Soil and Water Management Practices for

Blueberry growers in Northern NSW

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NSW DEPARTMENT OF PRIMARY INDUSTRIES

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CONTENTS

These best management practice guidelines have been developed to guide new and existing blueberry growers in northern NSW. The focus is primarily on natural resource management (NRM) issues in relation to soil and water resources.

This BMP primarily targets blueberry growers on steep lands with highly erodable soils in the northern NSW region where high seasonal rainfall is a regular event. However, the general principles will apply equally to other horticultural enterprises with similar intensive systems. Land managers therefore need to consider both the on and off farm effects of their management decisions.

The aim is to provide practical guidelines to help growers and land managers develop whole orchard practices that lead to a stable, productive and sustainable system. The systems also have off farm benefits to the wider community such as production of clean waterways and improved soil health and biodiversity.

It must also be acknowledged that some understanding by the community is necessary for short periods especially when natural very high rainfall events occur. These events may result in partial failure of the system. Inflexible regulatory approaches should be avoided if the larger community is to encourage sustainable natural resource management practices by orchardists under normal circumstances.

BMP	AREA	GOAL	PROCESS	GROWERS CAN
1	Managing run-on water	Diverting clean water	Build diversion banks	Maintain groundcovers
2	Minimising disturbance	Minimising erosion	Progressively disturb area	Choose the correct time of the year
3	Capturing water	Transfer water to drains	Build cross slope catch banks	Maintain cross slope banks
4	Groundcovers	Minimising disturbance	Re-establish quickly	Intensively manage
5	Irrigation design	Irrigation orchard design	Consult irrigation expert	Follow irrigation design
6	Moisture monitoring	Minimising runoff	Maximise water use	Use moisture monitoring devices
7	Nutrient management	Minimising nutrient runoff	Match plant nutrient demands	Use regular soil, leaf and water tests

SUMMARY OF BEST MANAGEMENT PRACTICES ADDRESSED IN THIS GUIDE

General objectives for managing soil erosion and sedimentation

When soil disturbance is necessary for redevelopment or new production there are certain objectives that should be met to reduce the amount of soil eroded during the disturbance event. These are:

Divert clean water away from the orchard by:
- diverting clean water around orchard where bare or disturbed soil exists
- managing clean water diversion so as not to increase its erosivity within the disturbed site.

Reduced disturbance by:
- limiting the amount of soil preparation operations and soil cover disturbance. As a result less soil erosion will occur leading to less sedimentation,
- picking the appropriate season when high rainfall is least likely (winter/spring)
- clearing vegetation only to the extent it is needed to be removed
- staying out of disturbed areas.

Direct capture of dirty water in the disturbed area by:
- reducing water velocity
- reducing slope length
- increasing surface roughness and protect soil with groundcovers
- using sediment trapping methods such as groundcovers, hay bales or silt traps using weedmat.

Revegetate by:
- maintaining permanent or temporary groundcover plants.

Monitor management practices by:
- monitoring erosion and sedimentation efforts
- monitoring revegetation of groundcovers
- adjusting management practices to reduce sedimentation and erosion.

BMP 1 MANAGING RUN-ON WATER

What goal am I trying to achieve?

I want to limit the amount of water entering the orchard to reduce the risk of erosion.

ESTABLISHING NEW PRODUCTION AREAS

To do this I need to:

- Divert water around the orchard by building diversion drains
- Make drains large enough to hold runoff water
- Plant creeping groundcovers to hold soil and minimise erosion
- Actively manage groundcovers by mowing or slashing
- Undertake earthworks only at appropriate seasonal times
- Transfer water to existing dams, waterways or watercourses.

MODIFYING EXISTING PRODUCTION AREAS

To do this I need to:

- Relocate irrigation mains
- Relocate some plants for diversion drains

SURFACE DRAINS

Uncontrolled water movement through an orchard may remove valuable topsoil exposing plant roots to desiccation. It may also cause ponding and waterlogging leading to disease problems as well as undermining mounded rows which may eventually collapse.

Surface drains are essential to carry water safely around the orchard or removing water that falls within the orchard. Any earth work needs to be undertaken in winter or spring on the NSW north coast to avoid high rainfall events. A drainage management plan of the property needs to be drawn up to identify watercourses and drainage lines before any earthworks are undertaken.

In most cases a drainage system will consist of a grassed diversion bank at the top of the orchard that runs across slope with a grade of less than 2% and transfers water that would normally run through the orchard around it. This run-on water is transferred safely through a series of broad dish drains and grassed waterways to a lower level downslope and then into a natural watercourse or dam. Dish drains need to have a gradient of 2.5-3% and be able to handle enough water from the catchment above without being overtopped. These drains need to also be trafficable to machinery for routine orchard management and to be broad enough to slash.

BUILDING DRAINS

Whilst building drains, remove topsoil first and set aside, especially if they are shallow soils. Retain the topsoil and replace last for groundcover re-establishment. Using subsoil will result in a poor groundcover establishment. Establish a creeping groundcover such as broad leaf carpetgrass, kikuyu or couch to prevent scouring. Immediately after earthworks are completed a quick- to-establish grass such as millet or ryegrass (depending on the time of year) should be sown that will germinate and help prevent erosion.

Hay bales can be anchored with star pickets in diversion drains immediately after earthworks are completed until groundcovers germinate. If rapid establishment of groundcover is needed then the option of commercial turf is a possibility.

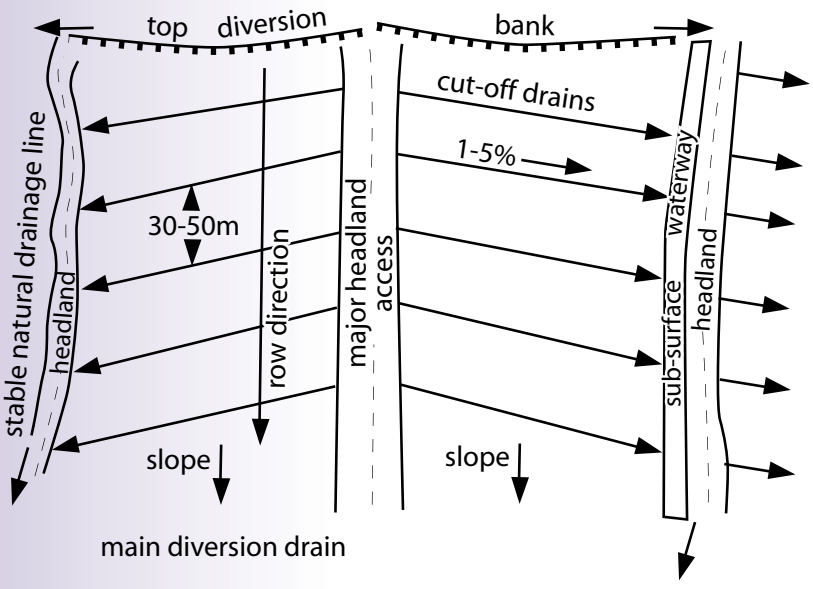

Figure 1: Showing diversion drains around orchard feeding water into grassed waterways

Figure 2: Two weeks after planting

Figure 3: Eight weeks after planting. Groundcover establishment on diversion bank

BMP 2 DISTURBANCE OF NEW OR REDEVELOPED PRODUCTION AREAS

What goal am I trying to achieve?

I would like to minimise the disturbance to new or redeveloped production areas in order to reduce erosion.

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Divert clean water that would normally run through the disturbed area around the site to grassed waterways
- Limit the amount of soil disturbance of existing groundcovers
- Avoid areas that are undisturbed
- Direct captured dirty water into sediment traps and ponds
- Revegetate the disturbed areas with groundcovers quickly
- Monitor erosion and sedimentation structures to either improve effectiveness or adjust to suit management practices.

MODIFYING EXISTING PRODUCTION AREAS

To do this I need to:

- Reshape grassed water ways so they have a broader flatter profile
- Minimise disturbance of existing groundcovers in cross drains
- Rapidly establish groundcover using strips of turf

The *Native Vegetation Act 2003* (NV Act) regulates the clearing of native vegetation on all land in NSW. If developing a new site, approval needs to be acquired to comply with the NV Act before any ground work is commenced.

DRAINAGE PLAN

A drainage management plan of the property needs to be obtained to identify watercourses and drainage lines before any earthworks are undertaken. Do not disturb existing well defined drainage lines especially if these drainage lines carry water from other catchments.

GROUND WORKS

Any ground work needs to be undertaken in winter or spring on the NSW north coast when the probability of high rainfall events is least. When soil disturbance is necessary for developing a production area there are certain objectives that should be met to reduce the amount of soil eroded during the disturbance event.

TOPSOIL

Topsoil should be reserved for later placement between mounds in the interrow or in drainage channels where water will flow. This will ensure groundcovers will establish, grow and persist. These interrow soils and drainage

Figure 4: Rows were disturbed as little as possible during the early set up stage

Figure 5: Bare soil immediately after mounding operations

Figure 6: Sub soil drains were installed to flow into sedimentation pond

channels will need to be actively managed by fertilising once they are established to maintain the groundcovers. Gypsum or lime should be applied on heavy clay soils to break up the structure.

Disturb areas progressively rather than disturbing the entire area. This will reduce the likelihood of erosion occurring during the construction period. As soon as practicable after soil disturbance has occurred, establish some form of vegetative ground cover.

BMP 3 DIRECT CAPTURE OF WATER WITHIN THE ORCHARD

What goal am I trying to achieve?

I would like to safely remove all surface water that falls on my orchard to a dam or watercourse without causing erosion.

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Complete the stabilisation of the bank within 10 days
- Place cross slope banks at the correct spacings determined by the slope. (see table below)
- Re-establish disturbed areas with perennial grasses that will persist
- Keep drains well grassed and managed year round
- Actively manage grassed waterways with fertiliser and mowing to maintain their vigour
- Install subsurface agricultural pipes.

MODIFYING EXISTING PRODUCTION AREAS

To do this I will need to:

- Provide 30cm wide grass strip beside mounds every 5-10 metres to divert water away from base of mounds
- Avoid mowing groundcovers too low as longer grass better assists in erosion control
- Leave grass sward in centre of interrows
- Cut back and remove plants in crossbanks and replant them at the end of rows.

Many blueberry orchards are established on old banana lands. The slopes are moderately steep to very steep ranging from 15 to 30 degrees. The mounds on which the blueberry plants are grown should be approximately 3 metres apart with grassed interrow. Mounds usually run up and down the slope for ease of machinery operation and management. Weeds and grasses at the base of mounds are managed by using herbicide. This herbicide strip should be narrow and drain water away from the mound base.
Slowing water velocity down the slope is achieved by draining water away from the base of each of the blueberry mounds to a grassed interrow and that water is then transferred to a number of cross slope banks. The interrow area between the mounds should be slightly concave.

The water from the cross slope banks is diverted into grassed waterways and then to a dam or watercourse at the bottom of the slope for removal or storage. Earthworks within the orchard are more varied and therefore need to be trafficable for normal orchard management.

DISH DRAINS

Dish drains direct water away from the bottom of the mounds to the centre of the interrow. The lowest point in the centre of the interrow should be 100-150 mm below the point at the edge of the mound. The centre of the row should ideally be relatively flat and about 300mm wide so that water does not concentrate in one spot.

CROSS SLOPE BANKS

Drainage water from the interrow dish drains flows into the cross slope catch banks.
Place cross slope catch banks at regular distances to remove water flowing from up slope out of the orchard. They should be between 2.5 to 3% slope.
This minimises potential erosive flows by slowing water speed before it has the chance to build up. A basic rule of thumb is that 'the steeper the slope the closer together the banks'. The table below gives maximum cross bank spacings in metres for different slopes.
These banks should remain permanently grassed with 90% groundcover and be actively managed throughout the year.

MAXIMUM BANK SPACINGS FOR VARIOUS SLOPES

SLOPE %	SLOPE DEGREES	MAXIMUM BANK SPACINGS (M)
<17	< 10	60
18-27	11-15	40
28-36	16-20	30
37-47	21-25	20
48-58	26-30	15

(taken from CALM Urban erosion and sediment control field book August 1992)

Figure 7: Blueberry mounds showing narrow herbicide strip and dish drain

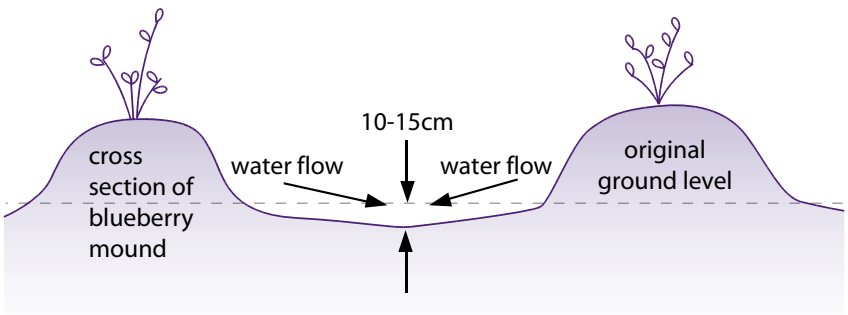

Figure 8: Cross section of typical dish drain between mounded rows running directly downhill

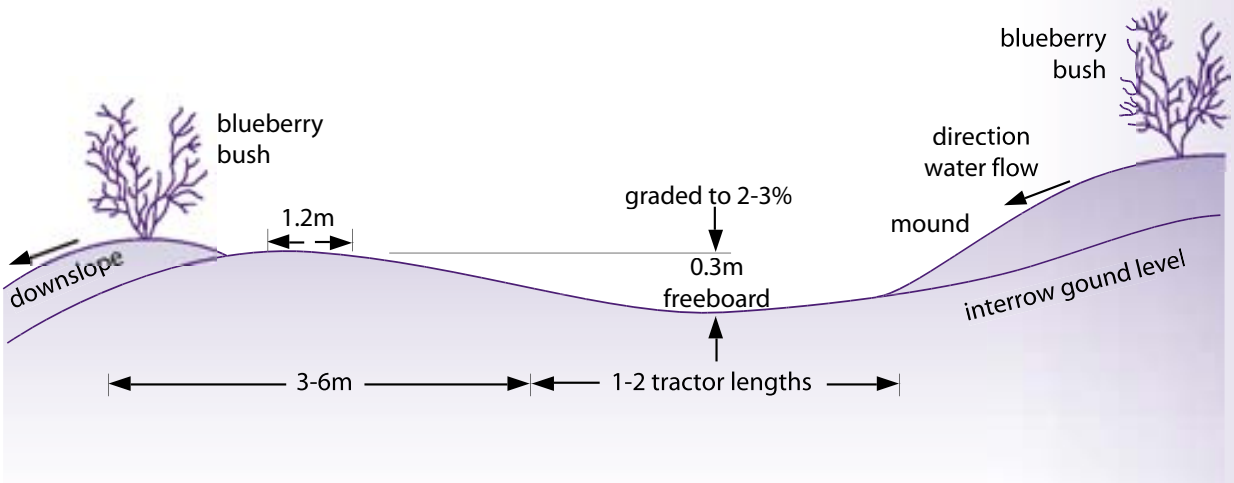

Figure 9: Typical Trafficable Cross bank – (taken from CALM Urban erosion and sediment control field book August 1992)

DESIGN OF CROSSBANKS

Trafficable crossbanks are sometimes called rollover banks (see Fig 2). On slopes of greater than 10 degrees these banks should be broader than on flatter slopes so as to not impede normal orchard operations such as slashing. By making the base of the drain at least one tractor wheelbase long the slasher will not dig into the mound or slash the groundcover too low. Some hydraulic adjustment may also need to be made to the machinery to minimise this impact.

Figure 10

Figure 11

Figures 10 and 11: Agricultural pipes laid underground and covered with gravel

SUBSURFACE DRAINS

In many orchards very wet areas called soaks have permanently flowing springs. These can be the result of poor farming practices, over irrigating and excess subsurface water exiting down slope.
Subsurface drainage is required to make the orchard trafficable to machinery at all times of the year. These subsurface pipes are covered with various grades of gravel (10mm to 40mm) which allow water to percolate through and then must drain to a watercourse or sediment pond. This helps to keep surface layers dry and allows constant machinery use without bogging. Grasses will eventually grow into these gravel areas and help to stabilise their movement during high rainfall events.

Fig 12: Subsurface pipes in the orchard 12 months after completion covered with groundcovers

Figure 13: Subsurface agricultural pipes laid below the surface keep springs below the ground level in an orchard

BMP 4 GROUNDCOVERS

What goal am I trying to achieve?

I want to maintain permanent groundcovers between rows and in all waterways to minimise erosion.

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Actively manage sown grasses by mowing and fertilising regularly
- Minimise the areas sprayed with herbicide to avoid machinery damage when mowing or spraying
- Divert water away from bare ground and into areas that have permanent ground covers
- Establish perennial grasses appropriate to climate and soils.

MODIFYING EXISTING PRODUCTION AREAS

To do this I will need to:

- Rapidly establish groundcover with the use of turf strips, using hay bales to capture sediment.

WHAT IS IT?

Groundcovers are any material on or near the soil surface that protects the soil against erosion through the actions of raindrop impact, surface water flow and wind. It could include plastic weedmat, woodchip gravel or plants. The most efficient groundcovers are living plants that hold soil and are difficult to remove.

WHAT DOES IT DO?

Vegetative groundcover slows water velocity and allows water to soak into the soil and deposits any sediment around plants. Plants provide a food source and habitat for soil organisms whose activities then improve the soil structure and make soil less erodable.

The amount of groundcover you need depends on:

- amount of rainfall
- intensity of rainfall
- soil moisture
- slope
- soil type and its erosion potential.

In drainage lines where water moves with considerable force, 100% of groundcover is required to prevent erosion. On most blueberry orchards with slopes of greater than 10 degrees, growers will need to maintain permanent groundcovers in the interrow and on grassed waterways. Regular maintenance of the groundcover includes slashing mowing and some fertiliser additions.

PERMANENT GROUNDCOVERS

The best way to have permanent groundcovers is to select plants well adapted to your climate, soil and enterprise so they persist without much attention. Groundcovers that spread by runners are easy to establish and provide a good secure hold which resists erosion. Grasses are better groundcovers than most other plants as they have a fibrous root system and are cheap to establish and maintain. Perennial grasses are preferable as they provide not only year round protection from soil erosion but last from season to season. Species such as kikuyu, couch and carpet grass are excellent groundcovers as they establish well, spread easily and provide good ground contact. A diversity of species will be beneficial for soil health.

Further information is available from NSW DPI Primefact *Maintaining groundcover to reduce erosion and sustain production.*

Fig 14: Hay bales in centre of interrow capturing sediment

Fig 15: Groundcovers growing into gravel

What goal am I trying to achieve?

An effective irrigation system for my whole orchard that consistently delivers the correct amount of water.

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Obtain a drainage plan of my total property
- Consult an irrigation consultant to help design an appropriate irrigation system
- Ensure continual maintenance of the irrigation system
- Purchase the most cost effective filtration system available.

MODIFYING EXISTING PRODUCTION AREAS

To do this I will need to:

- Install new sub mains in redeveloped areas
- Ensure distribution from sub mains starts at the highest point in the redeveloped block designed by an irrigation specialist.

CHOOSING A SYSTEM

Most blueberry farms deliver both fertiliser and irrigation water via one or two drip lines laid under plastic weedmat or organic mulches. These drip systems are highly efficient at delivering water and by consulting an irrigation professional early in the design phase it may save the grower time and money in the long term.

Some blueberry growers are using drip irrigation systems that were never designed to be used on steep lands. Many of the irrigation components being used are performing at well beyond their capability. The agronomic and hydraulic design of a drip irrigation system is fairly complex and in order to achieve correct uniform water application, a professional design is necessary.

FILTRATION

Filtration will remove physical, chemical and biological blockages. Never skimp on filtration systems as it will cost more in the long term on correcting blockages and maintenance time. The main filtration system can consist of either multiple plate type or graded sand filters. Ensure enough filters are installed to allow one to backflush while the system still supplies sufficient clean irrigation water to plants.

Pre treatment of irrigation water may help in some situations. These may include pre-screening to remove twigs and leaves usually by a strainer on the foot valve. Minerals such as iron may be removed by aerating irrigation water.

Drip line is often laid under plastic weedmat on top of blueberry mounds. If filtration is inadequate and blockages have occurred then the only way a grower will know if it is not delivering adequate water is once plants begin to die. By then it is too late.

MULTIPLE IRRIGATION LINES

If two irrigation lines are used then drippers need to be staggered so the zone between plants within mounds is kept evenly moist.

Irrigation systems need to be designed correctly so that plants at the bottom of a row are not drowning and being waterlogged while the plants at the top are still dry.

Growers on steep land should try to incorporate irrigation supply lines within cross bank drains as secondary mains. This will divide up whole irrigation blocks into smaller units. Many growers are already using pressure reduction devices that fit within the dripline. In the design phase it is far easier and economical to incorporate a secondary main in cross banks to give more even water distribution than putting pressure compensator valves within each of the driplines.

MONITORING

Moisture monitoring devices such as tensiometers are important to ensure that the correct amount of irrigation water is delivered to the total orchard, irrespective of the type of irrigation system.

Fig 16: Double drip lines installed before mulching

Figure 17: Double dripline used for fertigation with hardwood mulch

BMP 6 MOISTURE MONITORING

What goal am I trying to achieve?

I would like maximise berry production by using the required amount of water and minimise nutrient runoff**.**

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Install a suitable number of moisture monitoring devices within the orchard
- Monitor soil moisture levels as a guide to irrigation
- Record moisture readings
- Regularly maintain and service moisture monitoring devices
- Avoid over-irrigating.

MODIFYING EXISTING PRODUCTION AREAS

To do this I will need to:

- Ensure appropriate moisture monitoring devices are installed in each block and sub block

WHY MONITOR

The NSW north coast has an average rainfall of 1500 to 1800mm per year. It is known as a high rainfall region but all too often the rain falls at the wrong time of the year for most horticultural production.

It is difficult for blueberry growers on NSW north coast to rely solely on natural rainfall as it is very unreliable for good blueberry production. Raised mounds on which blueberry plants are grown are usually either fully or partially covered with plastic weedmat. The weedmat repels most natural rainfall so growers irrigate plants with drippers which run under the weedmat. Blueberry root systems are usually very shallow and confined to the top 250mm of the mound. Irrigation that extends below 250mm is wasted. This leads to waterlogging of the soil and anaerobic conditions within the mound resulting in increased root diseases.

Unfortunately growers have no way of knowing how wet or dry it is within the rootzone without moisture monitoring tools.

HOW TO MONITOR

Relatively cheap devices such as tensiometers are very effective at monitoring moisture levels within the mounds. Two tensiometers, one at 150mm depth and one at 300mm depth, will monitor moisture levels at the bottom of the mound and below the root zone.

A minimum number of 8 pairs of tensiometers or other devices are needed to correctly monitor soil moisture levels in an orchard block or irrigation unit. These are located in pairs at the top, middle and lower parts of the block

Over the 2006/07 season, growers irrigated blueberries from 20 to 60 mins at each event. This will mainly depend on the readings from the moisture monitoring devices. Any longer periods of irrigation tends to saturate plants at the lower end of the mounded row and leaves the upper end dry. A wet soil will be in the 5 to 10KPa range. A reading of 20 to 30 KPa indicates a need to irrigate.

The deeper tensiometer will indicate if too much water is being applied by staying constantly low. If water is going past the root system and down into the lower parts of the mound then shorter more frequent irrigation periods are required.

For larger operations and many soil types on the same orchard, a data logger (e.g. Enviroscan®) which constantly monitors soil moisture at various depths is more useful.

Further information is available from NSW DPI website Primefact *Tensiometer tips* by Jeremy Giddings, August 2000.

Figure 18: Sohan Atwal monitors soil moisture levels to guide him in deciding when and how much water to apply to his blueberries

Figure 19: Installing tensiometers in blueberry mounds

What goal am I trying to achieve?

I would like to maximise berry production whilst minimising nutrient runoff

ESTABLISHING NEW PRODUCTION AREAS

To do this I will need to:

- Have my irrigation system correctly designed
- Have an annual soil leaf and water test
- Check my water quality
- Sample my fertigation water regularly
- Regularly check and maintain my irrigation system
- Regularly flush my irrigation system.

MODIFYING EXISTING PRODUCTION AREAS

To do this I will need to:

- Ensure appropriate moisture monitoring devices are installed in each block and sub block

FERTIGATION

Most blueberry growers apply soluble nutrients to plants by fertigation. This technique supplies all the plant's nutrient requirements through dissolved fertilisers in the irrigation system.

A properly designed, efficient irrigation system that caters for the changes in topography on your orchard is an absolute must if fertigation is to be used effectively. Fertigation is a much more efficient method of supplying plant nutrients than ground application as it allows continuous small applications of soluble nutrients to be placed around the root system for rapid uptake.

It is important to have the irrigation system pressurised before nutrients are injected into the system. This ensures that all plants are receiving an equal share of the dissolved nutrients. It is also vitally important that the irrigation period is catering to the plant's requirements. Once dissolved nutrients are injected through the irrigation lines it is necessary to flush nutrients through before the irrigation cycle is completed. If too much water is applied many of the applied nutrients may be washed below the root zone. This may result in plant nutrient deficiencies or high nutrient loads in our watercourses and waterways. Fertigation increases the quantity of nutrients present in an irrigation system which leads to increased bacteria, algae and slime. These should be removed with regular injections of chlorine through the system but not when fertiliser is being injected.

Further information is available from NSW DPI Primefact 1-009 *Horticultural fertigation-techniques, equipment and management*.

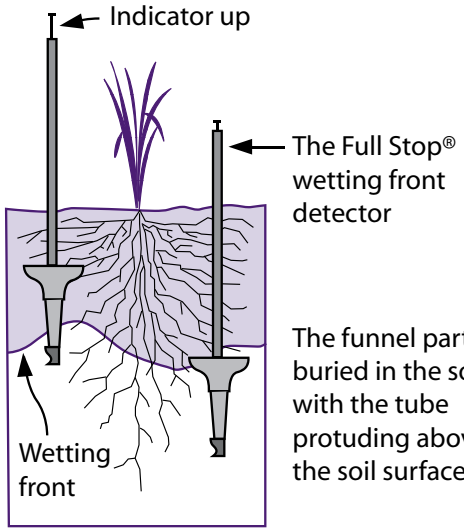

Figure 20: Full Stop® wetting front detector and nutrient monitoring device

MONITORING NUTRIENTS

Growers can better manage nutrient runoff by using BMP 6 in this publication. Monitoring moisture within the soil using tensiometers and during fertigation, will also manage nutrient loads in the soil solution. Growers can check soil fertility with a soil and leaf test.

There are a number of devices and nutrient monitoring tools, such as the Full Stop®, that are buried within a mound making it possible to collect a soil solution sample. This water sample can be withdrawn with the aid of a syringe and then tested for nitrate levels. These devices also monitor whether fertigation water is percolating through the soil and whether it moves below the root zone carrying valuable nutrients with it.

Currently there is inadequate information on the exact nutrient requirements of blueberry plants over the whole season. The information that is available comes from the North American experience. Further work on blueberry nutrition and leaf testing is contemplated by the industry body in the near future.

Information on fertiliser requirements for blueberries is available from NSW DPI Primefact 195 *Blueberry production in northern NSW.*

Figure 21: Greig Ireland and Sohan Atwal install nutrient monitoring device in a blueberry mound

CASE STUDY 1 WOOLGOOLGA GROWER REAPS REWARDS

Neville Dhillon, Freemans Road, Woolgoolga

HOW HE DID IT

Neville currently has 5 Ha of blueberries and 4 Ha of bananas on his Woolgoolga property. He plans to remove 2.5Ha of bananas and replant more blueberries.

Neville decided to change his irrigation practice as a result of attending the first field day at the industry best practice demonstration site at Sohan Atwal's orchard, his own observations and from talking to other blueberry growers.

Neville attended the NSW DPI Waterwise on the Farm course which was part of the Blueberry Industry Best Practice project. He found the course extremely valuable both for irrigation efficiency and design.

After attending the course Neville also decided to adopt the use of tensiometers to determine plant water use and irrigation scheduling.

Originally on his orchard rows were up to 120m long on steep slopes. This allowed water to build up velocity when moving downhill. The result of this layout was severe erosion and soil movement in between mounded rows during periods of heavy rainfall. Non uniformity of the irrigation led to over-watering of the lower end of the beds and large variations in the size of plants and yield from top of slope to the bottom.

To correct the previous mistakes made in orchard layout, all new plantings were broken into shorter row lengths with no row exceeding 50metres.

Neville has also incorporated cross roads in the newer plantings to capture water running downhill between blueberry mounds. This slows its velocity and potential to cause erosion. The roads are planted to permanent groundcovers and are angled back into the hillside to stop water overtopping the roadway. These cross slope roads collect water and transfer it from the orchard into well grassed waterways at the lower parts of the orchard again reducing its potential to cause damage.

Changes made to orchard layout have led to more efficient harvesting of fruit with less time and effort needed in walking along long rows to get the fruit out of the orchard.

Fruit production is more uniform from the top to the bottom of rows. There has been a 25% increase in yield due to better monitoring of irrigation.

Improved irrigation monitoring has also led to less water use and reduction in nutrient runoff.

Cross drainage and well grassed waterways means that erosion is not a major issue in the orchard now.

Neville believes that all growers should consider adopting the information in this booklet to make changes as they will benefit from better management of natural resources on their properties.

Figure 22

Figure 23

Fig 22 & 23: Neville shows cross slope bank which breaks longer downhill rows into shorter runs and incorporates irrigation sub mains

Iqbal and Suraj Gill. Middle Boambee Road. Boambee

HOW THEY DID IT

Iqbal and Suraj currently grow 5 Ha of blueberries and 8 Ha of bananas. Changes to their orchard layout and irrigation design were prompted by erosion problems that were occurring on their property. Iqbal and Suraj also realised that the plants growing at the bottom of long rows were getting far more water than plants further up slope. There was a gradation in height of small plants at the top to larger plants further down the slope.

Both growers attended the NSW DPI Waterwise on the Farm Course which formed part of the Best Management Practices guidelines for blueberry growers project. They found the information very useful in improving their irrigation design and management. Other information for changes to their irrigation system was obtained from a local irrigation supplier and from their own observations.

In order to ensure water was evenly distributed to all plants, Iqbal and Suraj split the longer rows and irrigation lines into two shorter rows with sub-mains feeding each block. This gave them more control over how much water to apply to plants in each part of the block.

Within each irrigation block, air release valves, pressure gauges and self flushing valves at the end of every row were installed. These measures combined with the shorter row lengths have led to further improvement in fruit yields and quality.

Cross roads were created by splitting long rows to shorter lengths. The cross roads, as well as providing a place for sub mains to be located, act as drains to remove water flowing from the inter-row areas.

The growers also decided to reduce the herbicide spray width along the sides of each mound to minimise the soil area exposed to erosion.

Fig 24: Checking tensiometers for soil moisture levels

Fig 25: Trafficable cross roads breaking longer rows into shorter lengths

Installing tensiometers to monitor soil moisture within the mounds, has allowed the growers to further refine their fertigation and minimise nutrient runoff.

The changes have resulted in a number of benefits. Harvesting has been improved, better water management and happier workers due to reduced time moving within the orchard using cross roads.

Crop production has increased with up to 35% higher yields and better fruit quality in the modified block.

Soil erosion is no longer a major issue.

Iqbal and Suraj will design all future plantings using the best practice guidelines.

ACKNOWLEDGEMENTS

This publication was developed with funding from the Northern Rivers Catchment Management Authority (NRCMA) as part of the project Best management practices in the blueberry industry and the Soil erosion solutions project. Best management practice is the currently recognised farming techniques capable of delivering environmentally and economically sustainable blueberry production.

It was delivered by staff of NSW Department of Primary Industries (NSW DPI) stationed at Wollongbar, Grafton, Alstonville and Coffs Harbour. It was written for use by blueberry growers and land managers in northern NSW.

The authors and editors wish to thank Sohan Atwal for his cooperation and help in setting up the current best practices on his orchard at Korora and making the site available as a demonstration site for other interested growers. We would also like to acknowledge the assistance of many farmers and professional colleagues who commented on many aspects of this document. The authors would also like to acknowledge the help and cooperation of the Irrigation Officer, Garry Creighton; Soil Erosion Solutions Project Officer, Stephanie Alt; Soils Extension Officer; Abigail Jenkins and Research Officer; Justine Cox for their involvement in the project.

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The information contained in this publication is based on knowledge and understanding at the time of writing ([September 2007]). 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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About this guide

These guidelines have been developed by NSW DPI in consultation with blueberry growers and the Northern Rivers Catchment Management Authority. Other related publications include Blueberry production in northern NSW and Establishment and production costs for blueberries in NSW both published by NSW DPI are available from the NSW DPI website www.dpi.nsw.govau. 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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REFERENCES

CALM *Urban erosion and sediment control handbook* 1992
www.epa.gov.au

Creighton.G**,** *Horticultural fertigation-techniques, equipment and management.*
NSW DPI internet at http://www.dpi.nsw.gov.au
Giddings.J, *Tensiometer tips*
NSW DPI internet at http://www.dpi.nsw.gov.au

Ireland.G, Wilk. P, *Blueberry production in northern NSW 2005*
NSW DPI internet at http://www.dpi.nsw.gov.au

Irrigation and drainage management plan guidelines
NSW DPI internet at http://www.dpi.nsw.gov.au

Jenkins. A, *Maintaining groundcover to reduce erosion and sustain production.*
NSW DPI internet at http://www.dpi.nsw.gov.au

Jenkins. A, *Soil erosion solutions*
Northern Rivers Catchment Management Authority http://www.northern.cma.nsw.gov.au

Lines-Kelly. R, *Soil Sense - Soil management for north coast farmers.* 1995 NSW DPI Wollongbar Agricultural Institute, Bruxner Hwy Wollongbar 2477

Spatial Information Xchange (SIX) NSW Department of Lands website for aerial photos of properties. http://www.lands.nsw.gov.au

Soil and Water Management Practices for

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