



Doing it right

Franklin Sustainability Project

Guide to Sustainable Land Management

Doing it right



Franklin Sustainability Project Guide to Sustainable Land Management

This Best Management Practice folder brings together three years of tests, trials, demonstrations and work carried out by the Franklin Sustainability Project (FSP).

Not Rocket Science

In this folder is a wealth of knowledge gleaned from trials and discussions with growers. Much of it is not new information and most of it is not rocket science. What it is, is practical and important information that if used appropriately, can help maintain and increase the long term productivity of soils in the Franklin area.

The Project

The Franklin Sustainability Project began in 1996 with discussions between the Pukekohe Vegetable Growers Association (PVGA), regional councils and Agriculture New Zealand. A major storm in May 1996, resulting in silt and stormwater flooding parts of Pukekohe township, focused public attention on the practices of outdoor vegetable growers. The PVGA needed to find a way of reducing the effects of erosion and increasing the long term sustainability of vegetable growing in the Franklin area.

Who is involved

The result was a three year project called the Franklin Sustainability Project, owned by the PVGA and managed on their behalf by Agriculture New Zealand Ltd. The project received "in kind" contributions from vegetable growers, and financial support from stakeholders including Ministry for the Environment, Franklin District Council, Auckland Regional Council, Environment Waikato, MAF Policy and AGMARDT.

Goals

The goals of the project were to look at ways of improving the overall sustainability of vegetable growing in the particular soils, climate and location of Franklin district. Emphasis was placed on erosion management, however the whole system was taken into consideration and issues as diverse as irrigation, pest control and nitrate leaching were addressed.

Growers Involvement

Of importance was the practicality of the information produced. Growers were involved with the choice and design of projects and every trial or demonstration site was on a grower's property. Field days, evening meetings, newsletters and articles in grower journals were just some of the ways information was relayed back to the grower.

Knowledge/ Information

The content contained in this folder should not be viewed as a 'recipe' to be followed to the letter. Every property, paddock and, for that matter, every grower is different. For this reason the information in this folder has been designed to provide you with the knowledge to assess your property and implement practices as necessary. The references at the end of each factsheet provide other sources of more detailed information.

I thank everyone who has been involved with this very successful project and wish all growers in the Franklin area many, many years of happy (and profitable) vegetable growing.

Anna Ravlich
Project Co-ordinator

Acknowledgements

Thanks to Bryan Hart for his effort and tireless work at the development stage of this project.

Throughout the project, growers gave their time, machinery, use of land and sometimes produce for the many trials and demonstrations held. The list of growers involved with the project is too long to mention here, but in particular the project thanks the following growers for providing their time, ideas and support:

Ganpat Hari of R.C. Hari & Sons Ltd and *Allan Fong* of Perfect Produce for use of the number 1 & 2 demonstration sites.

Thanks to members of the Pukekohe Vegetable Growers Association Environmental Committee who have assisted in different ways.

Many science providers were involved with the project. Special thanks to the soil team at Crop and Food Research, in particular *Prue Williams* and *Craig Tregurtha*. Thanks also to *Nadine Berry* of Crop and Food Research for her work with the brassica IPM project and *Les Basher* and *Craig Ross* from Landcare Research for their input on soil erosion issues.

Special thanks to *Tony Thompson* (ARC), *Rien van de Weteringh* (Environment Waikato), *Rosalind Wilton* (FDC) and *Phil Journeaux* (MAF Policy) for their support and contribution throughout the project's life.

Many thanks to *Andrew Barber* (AgNZ), *Joanne Hair* and *Linda Thompson* (Environment Waikato) for the time and effort they have put into this publication.



Pukekohe Vegetable
Growers' Association



Vegfed



Auckland **Regional** Council

Paddock Plan

Planning is vital to ensuring your erosion control measures will have maximum benefit.

The four major steps are:

1. Identifying the problem
2. Proper planning
3. Good construction
4. Maintenance

Planning should be done on a paddock by paddock basis, building up to a whole farm plan. This will make it easier to identify soil erosion problem areas. Erosion control measures will then be better integrated with your whole farm system.



"When we first go into a new block, planning the layout revolves around the lay of the land . . . where drains logically must go . . . Look at entry and exit points . . . what is happening around the block . . . history . . . row direction etc . . ."

KEVIN BALLE
Balle Brothers Ltd

Start the planing process by walking around each paddock - particularly when it is raining - and mark on a paddock map drawn to scale:

- Where water is coming from - roads, drains, buildings etc.
- Where the water is going or should go.
- Any existing erosion control measures.

Also on the map:

- Note the length of the sides of the paddock.
- Mark the direction and indicate the steepness of the slope in different parts of the paddock.

This map and information will be used to plan the most efficient and effective set of erosion management tools.

REMEMBER : If you fail to plan, you plan to fail



Hari Das

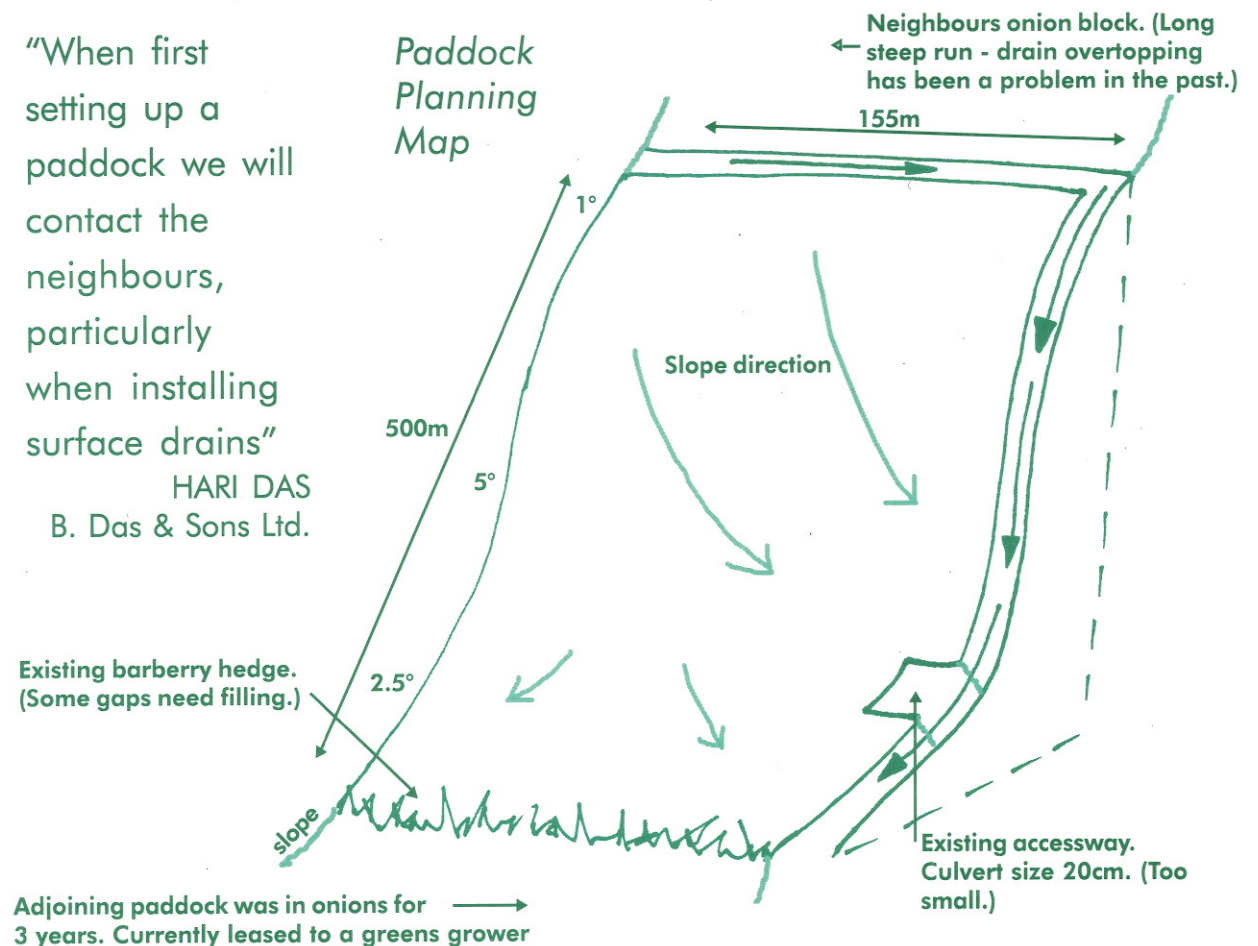
"When first setting up a paddock we will contact the neighbours, particularly when installing surface drains"

HARI DAS
B. Das & Sons Ltd.

For example, if there is a problem with rill erosion through the middle of a paddock, a map will identify where that water is coming from and how to best plan to manage it. If the erosion is caused by long, steep runs then contour drains and/or wheel track ripping may be necessary. If the erosion is caused by water entering a paddock from above, then it is necessary to have a cut-off drain that will capture the water before it can enter the paddock.

A well planned paddock will not only work better, but will:

- **reduce erosion problems**
- **be less expensive**
- **be well co-ordinated.**



A paddock map should incorporate all physical dimensions as well as observations and comments from experience

For more information call

Environment Waikato
Franklin District Council

0800 800 401
09 237 1300

ARC Enviroline
Agriculture New Zealand

0800 80 60 40
09 237 1267

Co-ordination of Erosion Control Practices

Franklin
Sustainability
Project

Factsheet

22 Co-ordination of Erosion Control Practices

Soil lost from a paddock equals lost productivity. To protect the longterm future of commercial vegetable growing businesses and the environment, it is important to keep soil where it is. Drains overtopping is the biggest cause of erosion in the Franklin District. Co-ordination of erosion control practices is an important step in minimising this erosion.

For soil erosion control practices to work effectively, they must all work together and not be in opposition to each other. There is no point having a well designed and constructed drain if it does not connect with another drain further down stream.

Co-ordination of practices involves looking at the whole system.

Communication with your neighbours and council is essential. Meet on site with them when it is raining to talk and agree on what needs to be done.

For each paddock check:

- **Where is water coming from?**
- **Where is water going to?**
- **How can the paddock be set up to minimise erosion and soil loss?**

It is important to have control of water from one end of the paddock to the other. This may mean using a range of tools and linking them together. Such techniques include:

- 1 **Interception** or cut-off drains at the top of the paddock, catching water and diverting it away before it can enter the paddock.
- 2 **Permanent drains** in the field on long slopes to intercept and divert water to the main drains at the sides of paddocks.
- 3 **Benched headlands** to direct water in certain directions. See factsheet on Headlands.



Effect of not co-ordinating erosion control practices



*Bruce Budge and Lani Kafee,
AS Wilcox & Sons Ltd.*

"It is becoming increasingly difficult to find suitable areas close in to Franklin. Protecting what we have is much more important."

KEVIN BALLE
Balle Brothers Ltd

4 **Silt traps** to separate the silt from the water.
See factsheet on Silt Traps.

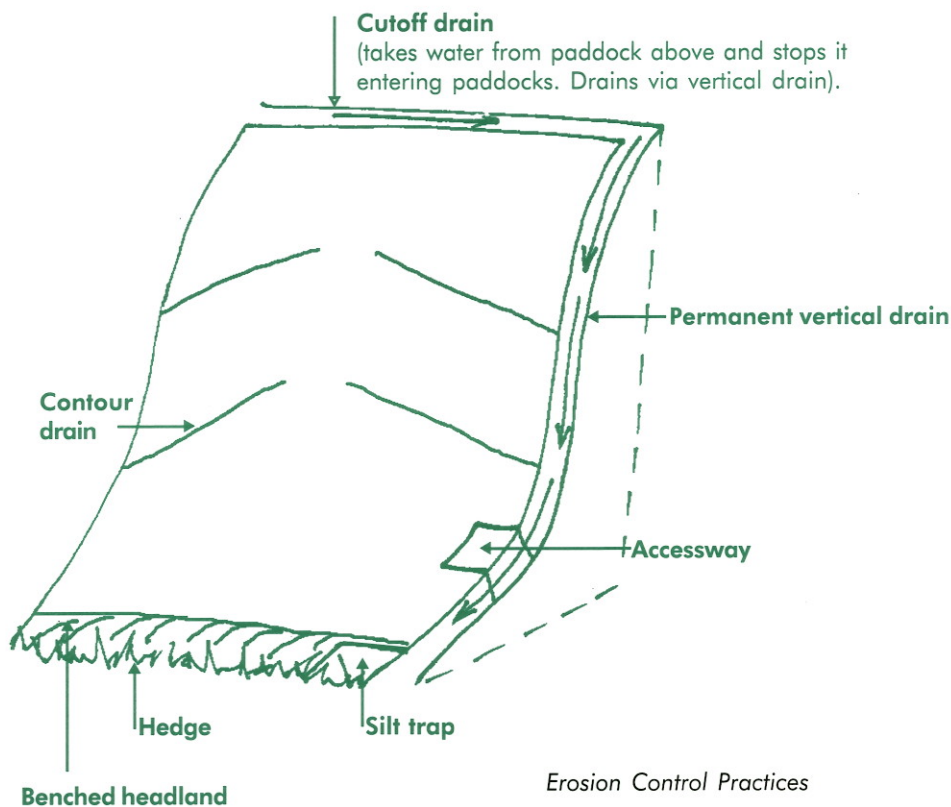
5 **Raised accessways** to ensure water and silt cannot flow onto the road and/or roadside.
See factsheet on Accessways.

6 **Contour drains** draining sections of the field and feeding into larger, more permanent drains. See factsheet on Contour Drains.

Other Reading:

FSP Newsletters:

No. 14, April 2000, No. 3, June 1997, No.4, August 1997, No. 11 February 1999, No.12, May 1999, No. 13, May 1999.



Also:

- Ensure all drains are linked.
- Check that drains and culverts are large enough to cope with the volume of water.
- Carry out regular drain maintenance.
- Discuss with your neighbours any overlap of drainage systems.

Trying to get on with our
neighbours is important . . . "

BRUCE BUDGE
AS Wilcox & Sons Ltd.

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Raised Accessways

Raised accessways must form part of your co-ordinated sediment control practices. All runoff can then be managed and treated before leaving your property, stopping the loss of valuable soil from paddocks onto roads and into waterways.

Stormwater or runoff water from a field should NOT be allowed to flow out of accessways (carrying soil with it) directly onto roads.

Accessways should be raised to ensure that all runoff is treated and controlled before leaving your property.

Ensure your accessway is NOT a weak link in the whole farm drainage and erosion control system.

Remember - accessways are there to provide for vehicle crossings, not for soil in storm water.

The following practices, well planned and used together, will avoid or minimise soil losses from accessways.

1 Away from lowest point

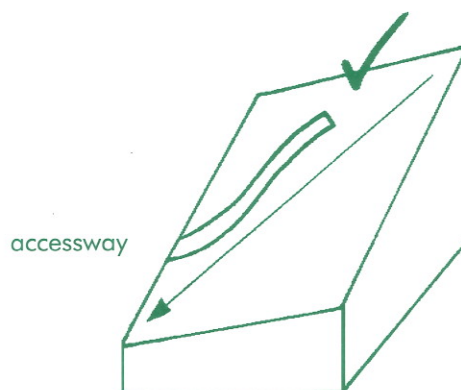
Never place accessways at the lowest point of the field where water is naturally diverted or concentrates. This may mean "off-setting" it by as little as two metres from the bottom corner (see diagram).

2 Raised accessways

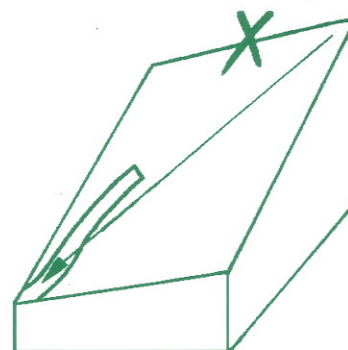
Raise the actual accessway above the surrounding area to divert water into your drainage system. This may be as simple as using a load of metal to form a hump over the accessway (see photo).



Accessway raised using a load of metal



Access way 2 or 3 metres away from the bottom corner



Don't put accessways at the lowest point

"Water is prevented from flowing straight out onto the road."

GANPAT HARI
RC HARI LTD.



Accessway hump



Accessway hump (side view)

"Raised accessways work very well . . . "

GANPAT HARI
RC HARI LTD.

3 Check point

Use the access way as a check point where you can spend a few minutes removing soil that has become stuck to the tractor. Soil is a valuable resource. Don't leave it on the road as you drive away. Keep it for your crops.

4 Culvert

All accessways that go directly onto a road should be piped. The size of the pipes/culverts is important - the BIGGER the BETTER. As a guide, the Pukekohe Hill Drainage Scheme access culvert diameters start at 600mm near the top of the hill and reach 1200mm at the bottom.

For ideas on how to raise your accessway, visit the **No 1 Demonstration Site** on Middleton Rd. Even though the access way is in the bottom corner of the paddock it has been moved two metres up the road and raised to form a hump over the culvert with a load of metal.

"It takes just one load of metal and then simply shape it like a speed hump."

GANPAT HARI
RC HARI LTD.

Other Reading:

FSP Newsletters
No. 12 April 2000,
No. 13 May 1999.

For more information call

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Wheel Track Ripping

Wheel tracks can be a major source of erosion.

In a survey commissioned by FSP to look at the extent of erosion damage during the January 1999 storm event it was found that 'the main form of damage was by rill erosion, typically formed along wheel tracks or shallow cultivation marks'.

'Wheel tracks' channel-like shape and hard compacted nature mean that whenever rainfall exceeds the infiltration rate, water will scour out the sides and base.

When this runoff reaches the bottom of the paddock it must be dealt with by other soil erosion tools (benched headlands, silt traps etc). The easiest and most effective way to deal with this problem is not to produce the runoff in the first place. A very simple way of doing this is to rip the wheel tracks.

Why rip wheel tracks?

In 1998 an FSP trial looking at the effect of wheel tracks on erosion rates found that wheel tracks are the key zones for initiation of surface runoff and erosion. This is because wheel tracks are highly compacted with low infiltration rates, but are also sites of water convergence. As rainfall rates are often higher than the infiltration rate on uncultivated wheel tracks, runoff is generated.



Wheel tracks being ripped

Reduction of water movement along wheel tracks is the key to reducing erosion rates. In the 1998 trial, cultivation of wheel tracks increased the infiltration rate from an average of 5mm an hour to 350mm an hour, and so stopped the movement of water down the wheel tracks.

Another trial looking at wheel track ripping was held over the 1999/2000 season, in an onion paddock. The results from this work concluded that wheel track ripping does increase infiltration rates and significantly reduces soil erosion.

" Wheel track ripping is the single most important factor for reducing soil erosion . . . "

LES BASHER
Landcare Research

Table 1 Erosion rate (t/ha)

Treatment	21 June - 24 August	25 August - 6 Dec	TOTAL - June to Dec
Uncultivated	16.7	4.6	21.3
Cultivated	0.98	0.13	1.1

Table 1 shows very large differences in the amount of soil transported by ripped and non ripped wheel tracks and deposited (in this case) in the silt fence.

Table 2 Infiltration rate (mm/hr)

Treatment	June	October	January
Uncultivated wheel track	0.5	12.7	77.2
Cultivated wheel track	60,312	12,456	8,582
Onion beds	411	485	907

"We have been successfully wheel track ripping for over 12 years."
HARI DAS
B. Das & Sons Ltd.

These results show that:

- Uncultivated wheel tracks will produce runoff in rainfall event that exceeds 0.5 mm/hr.
- Uncultivated wheel tracks have a very low infiltration rate at the time of planting - too low compared to typical rainfall intensities. During the season the infiltration rate increases slightly. This is thought to be due to wetting and drying cycles creating surface cracks.
- Cultivated wheel

One leg of a wheel track ripping implement

tracks show the reverse trend with a decrease in infiltration over time. This is believed to be due to consolidation of the ripped area. It is worth noting that even the lowest recorded infiltration rate (8,582 mm/hr) for the ripped wheel tracks is well in excess of any rainfall event.

- The onion beds also had a very high infiltration rate that is unlikely to be exceeded by rainfall.

Because the infiltration rates are so high in both the cultivated wheel tracks and onion beds, runoff would only be generated if the capacity for the soil to store water is exceeded. This would require several January 1999 rainfall events to occur together.

How to rip wheel tracks

Wheel track ripping is carried out as soon as possible after planting. A shallow tyned implement pulled behind a tractor is used for this purpose. It has double leg subsoiler shanks with small wing bases, mounted behind the wheels on a straight toolbar. Weights attached to the middle of the toolbar help with penetration of the implement.

Other Reading:

The role of wheel track compaction in runoff and sediment generation under vegetable production at Pukekohe. L.R. Basher, C.W. Ross, J. Dando, J. Ekanayake. Landcare Research 2000

Erosion at Pukekohe during the storm of January 21, 1999. L.R. Basher & T. Thompson

The effect of wheel track compaction on water movement and rates of erosion at Pukekohe. L.R. Basher, C.W. Ross, J. Dando Landcare Research 1999

FSP Newsletter No. 12, April 1999 & No.16, June 2000.

Summary

Cultivation of wheel tracks significantly increases infiltration of rainfall and consequently reduces erosion rates.

"We haven't found that it knocks or covers a young crop as the blade is narrow with a small foot . . . it just creates a narrow cut which acts as a little drain"

HARI DAS
B. Das & Sons Ltd.

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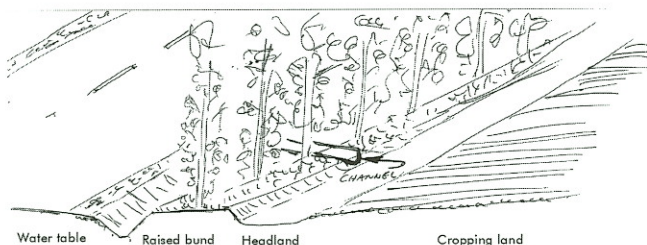


Diagram showing raised earth bund

B. Installation in permanent drains

Scoops

Small silt traps can be installed along the length of open drains. When drains are being cleaned out, just take a deeper scoop every 15-20m, along the drain. Alternatively don't level the base of the drain but leave a few raised sections so that soil can build up behind them.

These extra scoops need cleaning out when full of sediment as they do catch a large amount of soil. Regular cleaning (digging out) of silt traps is necessary for continued performance. Remove built up soil and re-dig or replace traps.

Raised Barriers

Build shallow walls made of sandbags filled with a mixture of sand, gravel and concrete. These structures are very effective in steep drains. They act as a silt trap and as silt builds up behind them, they flatten out the gradient of the drain slowing down silt and reducing the damage caused by scouring. Sandbags can be made from used fertiliser bags or other similar materials. (Exposure to ultra violet light will degrade the bags within 12 months but the concrete will set and hold the sandbags together.)

Other Reading:

FSP Newsletters
No. 4 August 1997,
No. 12 April 2000.

"We find we need one silt trap per 15 to 20 acres or thereabouts . . . Maintenance is important - we will clean traps out at least once a year"

PETER REYNOLDS
TA Reynolds Ltd



Drain profile showing staggered scoops dug out.

Lost soil is lost profit



Drain profile showing sandbags barriers

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Silt Traps



Silt trap installed at the bottom of a paddock

Silt traps aim to minimise sediment or soil leaving the property in runoff water. They work best in combination with other practices that reduce the amount of runoff and avoid the need for large silt traps. Silt traps alone are not the only means of controlling soil loss, but are part of an overall system.

Silt traps are particularly effective on most local clay loam soils because as soon as stormwater is slowed down, the suspended particles rapidly drop out of solution. Silt traps should be constructed in paddock drains as well as before the outlet point to roads or neighbouring properties.

“Silt traps make up part of the jigsaw puzzle together with wheel track ripping, interception drains, vegetation barriers etc.”

PETER REYNOLDS
TA Reynolds Ltd

Building Silt Traps

A. Installation at the bottom of a paddock

Before water flows into a roadside drain or a neighbours drain it should pass through a final silt trap.

Final silt traps can be constructed in several different ways. Here are two methods:

1. Dig out a rectangular hole with the spillway raised above the base and at the diagonally opposite side to the entry point. Care needs to be taken that trapped water caught below the spillway can either slowly drain away through a small pipe at the base, or the water is shallow enough not to cause a hazard. If a drain pipe is used it will need protection from silting up.
2. If the paddock slopes towards a corner then a bund with a spillway can be constructed in the bottom corner of the paddock. Again, care needs to be taken that any trapped water is either not deep enough to cause a hazard or a small pipe is laid at the base of the bund that lets water slowly drain out.

TRAP YOUR SOIL BEFORE IT LEAVES YOUR Paddock!

● Cover Crops

What are Cover Crops?

Green manure or cover crop describes any crop which is grown to be ploughed into the soil rather than harvested. This incorporation of a crop back into the soil is to improve soil quality, and long term production.

Benefits

The use of cover crops is beneficial in all long - term cropping situations for three main reasons:

1. **To stabilise soil from erosion.**
2. **To produce dry matter which improves organic matter and soil structure.**
3. **To use residual nitrogen from the previous crop.**

Other benefits of using cover crops include:

- Smothering weeds (helps reduce weed control costs).
- Improved soil fertility (improves productivity).
- Stimulating soil biological activity (e.g. earth worms) and assisting in breakdown of previous crop residues to reduce disease carry over and soil-borne diseases.
- Providing a habitat for bees and/or other beneficial insects.
- Fixation of nitrogen by some species.

The use of cover crops suitable for the Franklin District was investigated by FSP on several grower demonstration sites to address issues of soil erosion, soil stability and nitrate leaching.

Cover crops put large amounts of dry matter (organic matter and organic carbon) back into



Dinesh Bhana

the soil. This organic matter, when decomposed, has the ability to bind and re-release nutrients for subsequent crops. It also improves the soil structure by keeping the soil particles more stable (aggregate stability), which allows for better water penetration and drainage. The rest of this factsheet summarises the findings from the FSP trials.

Results of Cover Crop Trials

Cover crops, including oats, oats/ryegrass, mustard, phacelia, BQ mulch and sorghum, were tested for yield of dry matter and nitrogen uptake.

In the **first trial** the cover crops were planted after early potato and onions in the 1997/98 season. The yield results for these trials were considered only average due to the very dry conditions throughout January and February.

Crop type	Yield - Dry Matter (t/ha) average of 4 plots
Oats	6.02
Mustard (late November planting - with rain)	5.89
Mustard (January planting - without rain)	2.52
Phacelia	3.18

The second trial was planted near the end of February 1998 and ploughed in early April 1998. Approximately six to seven weeks' growth produced the following dry matter.

Crop type	Yield - dry matter (t/ha)	Nitrogen uptake (kgN/ha)
Oats & ryegrass	7.4	145
Sorghum	3	62
BQ brassica # 1	3.6	87
BQ brassica # 2	4	135
Phacelia	3.3	109

Note: only the above ground herbage was measured in these trials. These crops also produce large quantities of roots (especially the oats and ryegrass mix), which are important for adding organic matter and improving stability of soil aggregates.

Nitrogen Uptake

Mineralisation (release of nutrients) of soil organic nitrogen and nitrogen residues from previous crop fertiliser applications can accumulate in the soil and be lost by leaching when drainage occurs (due to rainfall or irrigation). These losses can elevate soil ground water nitrogen levels and are also a loss to following vegetable crops. A good way to capture this mineral nitrogen so that it is not leached is to grow a cover crop instead of leaving the soil fallow. The nitrogen is then released later when the organic matter from the cover crop breaks down and the nitrogen can be used by the following vegetable crops. This maximises the dollar benefit from applying nitrogenous fertiliser.

Cover crop types

Greenfeed or Massif Oats

Oats can be planted as both a winter and summer cover crop. It can also be mixed with an annual or short rotation ryegrass (e.g. Concord) in winter.



Oats

Summer plantings

Plant at 140 kg/ha before mid March. Maturity should be reached in 90 to 120 days. If planting an oats and ryegrass mix, sow 20kg Concord ryegrass and 60kg Massif Oat. The pure oat sward will produce a greater bulk than the combination, but the oat/ryegrass mix will last longer into spring.

Winter and spring plantings

Plant at 110kg/ha. Maturity should be reached in 70 to 90 days. If planting an oats/ryegrass mix, sow 20kg Mavrick Gold ryegrass and 60kg/ha Massif Oats.

Advantages of Oats	Disadvantages of Oats
Very high dry matter production	Root system not as vigorous as ryegrass
Doesn't need a fine seed bed - easy to sow	Regrowth can occur if not ploughed in at the right time
Very good weed control (due to bulk of vegetation)	May be hard to work into the ground due to the bulk of vegetation produced
Large amounts of potassium will be recycled	Can leave soil very wet if cultivated into soil in wet conditions, or in winter.