as 'whoo-ups' and culverts are working.

- Repair wheel ruts before they develop into major problems.

As Panama disease can be spread in soil and mud, concrete or gravel roads will reduce its spread around the plantation.

Roads across the slope used as drains can divert contaminated water out of the plantation instead of it running through the plantation.

Drainage maintenance

- Keep drains protected from erosion with vegetation, rocks or structures to slow down water if required.
- Ensure natural watercourses remain well grassed.

- Reduce impact of waterfalls with rocks.
- Inspect culverts on a regular basis for blockages.
- Repair any minor damage before it becomes major.

Irrigation system maintenance

- Check for leaks and blockages.
- Check for uniformity of coverage, especially if using fertigation.

Dam maintenance

- Keep the spillway well vegetated or reinforced.
- Install a silt trap upstream from the dam and keep it cleared of debris as necessary.



Even a small rock wall, like this one at Ian Simpson's can slow down water flow and stop gullies eroding through a plantation.

FURTHER READING

Banana Growing Basics for New South Wales, Newley P, Akehurst A, Campbell B and Treverrow N. NSW Department of Primary Industries, May 2008.

www.dpi.nsw.gov.au/agriculture/horticulture/tropical/bananas/growing-basics

Banana Growing Guide – Cavendish Bananas, Newley P and Akehurst A. NSW Department of Primary Industries, June 2008.

www.dpi.nsw.gov.au/agriculture/horticulture/tropical

Soil Erosion Solutions – Helping North Coast landholders reduce soil erosion, Jenkins A and Alt S. Department of Primary Industries, June 2007

Also see the following websites:

The Northern Rivers CMA website – www.northern.cma.nsw.gov.au

NSW DNR Soils publication website – www.waterwise.nsw.gov.au/care/soil/soil_pubs/index.html

Landcare website – www.daff.gov.au/natural-resources/landcare

NSW DPI website – www.dpi.nsw.gov.au/agriculture/horticulture