SmartCane Fallow and Land Management
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# CONTENTS

1. ACKNOWLEDGEMENTS ........................................................................................................................................... 1
2. GLOSSARY OF TECHNICAL TERMS .......................................................................................................................... 1
3. INTRODUCTION .................................................................................................................................................... 3
4. PHILOSOPHY OF BEST MANAGEMENT PRACTICE - FALLOWING ................................................................. 3
5. CURRENT SYSTEMS ............................................................................................................................................. 4
6. IMPROVED SUGARCANE CROPPING SYSTEMS - FALLOWING ........................................................................ 5
7. PLANNING THE NEXT CROP ............................................................................................................................... 6
8. DESTRUCTION OF THE PREVIOUS CROP ............................................................................................................ 9
9. LAND RECTIFICATION ......................................................................................................................................... 12
10. FALLOW MANAGEMENT .................................................................................................................................... 14
11. CONCLUSION ...................................................................................................................................................... 20
12. SELF EVALUATION ........................................................................................................................................... 21
13. FURTHER READING ......................................................................................................................................... 22

**APPENDIX 1:** SOIL SAMPLING GUIDELINES .......................................................................................... 23

**APPENDIX 2:** TESTING FOR PACHYMETRA ROOT ROT ........................................................................... 24

**APPENDIX 3:** CALCULATING THE NITROGEN DELIVERED BY A LEGUME CROP ..................................... 25
1. ACKNOWLEDGEMENTS

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2. GLOSSARY OF TECHNICAL TERMS

**Acid soils**: Soil with a pH below 7. Sugarcane is very tolerant of acid soils. See “pH”.

**Adelina**: A beneficial soil-dwelling protozoan which parasitises canegrubs.

**Amelioration**: The chemical and physical improvement of soil through the application of substances (ameliorants) such as lime, gypsum and mill byproducts.

**Ash**: A sugar mill byproduct from the burning of bagasse. Mill ash can be used as a source of potassium and silicon, and for ameliorating sodic soils.

**Bare fallow**: Where there is no crop grown between sugarcane crop cycles.

**Best Management Practice (BMP)**: Methods that have been determined to be the most effective practical means of managing an activity to ensure environmental harm is minimised using cost-effective measures that make the most profitable use of inputs.

**Biota**: All of the organisms, including animals, plants, fungi, and microorganisms, found in a particular location at a particular time.

**Break crop**: The growing of an alternative crop between crop cycles of sugarcane to break the sugarcane monoculture. A legume crop is the most common alternative crop. See “legume”.

**Controlled traffic**: Practice of permanently separating crop growth zones from traffic zones and matching row spacing with machinery wheel spacing.

**Coulter**: A sharp, flat, vertical steel disc that cuts into soil or cane trash.

**Direct drill**: A technique that enables no-tillage planting of legumes to be undertaken. The legume seed is dropped into a slot created by a coulter slicing through the trash residue and soil.

**Green cane trash blanket (GCTB)**: The layer of sugarcane residues covering the ground after harvest of the crop which had not previously been burnt.

**Improved farming system**: A sugarcane cropping system based on the concepts of reduced or minimum tillage, controlled traffic and legume break crops. It is often referred to as the “new farming system”.

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Legume: Plants such as cowpeas, beans and peanuts which can supply nitrogen to the soil by the process called nitrogen fixation.

Legume break cropping: The growing of a legume crop between crop cycles of sugarcane to break the sugarcane monoculture.

Meta rhizium: An endemic Australian fungal genus which parasitises the greyback canegrub.

Mineralisation: The process whereby nutrients bound in organic forms are converted to forms available for uptake by plants.

Minimum tillage: The minimum amount of cultivation or soil disturbance necessary for crop production. Related terms are conservation tillage and reduced tillage.

Nitrogen fixation: The process whereby atmospheric nitrogen is converted to amino nitrogen. This process must occur before the atmospheric nitrogen can be used by plants. The most widely known example is the association between Rhizobium bacteria and legume roots.

Organic matter: Consists of plant residues, soil organisms and animal remains. It contains many of the essential plant nutrients which are slowly available for plant growth. It acts as a reservoir of plant nutrients, helps conserve moisture, improves the physical structure of the soil and provides a favourable environment for soil micro-organisms. Organic matter (%) may be estimated as 1.72 x organic carbon (%).

Pachymetra: A soil fungus associated with root rot of sugarcane.

pH: A measure of acidity or alkalinity (of the soil, water, etc) on a scale of 0 (extreme acidity) to 14 (extreme alkalinity). Pure water has a pH of 7. The scale is logarithmic: a change of one unit on the scale represents a 10-fold change in acidity. Sugarcane is tolerant of soils that would be too acidic for most crops. The normal pH range for canegrowing is 5.2 to 6.0, apart from the Burdekin Delta region where pH levels are commonly around neutral (7.0).

Ploughout - replant: Also called replant. The plant crop which is established very soon after the harvest of the previous crop without the benefit of an extended fallow period or legume break crop.

Productivity: The amount of sugar produced per hectare.

Replant: See “Ploughout – replant”.

Strategic tillage: Tillage that minimises the area of land that is cultivated and the number of cultivations. Usually the zone of cultivation is restricted to the row area. Also referred to as zonal tillage.

Sugarcane crop cycle: Successive crops of sugarcane that include a plant crop and a number of ratoon crops (usually three to four). After the final ratoon, the regrowth will be destroyed either by chemical or physical means.

Sustainable sugarcane production: Profitable cane production achieved in combination with the maintenance of the soil, water and biodiversity resources onfarm and with minimal offsite effects.

Yield decline: The loss of productive capacity of sugarcane growing soils that may be caused by a combination of the long-term monoculture and farming techniques that adversely affect soil structure and biota.

Zero tillage/cultivation: The practice where the land is not tilled.

Zonal tillage: See “Strategic tillage”.

The SmartCane booklets will serve as a reference for growers and their advisors. They will also be used to demonstrate the commitment of the industry to profitable, yet sustainable sugarcane production.
3. INTRODUCTION

Establishment of a good plant crop is the most important and expensive operation in canegrowing. It is important because it not only determines the yield of that crop but also influences the yield potential and longevity of the ratoon cycle.

In this booklet we promote the principle of fallowing of land between crop cycles with minimum disturbance of the soil during the fallow period. This is aimed at long-term sustainability and biodiversity of the sugarcane cropping system. This approach will also assist in enhancing productivity, profitability and on-farm management. It does not infer that this should or will be the only system operating within the sugarcane production system.

When the final ratoon is harvested at the end of a crop cycle it provides a grower with two options:
- To follow a ploughout - replant strategy.
- Adopt a fallow planting strategy.

Growers operating a ploughout - replant strategy are dependent on a rapid turn-around between the harvest of the final ratoon and replanting the new crop. Time is of the essence and there is little opportunity for effective planning. This may require the adoption of aggressive tillage, often at inappropriate soil moisture content. As a consequence of this, soil structure and organic matter content of the soil are adversely affected and compaction may be compounded in the next crop cycle.

By contrast, adoption of a fallow planting strategy provides a grower with time. There is time to:
- Plan effectively for the next crop.
- Rest the soil and provide opportunity for rejuvenation to occur.
- Break the monoculture and manage root diseases better through an extended break from sugarcane.
- Correct nutritional disorders by addition of soil ameliorants.
- Carry out land rectification to improve drainage or facilitate efficient irrigation.
- Manage weeds better on farm.

4. PHILOSOPHY OF BEST MANAGEMENT PRACTICE - FALLOWING

The current philosophy on fallowing within the sugar industry is based on the results of research conducted by the Sugar Yield Decline Joint Venture (SYDJV). These investigations commenced in 1993 to tackle the issue of yield decline – the loss of productive capacity of sugarcane growing soils under long-term monoculture – in the Australian sugar industry. This 14-year research program has led to the development of realistic, achievable guidelines for implementing a sustainable sugarcane farming system. There are three principles that form the backbone of an improved farming system, commonly referred to as the new farming system. These are:
- Inclusion of a break from continuous cane at the end of each crop cycle and the growing of well managed legume crop during the break.
- Tillage reduced to the minimum required to produce sound, healthy crops.
- Wider row spacing allowing for controlled trafficking of machinery.

The improved farming system has the potential to significantly reduce farming costs, improve soil health and arrest sugarcane yield decline. The benefits are medium to long term and result from gradually improving soil health, organic matter and soil structure and, therefore, enhancing sustainability. This means that productivity and profitability gains should be achieved in combination with environmental responsibility. The implementation of the improved farming system will not be achieved by recipe farming. Growers will experiment with the various aspects of the system and develop strategies that best suit their farm situation.

In this booklet we will focus primarily on two of these principles, break cropping and reducing tillage. We will outline different scenarios and guidance for growers developing improved farming strategies.
5. CURRENT SYSTEMS

The current farming system has developed with time. It is a product of past practices that have been used for many years, together with some newer innovations. This system (or components thereof) has undergone modification with time.

Research, development and extension programs have contributed to this development by initiating new (or alternative) techniques or philosophies, and facilitating the incorporation of these into the evolving system. The diversity of the industry has resulted in slightly different systems across the industry according to local needs and experiences. The continuum of onfarm operations and management styles may result in some ‘accepted’ practices being more compatible with agreed best-practice options than others.

The guidelines presented within this booklet aim to detail the most appropriate options available. However, it should be recognised that components of the overall best-practice ‘system’ may be more suited to some circumstances than others. This reinforces the basic principle that there are no set ‘recipes’, but rather a set of guidelines that will allow for progress towards the adoption of various best management practices within a set of specific circumstances.

**Fundamental aspects of the recommended sugarcane production system**

The current recommended sugarcane production system has certain characteristics that are fundamental to the concept of best management practice. These include:

- Use of harvesting and other farm machinery or vehicles that match row-spacing configurations.
- Planting of fallow break crops.
- Minimum cultivation necessary to suit available planters.
- Nutrient application rates within current guidelines.
- Subsurface applied fertiliser to plant and ratoon cane.
- Appropriate targeted pest, disease and weed control.
- Land grading to facilitate drainage and irrigation.
- Irrigation (when appropriate) that enables the cane plant to receive the right amount of water in the right place at the right time.
- Well-presented crops for harvesting to ensure quality cane delivered to the mill.
- Maintenance of trash after harvesting where appropriate with the aim of not burning cane or trash in the long term.

These practices have been adopted, either fully or partially, on many sugarcane farms. However, there are still situations on some farms where other best practice options need to be considered as alternatives to current practices.

**Occurrences where best practice alternatives need to be considered**

Where growers use the following practices, they are encouraged to consider best practice alternatives:

- Replanting without using a break crop at the end of a sugarcane crop cycle.
- Limited fallows that may or may not contain volunteer cane.
- Trash not retained, particularly after harvesting the last ratoon in a crop cycle prior to fallowing.
- Excessive cultivation aimed at ‘full’ land preparation.
- Ineffective weed control.
- Row spacings that are incompatible with the width of current harvesters, machinery and vehicles.
- Uneven land surface profile causing periodic localised waterlogging.
6. IMPROVED SUGARCANE CROPPING SYSTEM - FALLOWING

Although fallow planting was traditionally practised in the Australian sugar industry, there was a reduction in the area fallowed when assignment restrictions were lifted in 1975. This trend has been reversed in more recent times and fallow planting is regaining popularity as growers become more concerned about declining productivity under continuous monoculture. Past falls have often consisted of poorly managed cowpea crops that contained severe weed infestation. Volunteer plants of sugarcane were also often present which negated the potential benefit of breaking a disease cycle (Figure 1a).

The following are important components of fallow management within the improved farming system:

- Fallow at the end of the crop cycle to break the monoculture.
- Eliminate sugarcane from the fallow to break the soil disease cycle.
- Grow an alternative crop during the break if possible. Legumes are a suitable crop.
- Use a planter if possible to establish the legume crop.
- Grow this fallow on raised mounds or in the old cane row.
- Control early weed competition to benefit the legume.
- Eliminate problem weeds to provide a better environment for the following crop.

Growing legumes during a fallow (Figure 1b) provides better balanced soil biology, fewer root pathogens, improved soil structure, biologically fixed nitrogen and better cane growth and yield (Table 1). The implementation of a legume break crop goes a long way to improving soil health.

![Figure 1a: Examples of fallow management (a) unmanaged weedy fallow, inadequate drainage, volunteer cane, no legume; and (b) well managed soybean legume fallow.](image)

**Table 1:** Cane yields from crops planted with a ploughout - replant system and a fallow planting system. Example data from SYDJV rotation experiments.

<table>
<thead>
<tr>
<th>Site and crop class</th>
<th>Cane yield (t/ha) in a plough-out - replant system</th>
<th>Cane yield (t/ha) following a legume fallow crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tully (P*)</td>
<td>88</td>
<td>102</td>
</tr>
<tr>
<td>Ingham (P)</td>
<td>48</td>
<td>61</td>
</tr>
<tr>
<td>Mackay (P)</td>
<td>63</td>
<td>90</td>
</tr>
<tr>
<td>Mackay (R+1)</td>
<td>92</td>
<td>116</td>
</tr>
<tr>
<td>Bundaberg (P)</td>
<td>107</td>
<td>124</td>
</tr>
<tr>
<td>Bundaberg (R1)</td>
<td>110</td>
<td>138</td>
</tr>
<tr>
<td>Bundaberg (R2)</td>
<td>107</td>
<td>125</td>
</tr>
</tbody>
</table>

*P and R represent plant and ratoon crop data, respectively.*
There is also an emphasis on reducing or minimising cultivation within this improved farming system to prevent the loss of organic matter and deterioration in soil physical condition. Introducing zonal or minimum tillage into parts of the cropping system will help reduce cultivation.

Organic matter plays an important role in soil. It contributes to the health, nutrition and good physical condition, generally referred to as the inherent soil fertility. Tillage practices used to grow crops increase the rate of organic matter decomposition (Table 2). Minimising cultivation helps to preserve organic matter content in soil.

**Table 2:** Influence of clearing and cultivation on soil organic matter under tropical conditions.

<table>
<thead>
<tr>
<th>System</th>
<th>Organic Carbon (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin rainforest</td>
<td>2.97</td>
</tr>
<tr>
<td>Rainforest cleared and grassed for 15 years</td>
<td>1.62</td>
</tr>
<tr>
<td>Rainforest cleared and cultivated for 15 years</td>
<td>1.14</td>
</tr>
</tbody>
</table>

Other advantages of reduced tillage include less damage to soil structure and enhanced soil moisture retention. Reduced tillage also facilitates the build-up of earthworms and beneficial soil organisms such as *Metarhizium* and *Adelina* that have a role in the natural control of canegrubs.

However the ploughout - replant strategy may still have a role within the new system, although it is envisaged that this should only be for strategic reasons. As an example, a combination fallow/replant strategy may be used to minimise economic loss when amalgamating two fields of different crop classes. Otherwise, one field would have to be fallowed for two years if the replant strategy was used in this case.

Fallow management is changing within the improved farming system. This process is outlined in the following sections:
- Planning for the next crop.
- Destruction of the previous crop.
- Land rectification.
- Fallow management.

**7. PLANNING FOR THE NEXT CROP**

Planning for the fallow should commence well before harvest of the final crop in the previous crop cycle. It should cover a range of activities aimed at maximising the benefits of the fallow and the success of the following crop. The type of activities that need to be considered when planning the fallow management for a particular field include:
- Record keeping.
- Nutrient status.
- Soil health.
- Land rectification.
- Stool eradication.
- Weed control.
- Legume crops.

**Record keeping**

This is placed first in the list because it is the basis of all good farming systems. Appropriate records of all operations performed on a particular paddock enable a factual assessment to be made of the performance of that paddock. Good records take the guesswork out of management.

**Nutrient status**

Nutrient status of a soil can only be identified with a soil test. Soil nutrient analysis assists in identifying any nutrient deficiencies or imbalances. It is used as the basis for developing a profitable and sustainable fertiliser program. Fallowing is an ideal time for soil tests to be carried out. This allows a representative sample to be collected, as it is possible to detect variations within the block (e.g. good and poor growth areas) and take these into account when collecting a sample. Areas behaving differently should be sampled separately. One sample per crop cycle is normally adequate. Soil sampling guidelines are provided in Appendix 1.

These soil tests are used as the basis for determining the nutritional program for the next crop. However, the most important use for these during the fallow is to determine if soil ameliorants are required to rectify calcium, magnesium and silicon nutrition and acidic or sodic soils.
Amelioration of soil acidity for the fallow crop and the following sugarcane crop: Legumes are less tolerant of acidic conditions than sugarcane and, where necessary, soil should be limed to pH 5.5 or just above to ensure soil conditions are satisfactory for good legume growth (Figure 2a, c). Soil pH can influence root nodulation, which can be inhibited in very acidic soils.

Nutrient requirements for the fallow crop (and for the following sugarcane crop): Nutritional requirements should not be ignored at this stage and calcium, magnesium and silicon should be applied if soil tests indicate they are needed. Surveys by BSES agronomists have highlighted widespread deficiencies of calcium and magnesium in sugarcane fields throughout the industry. For the relatively small cost of a soil test, large monetary gains can be made if these deficiencies are rectified prior to planting a legume crop. The benefits will carry through to the subsequent sugarcane crop. These nutrients are usually applied as a calcium/magnesium soil ameliorant. Satisfying calcium and magnesium nutrient requirements and rectifying soil acidity usually go hand-in-hand on most soils. Other nutrients also need to be considered to ensure that the legume crop (which may be harvested) is not limited by nutrient deficiencies.

Filter mud (Figure 2b) or filter mud/ash mixtures can also be used as a soil ameliorant to neutralise soil acidity. Both products supply calcium and magnesium, whilst mud/ash mixture also supplies silicon. These are cost effective products as they also supply an additional range of nutrients including nitrogen, phosphorus, potassium, sulphur, and minor elements. Nutrient inputs from inorganic fertiliser can then be reduced in the subsequent crop to allow for the nutrients already applied when mud or mud/ash materials have been used. The fallow is an ideal time to apply these products, as they can be incorporated into the soil soon after application (as required with the use of these products).

Figure 2: Applying soil ameliorants (a) liming product; (b) filter mud; (c) checker board effect showing response to different calcium levels in a soybean crop planted on a lime trial site at Tully. Good growth in foreground with adequate soil calcium levels.
Amelioration of sodic soil conditions: High soil sodium levels can cause breakdown of soil structure that affects aeration, water infiltration and movement of water through the soil. Some soils are more sensitive to this problem. Usually the effects become apparent once exchangeable sodium levels exceed 6% of the exchangeable cations.

The fallow is an appropriate time to remediate soil affected by sodicity. This can be achieved by applying gypsum or mill ash to promote replacement of sodium with calcium on the clay particles. This will assist in improving soil structure. Mill ash will also have a physical, as well as chemical, effect on soil. If the soil is acidic as well as sodic, lime can be used instead of gypsum.

Soil Health

Yield decline of sugarcane was found to be due in part to a build-up of deleterious soil biota under long-term sugarcane monoculture. Research undertaken as part of the Sugar Yield Decline Joint Venture showed that a break from sugarcane reduced populations of deleterious soil biota and increased yield of the following cane crop. This effect was enhanced by growing a legume crop during this break (Figure 3). Unfortunately, most of the deleterious soil biota have not been identified and, consequently, their levels in the soil cannot be measured.

However, one of the detrimental soil organisms, the fungal root pathogen *Pachymetra chaunorhiza*, has been identified. Affected roots typically exhibit a soft flaccid rot of the larger roots (Figure 4a) and are much smaller than healthy roots. Yield losses of up to 40% in susceptible varieties have been associated with this disease. *Pachymetra* root rot is a major disease in many parts of Queensland and New South Wales.

A soil assay for *pachymetra* root rot, based on counting spores of the fungus in field soil, can be used to determine the likely severity of the disease in commercial fields. Sampling guidelines are provided in Appendix 2. *Pachymetra* has a distinctive spore which simplifies the counting process (Figure 4b). Short-term fallows (<12 months) have minimal effect on *pachymetra* root rot, and control of the fungus is based on planting of resistant varieties. Therefore, it is important that spore levels in the soil be determined during the fallow to enable a variety with the appropriate level of resistance to be selected for the next crop. Spore counts may not be necessary if it is planned to grow a resistant variety.

**Figure 3:** A glasshouse experiment comparing sugarcane root growth and responses to soil pasteurisation in soil from monocultured sugarcane (left-two root systems) and legume rotation (right-two root systems). Within each pair the root system on the left is from soil that has been pasteurised. Note the better growth where the cane monoculture has been broken, and when the soil has been pasteurised.

**Figure 4:** (a) Thicker sugarcane roots exhibiting typical *pachymetra* root rot symptoms; (b) a spore of *Pachymetra* illustrating the characteristic large blunt projections on the spore wall making it easier to identify for spore counting.
8. DESTRUCTION OF THE PREVIOUS CROP

Traditionally the old stubble was destroyed by cultivation. Several options are used in the new farming system, with the emphasis being on minimising both the degree of cultivation that is used and the potential for adverse environmental impacts. However, the management practice selected may need to satisfy other management requirements, such as drainage improvement.

Spray out sugarcane

Spray out is the preferred stool eradication option if best management principles are being addressed. In this situation, the final ratoon crop should be destroyed with a suitable non-residual herbicide, such as a glyphosate-based product, and the stubble and trash blanket (burnt or green) left in place. There is no specific time frame for this exercise, except the herbicide should not be applied until the ratoon crop has produced enough foliage to absorb sufficient herbicide to kill the cane as per the herbicide label. The results can sometimes be variable, and follow-up sprayings may be needed to destroy any surviving cane stools that could harbor cane pests and diseases. Once this is done the block will be ready for planting a legume break crop.

This system is modified for blocks harvested late in the year, when waiting six weeks for ratooning and then spraying-out the old ratoons is not an option. This is because the window of opportunity with suitable weather for successful legume establishment is too small. The legumes should be planted while the cane is ratooning and the ratoons sprayed out with a suitable herbicide. Avoid application when rainfall that may lead to a runoff event is probable.

The advantages of the spray out system are:

- It minimises offsite movement of nutrients and pesticides because of minimal soil movement.
- It assists in the preservation of organic matter and soil biota such as earthworms, Metarhizium and Adelina because soil is undisturbed.
- Soil moisture is conserved.
- It helps preserve soil structure because there is no cultivation at this stage.

The disadvantages of the system are:

- Efficacy of residual herbicides is severely restricted because of the trash blanket and effective weed control is difficult with problem weeds such as guinea grass.
- Late harvest of the ratoon crop can lead to delayed planting of the legume and may result in poor germination and establishment.
- Legume growth may be restricted because of soil compaction.
- Germination of the legume may be negatively affected if the seed is caught in the trash blanket (especially when sizable pieces of fresh trash are present).

If sugarcane is eradicated from the fallow, this reduces the level of adverse soil borne disease in the paddock. If ratoon stunting disease (RSD) was present in the previous crop, eradication of cane during the fallow will prevent it being spread into the next crop. In this situation a six-month fallow is recommended. Application of liming products to the soil surface without incorporation may be appropriate in some circumstances, but the influence of this method on lime efficacy under dry conditions is still under investigation. This system of lime application appears to work in the wet tropics, although the full implications on nutrient stratification are still being assessed.
**Cultivate-out sugarcane**

With this system, cultivation is used to destroy the stool of the final ratoon crop. This can either be zonal or full tillage. Cultivation may even be used in combination with spray out techniques to ensure the old stools of cane have been killed.

**Zonal tillage**

Zonal tillage is when only the row area is cultivated and the inter-row area remains undisturbed. It is primarily used in the fallow to alleviate compaction, particularly on heavy textured soils and to provide a better seedbed for legume growth. This system improves the efficacy of pre-emergent herbicides due to the absence of a green cane trash blanket (GCTB). It therefore results in better control of problem weeds.

Zonal tillage provides farmers with a number of benefits over conventional (full) tillage and is a compromise to address some of the problems that may occur with the spray-out system. The most immediate and obvious benefit is the very significant reduction in farm input costs and time compared with conventional cultivation. Soil erosion, offsite movement of nutrients and pesticides and deleterious effects of cultivation on soil organisms and organic matter are less than with conventional cultivation.

Most growers implementing the zonal tillage system use combinations of rippers and rotary hoes (Figure 6a). Purpose-built machines are now becoming available (Figure 6b). These usually include rippers, discs and a roller, and omits the rotary hoe which is an aggressive cultivation tool that destroys soil structure if used excessively.

**Figure 5:** (a) An example of spray out fallow on mounded rows on 1.85 m spacing. This overcomes the problems of soil erosion which can occur when fallow paddocks are cultivated and left without cover (b).

**Figure 6:** Zonal tillage land preparation (a) ripper/rotary hoe combination being used to till three rows, and (b) single row zonal tillage using a ripper/disc/roller combination.
**Conventional (or full) tillage**

Conventional tillage is where the full area, both row and inter-space, are cultivated or tilled (Figure 7a). This normally involves several passes with various implements, often including ploughs, tynes, discs, and rotary hoes or rotorvators. Cultivation may be used in combination with spray out to ensure an effective kill of the old cane stools (Figure 7b).

Excessive tillage damages soil structure, kills beneficial soil biota and enhances degradation of organic matter. There is also increased potential for soil erosion and offsite movement of nutrients and pesticides because all the soil has been cultivated. Thus it is important that these risks are minimised by planting a legume crop as soon as possible to provide cover and bind the soil with the roots.

Conventional or full tillage is still necessary under certain circumstances in the new farming system. While the emphasis is on minimising cultivation under best management practices, cultivation is only one of the components of crop production. Therefore, there are times when these other components could become important. Some of the circumstances where full cultivation is necessary are:

- Widening row spacing and forming raised beds to implement controlled traffic.
- Land grading to improve drainage or irrigation.
- Altering blocks by changing row direction and/or amalgamating areas.
- Assisting in the control of problem weeds.
- Applying mill mud or lime.

Some beneficial effects of conventional tillage include breaking up row compaction accumulated over the previous crop cycle and ‘diluting’ the levels of the soil fungus *Pachymetra* within the paddock. However, these two factors should not be seen as sufficient reasons in themselves to adopt full cultivation.

In summary, full cultivation should involve just enough mechanical operations to achieve an adequate soil tilth. The soil should never be pulverised with a rotary hoe to a powder.

**Figure 7:** Conventional (full) cultivation using (a) offset disc harrows and (b) rotary hoe.
9. LAND RECTIFICATION

The fallow period provides the opportunity to perform tasks that can only be undertaken in the absence of a crop. This includes changing row spacing or land grading to improve drainage, furrow irrigation or bed-forming. These systems all require land that has been conventionally tilled.

**Controlled traffic**

The fallow period presents the opportunity to establish a controlled traffic system. This is an important component of the improved farming system.

Controlled traffic is the system of matching row spacing to the track width for the machinery used on cane farms. Rows spaced at 1.83 – 1.9 metres will accommodate the machinery used in both farming and harvesting operations. This ensures compaction is confined to the interspaces, as well as minimising stool damage. For this system to be fully effective, all machinery used in both the farming and harvesting operations needs to be fitted with Global Positioning System (GPS) guidance when economically possible.

The system is improved if the row areas are formed as raised beds or mounds. Forming the beds at the beginning of the fallow allows them to consolidate over the wet season (Figure 8a and 8b). Germination problems have been experienced in beds formed pre-planting due to lack of moisture from dry soil being used to form the raised bed. Mounding reduces soil moisture in upper parts of the root zone by 4 to 6%. This reduces water movement through the fertiliser band and nitrogen losses in drainage water. The reduction in soil moisture around the fertiliser band should reduce denitrification. It also clearly defines the row area and therefore assists with the prevention of machinery traffic on the row.

With this system, soil health will be improved in the medium term and a more sustainable system will ensue.

**Drainage**

**Surface drainage**

Too much water is as big a problem in crop production, as is too little. When cane is waterlogged, it stops growing and in extreme cases will die. The elimination of surface ponding can prevent many of the problems caused by excessive soil wetness.

Land planing to fill small depressions and to provide a continuous slope of the soil surface in the row direction is the most effective surface drainage technique. This is usually achieved using conventional land planes or graders. In most canegrowing districts, particularly those practising furrow irrigation, laser controlled scrapers and graders are used to provide more even grades. For larger cuts and fills, it may be necessary to use a bulldozer to remove topsoil and a scraper to level the subsoil before the topsoil is replaced. This is particularly relevant with shallow topsoils or where impermeable sodic subsoils occur.

**Figure 8:** (a) Initiating a controlled traffic system by installing raised beds at 1.85 m spacing prior to the wet season, (b) beneficial effects of the raised beds on improved drainage for a soybean crop planted in the same field.
A grid survey should be completed before levelling is carried out to determine direction of slope and the most efficient way of carrying out the required cuts and fills.

The opportunity is often taken to remove water furrows by precision laser grading of blocks into larger units (Figure 9). This practice improves efficiency of both farming and harvesting operations. Elimination of water furrows reduces sediment export by as much as 19%.

Soil analyses to determine nutrient and Pachymetra levels should be delayed until levelling operations have been completed. This will ensure the assay data reflects the actual levels that the sugarcane plants will encounter. Remedial action should be based on these data.

**Headland management**

Soil accumulation on or adjacent to headlands can act as a barrier to drainage from the field. This affects accessibility of the headlands and the block because of the waterlogging resulting from this impeded drainage. Traffic on headlands that are too wet results in ruts and damage to grass cover that can lead to headland erosion. Some of the options available to overcome this impediment include lowered headlands, slotted pipes and sand-filled mole drains, either alone or in combination. Reduced tillage also minimises the build-up of soil associated with implement-lifting at the end of the rows.

Headlands usually act as sediment sinks and their trapping efficiency is enhanced with a healthy or intact grass sward. It has been estimated that headlands start to erode at ground cover levels below 65%, whereas above this value they will act as a sink with efficiency improving as the level of ground cover increases.

Headlands should also be prepared in such a way that they are suitable for efficient harvest and delivery of sugarcane to the delivery point.

**Subsurface drainage**

The most common method of subsurface drainage used in sugarcane areas is the use of deep open drains because of the need to dispose of both runoff and deep drainage water. Maintenance programs should be carried out on the drains adjacent to fallow blocks to maintain good subsurface drainage. It is important that revegetation of the drains be enhanced to minimise sediment loads.

Previously, deep drains were established to manage water movement from fields. Laser grading has in many circumstances removed the need for these drains. This includes situations where acid sulfate soils occur.

It is also important that maintenance programs be carried out to maintain the efficacy of any other subsurface systems installed previously. These may consist of subsurface drainage pipes to drain a spring or seepage area, or mole drains installed in those areas with heavy-textured soils, or in flat flood plains or former swamp areas. In some cases, new installations may be required to improve drainage within the block, particularly if green cane trash blanketing has been adopted.
10. FALLOW MANAGEMENT

Bare fallow

In some circumstances, planting a legume crop might not be possible because the area is subject to inundation. Using a spray out system is the best method of fallow management in this situation (Figure 10). The soil still benefits from the break from sugarcane and no cultivation. However, it does not gain the additional benefits associated with growing a legume cover crop. The presence of a trash blanket (burnt or green) during the fallow will enhance the beneficial effect of zero cultivation in minimising the risk of erosion and the associated problems of offsite sediment, nutrient and pesticide movement.

Weeds should be controlled during a bare fallow with non-selective contact herbicides. Regular spraying will be required to control problem weeds like guinea grass or vines.

Legume fallow

Legume fallows provide many benefits to growers and the environment. The benefits include reduced reliance in chemical nitrogen fertiliser and reduced ground exposure during periods of high rainfall and potential runoff.

Two types of legume fallows are used in the sugarcane farming system:
- Green manure or cover crop.
- Grain legume fallow.

The reasons for choosing one of these depend on several factors that include on farm management, distance to grain markets and local infrastructure.

There are several types of summer legumes being grown as cover crops in sugarcane fallow. These include dolichos lablab, cowpeas, soybeans (Figure 11). The grain legume crops are primarily soybeans and peanuts.

Figure 11: Three common legume fallow crops (a) Dolichos lablab, (b) Meringa cowpea and (c) Leichhardt soybean.

Figure 10: Comparison of spray out/bare fallow and soybean legume fallow.
Soybeans are more tolerant of wet soil conditions, produce more dry matter and fix more nitrogen than cowpea or lablab (Table 3). However none of these legumes are resistant to inundation, although soybeans may have more tolerance (Figure 12). By planting into raised beds, legumes are less likely to suffer from waterlogging effects. Cowpea and lablab are more tolerant of high temperatures and low soil moisture than soybean, therefore, provide more management flexibility. They also provide better ground cover that assists with weed control.

The type of legume selected will be influenced by an individual’s location and planned management strategy.

Table 3: Nitrogen returned for different legume species or management from experiments in north Queensland*.

<table>
<thead>
<tr>
<th>Fallow management situation</th>
<th>Nitrogen input (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmanaged cowpea</td>
<td>31</td>
</tr>
<tr>
<td>Unmanaged lablab</td>
<td>76</td>
</tr>
<tr>
<td>Well managed cowpea</td>
<td>140</td>
</tr>
<tr>
<td>Well managed soybean</td>
<td>150-310</td>
</tr>
</tbody>
</table>

*SYDJV data.

**Planting legumes**

For both green manure and grain crops it is important to plant into moist soil, although cowpea and lablab are more tolerant of dryer conditions. Sowing seed with a planter into beds and using appropriate herbicides will give the best results. This is illustrated by the increase in nitrogen fixed by cowpeas when management is improved (Table 3). Appropriate inoculants must be used for successful nodulation.

All seed should be sown with a planter, irrespective of legume type. This ensures good germination, because planting rate and depth are controlled, particularly if ground speed is slow enough to minimise tyne and seed bounce that result in variable planting depth. Broadcasting seed sometimes leads to poor germination as planting depth is uncontrolled.

Zero tillage or direct drilling is used to plant legumes in spray out blocks (Figure 13a). The seed is planted in a narrow slit opened by a coulter cutting through the trash blanket into an otherwise undisturbed soil. The legume is sown into the mound on either side of the old cane row. Soil compaction can pose a problem on heavy textured soils, as legumes do not grow well in compacted soils. A coulter ripper near the stool will break up the compaction with minimal disturbance of the trash cover.

When paddocks have been cultivated with either zonal or full tillage (Figure 13b) there is a range of planters that can be used as they do not need to cut through the trash.
With full cultivation, the best results will be achieved if the legumes are planted on pre-formed mounds to minimise the effects of waterlogging. This also enables fallow grain crops to be produced in some districts using furrow irrigation. However, they can be grown successfully in a flat seedbed in well drained soils. The existing row mound is used in zonal tillage situations. Sowing legumes for green manure in the wet tropical regions after mid-January should be avoided as the resulting plants will be small and have limited nitrogen fixation. The same applies in the southern regions if autumn cane planting is being considered. When growing legumes for grain use a suitable variety for the region and plant it at locally accepted times for best results.

**Figure 13:** Successful legume establishment following direct-drill planting into (a) zero, or (b) zonal tillage fallow.
Irrigation

**Green manure**
Legumes being grown as a green manure crop are often not irrigated. Some growers may irrigate once to promote germination, particularly of soybeans.

**Grain legumes**
Soybeans and peanuts are sensitive to moisture stress from flowering to late grain-fill and adequate irrigation will be required to maximise yields. Depending on location across the sugar industry the amount of irrigation water required will vary. Although normal cane irrigation practices are usually adequate for soybean crops, additional irrigations may be necessary for peanuts.

Weed control

Weed control during the fallow has several aims:
- Reducing weed competition within the legume crop.
- Reducing the weed seed population for the subsequent cane crop.
- Eliminating sugarcane volunteers that are considered a weed in a fallow situation.

The types of weeds and the weed burden of the paddock will influence both the weed control strategy and the type of cultivation system adopted during the fallow (Figure 14). For example, the strategy for effective control of a heavy infestation of guinea grass may require full cultivation followed by a knockdown herbicide to eliminate subsequent emergence of weeds. Additional strategic application of a post-emergent grass selective herbicide may be required to control competing grasses in the legume crop. These strategies combined with additional control in the plant crop should ensure a minimal weed problem in the ratoons.

Young legumes, particularly soybean crops, do not compete well with weeds. However, inter-row cultivation is not recommended because of the need to minimise cultivation.

Chemical weed control is the preferred option and the choices of herbicides have expanded markedly in recent years. Depending on the situation, these herbicides can be applied as pre-plant, post-plant, pre-emergent and post-emergent in zonal and full tillage systems. However, pre-emergent herbicide may have limited effectiveness in green cane trash blanket situations where the legume has been direct drilled. In the past, poor weed control occurred in some instances because the herbicide was incorporated too deep to be effective against emerging weeds.

Post-emergent herbicides are the only options with spray out/direct-drill fallows. Efficacy of the chemical will be improved by applying low water rates on small weeds using small nozzles (015 - 02). Post-emergent herbicide applications are feasible, even under fairly moist conditions because the inter-row was not cultivated.

Vines can be a major weed problem where green cane trash blanketing is carried out. There is limited opportunity for chemical control of vines if a legume is grown in a spray out fallow because efficacies of pre-emergent herbicides are limited by the trash. The only effective method available is to spray both the legumes and the vines prior to the latter setting seed. This may limit the effectiveness of the legume.

Guinea grass control can also be a problem in these circumstances and control methods are still being evaluated, although good control has been reported with some contact herbicides. Some form of cultivation may be appropriate in these circumstances as effective chemical control can then be achieved with these problem weeds.

**Figure 14:** Guinea grass and cane infestation of a soybean fallow.
Insect management needs to be considered if the legume is being grown for grain. Both soybeans and peanuts can tolerate significant leaf damage prior to flowering without affecting yield. The risk is highest from flowering to late pod fill when unchecked pests may cause serious yield and quality losses. For soybeans, the two major pests are heliothis larvae and green vegetable bugs. For peanuts, the pests are generally below ground and include the white fringed weevil, canegrubs and the larvae of *Etiella* moth.

**Harvesting for grain**

Soybeans take between 4 and 5 months to reach maturity and they should be harvested as soon as the pods mature. The target moisture content should be around 12-13%, but grain can be harvested up to 16% and dried at a drying facility. Harvest usually occurs from mid April to mid May but it is dependent on the variety and location. It may be necessary to defoliate soybeans prior to harvest to improve ease of harvesting and improve grain quality.

Peanuts are a 20-24 week crop depending on varieties and growing condition. Harvesting is a two stage process with the peanuts first dug and inverted into a windrow for drying. Once the peanuts reach 18-20% moisture they are threshed to remove the pods from the plants. Moisture content below this generally leads to increased harvesting losses.

**Destruction of the legume crop**

**Green manure crops**
The best time to destroy a non-grain legume crop for maximum nitrogen and dry matter levels is when pods have formed but the seed is still immature. This avoids unwanted germination that can occur if the seeds are left to mature.

There are three management options for destruction of a legume crop (Figure 16). In order of preference they are:
1. Spray the legume with a herbicide and leave as standing stubble.
2. Slash the legume and leave as a surface mulch.
3. Disc the crop in and leave it to decompose for a number of weeks (traditional method).

**Grain crops**

With harvesting of soybean and peanut crops, it is recommended that the stubble be left as a soil cover across the harvest width. This will ensure an even spread of the resulting layer of organic matter and relatively uniform release of mineralised nitrogen across the block. This resembles management Option 2 described above. Cultivation is unnecessary with soybeans at this stage (the grain will die if left on the soil surface). Some cultivation (to prepare and reform beds for cane) may be necessary after harvest of peanuts as some peanut threshers cause compaction as they travel down the top of the beds.

**Figure 15:** (a) Destruction of a legume crop by offset discing, (b) zonal tillage to incorporate a soybean crop after spraying it with herbicide to kill the crop to preserve the nitrogen.
Nitrogen fertiliser management in the subsequent cane crop

Nitrogen fertiliser requirements should be adjusted in the subsequent cane crop depending on the type of legume and its estimated yield. Table 4 provides a comparison of the potential contribution from different legume crops.

Table 4: Calculation of N contribution from a legume crop (as supplied by the SYDJV). Guidelines for calculating the N delivered by a legume crop are provided in Appendix 3.

<table>
<thead>
<tr>
<th>Legume crop</th>
<th>Fallow crop dry mass (t/ha)</th>
<th>N%</th>
<th>Total N contribution (kg N/ha)</th>
<th>N contribution if grain harvested (kg/ha)</th>
</tr>
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<tbody>
<tr>
<td>Soybean</td>
<td>8</td>
<td>3.5</td>
<td>360</td>
<td>120</td>
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<td></td>
<td>6</td>
<td></td>
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<td>2</td>
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<td>90</td>
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<tr>
<td>Peanut*</td>
<td>8</td>
<td>3</td>
<td>N/A</td>
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<tr>
<td>Cowpea</td>
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<td>70</td>
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<tr>
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<td>2.3</td>
<td>240</td>
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*Mike Bell, 2007.

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*Mike Bell, 2007.
11. CONCLUSION

In this booklet we promote the principle of fallowing land between crop cycles of sugarcane with minimum disturbance of the soil during the fallow period. Best management practice relating to fallow and land management is important because it provides a sound basis for long-term sustainability and biodiversity of the overall sugarcane cropping system. This booklet contains information on planning for the next sugarcane crop, destruction of the previous sugarcane crop, land rectification and management of the fallow break crop. It, therefore, covers onfarm activities that are conducted towards the end of the last ratoon of the previous sugarcane crop and during the fallow period between successive sugarcane crop cycles (Figure 16). The booklet entitled SmartCane Plant Cane Establishment and Management follows logically after this booklet.

![SmartCane Fallow Management Diagram]

**Figure 16:** Aspects of onfarm management that need to be considered during the last ratoon of a crop cycle and during the break/fallow crop.
12. SELF EVALUATION

Farm management differs from person to person and from farm to farm. A single ‘recipe’ for all situations is not possible. However, some growers are closer to best management than others. This self evaluation is aimed at identifying your perceptions of best management practice and if and where improvements can be made in adopting best-management principles and strategies.

In undertaking this self-assessment it is important to distinguish between your attitude to a particular principle or strategy, and the actual adoption onfarm. For example, you may fully support the idea of best management practice and give it a rating of 5 (strongly agree), but you may only give it a rating of 3 in terms of compliance or adoption on your farm.

Table 5: Self evaluation for identifying best management practice.

<table>
<thead>
<tr>
<th>Rate each of these statements according to the scale of 1 to 5 in terms of attitude and onfarm adoption</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The concept of best management practice incorporates the idea that farm practices are continually improving.</td>
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<tr>
<td>Attitude</td>
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<tr>
<td>Fallowing of land between crop cycles of sugarcane with minimum soil disturbance will enable sustainable sugarcane production.</td>
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<td>Attitude</td>
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<tr>
<td>Growing legumes during a fallow provides better balanced biology, fewer root pathogens, improved soil structure and a source of biologically fixed N.</td>
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<td>Attitude</td>
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<tr>
<td>Organic matter has an important role in contributing to the health, nutrient status and good physical condition of soil.</td>
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<td>Attitude</td>
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<tr>
<td>Planning for the fallow and next sugarcane crop cycle should commence well before harvest of the final ratoon of the previous sugarcane crop cycle.</td>
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<td>Attitude</td>
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<tr>
<td>The destruction of the previous sugarcane crop should be carried out with an emphasis on minimal soil disturbance and environmental impacts.</td>
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<td>Attitude</td>
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<tr>
<td>The fallow period enables the establishment of a controlled traffic system in-field that is compatible with harvesters, machinery and vehicles</td>
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<td>Attitude</td>
<td>Adoption</td>
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<tr>
<td>A well-managed fallow crop will ultimately lead to benefits within the next sugarcane crop cycle.</td>
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<td>Attitude</td>
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<tr>
<td>Appropriate weed management within the fallow legume cropping period will ensure fewer weed problems in the subsequent sugarcane crop cycle.</td>
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<td>Attitude</td>
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<tr>
<td>Nitrogen fertiliser requirements for the subsequent sugarcane crop should be adjusted according to the type and yield of the legume fallow crop.</td>
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13. FURTHER READING

The material covered in this booklet includes information drawn from various sources. This expertise and knowledge is gratefully acknowledged, particularly in relation to the following publications and/or reports. The list also provides details of some further reading options.


APPENDIX 1: SOIL SAMPLING GUIDELINES

A number of important steps should be followed when soil sampling a block of land that is used for sugarcane production:

- **Determine** the area that is to be sampled.
- **Ensure** that the area being sampled does not exceed 2 or 3 hectares and that it is relatively uniform.
- **If** a block consists of more than one distinct soil type, sample them separately.
- **Avoid** areas that differ in crop growth, or where large amounts of mill mud or other amendments have been dumped (sample such areas separately if necessary).
- **Sampling** is best done with an auger (either a turning auger (Figure 1) or a soil tube).
- **At** least 10 or 12 ‘augerings’ of soil should be collected from the area to a depth of about 20 – 25 cm using a zig-zag or grid pattern as shown in Figure 2.
- **The** basic principle is that more ‘augerings’ are better than fewer.
- **All** the ‘augerings’ should be collected in a good-quality plastic bag or a clean plastic bucket to form a single composite sample.
- **Care** should be taken not to use a bucket with a galvanised handle as this source of zinc could contaminate the soil sample.
- **After** collection, all the ‘augerings’ should be mixed thoroughly to ensure a uniform sample.
- **If** the complete sample is too cumbersome, a portion (500 g – 1 kg) should be sub-sampled for dispatch to the laboratory.
- **Ideally** this sub-sampling should occur after air-drying and initial sieving, but facilities to do so may not always be available. Assistance may possibly be obtained from your extension officer or adviser.
- **Dispatch** the complete sample to a reputable laboratory for analysis.
- **Supply** as many details as possible on a label and on the sample bag to ensure that the sample can be easily identified, and that meaningful interpretation of the results is possible.
- **It** is important that soil assays conducted by the laboratory correspond to those calibrated for sugarcane production.

![Figure 1: Soil sampling using a turning auger.](image1)

![Figure 2: Some suggested sampling patterns within blocks of cane.](image2)
APPENDIX 2: TESTING FOR PACHYMETRA ROOT ROT

Introduction
Pachymetra root rot is a sugarcane disease unique to Australian cane fields. The disease is not seen in any other country, or in fields where sugarcane has not been previously grown. The disease greatly reduces root growth and yields in susceptible varieties. Pachymetra root rot is a major disease in many parts of Queensland and New South Wales. It is important that appropriate controls are implemented to minimise losses.

Causal organisms
The disease is caused by a Peronosporomycete fungus, *Pachymetra chaunorhiza*.

Symptoms
Affected root systems typically exhibit a soft, flaccid rot of the larger roots, and are much smaller than healthy root systems. The fungus invades individual roots, usually near the root tip, and breaks down the internal root tissues. These roots either stop growing, or are completely destroyed. This leads to a poorly developed root system and a loss of stool anchorage, which may give rise to excessive stool tipping. Root reddening may accompany the early stages of pachymetra infection.

Yield loss
Yield losses of up to 40% in susceptible varieties have been associated with the disease.

Soil sampling
1. Standing Crop
   - Collect soil from the row.
   - Take soil to 25 cm depth.
   - Collect soil from 68 places.
   - Bulk the soil, mix thoroughly and sub sample (total amount required approximately 200 g).
   - Place soil in a labelled plastic bag and attach completed Tully Soil Biology Laboratory, Assay Request form, available from your local BSES office.
   - Contact your local BSES office to make arrangements to despatch soil sample to the BSES Tully Soil Biology Laboratory.

2. Cultivated Ground
   - Take 68 samples to a 25 cm depth.
   - Bulk the soil, mix thoroughly and sub sample (total amount required approximately 200 g).
   - Place soil in a labelled plastic bag and attach completed Tully Soil Biology Laboratory, Assay Request form, available from your local BSES office.
   - Contact your local BSES office to make arrangements to despatch soil sample to the BSES Tully Soil Biology Laboratory.

Figure 1: Pachymetra-infected stool.
This process simply involves measuring the crop biomass before it is incorporated into the paddock. Maximum nitrogen input will be at approximately the time of maximum legume biomass. For example, maximum biomass for a soybean crop will normally be reached by mid pod-fill; at this stage the crop will be between 3.5-4 months old (from a mid-November to mid-December planting) and still green. However, nitrogen is not lost if the crop is left longer than mid pod-fill, so it is not essential to incorporate the crop at precisely this time.

**STEP 1:** Calculate wet biomass of your legume crop (t/ha). The weight of your legume crop is easily estimated by simply cutting out a measured portion of the crop and weighing it - several areas of one square metre in an average section of the crop will do. Cut the plants at ground level, bundle them together and weigh them immediately. This is important because the plants begin to lose water as soon as they are cut. This weight is a measure of what is called ‘wet biomass.’ If this number (weight of crop from 1 m²) is multiplied by 10,000 you will have a close estimate of the wet biomass per hectare.

**STEP 2:** Calculate dry biomass (t/ha). Now you need to convert the wet biomass to dry biomass. This is normally done by drying your sample in an oven. However, results we have obtained from well grown green legumes confirm that approximately 75% of the wet biomass will be water. Therefore the dried biomass will be calculated as 25% of the wet biomass per hectare. For example, if you estimate the wet biomass to be 20 t/ha, the dry biomass will be about 5 t/ha.

**STEP 3:** Measure nitrogen concentration. It is a good idea to have a sample of the crop analysed to measure precisely the nitrogen concentration, because this can vary between species and according to the time the crop is sampled. Nitrogen concentration is expressed as percentage of dry weight. Extensive experiments conducted by the SYDJV have provided very good approximations you can use; our experience suggests that a green soybean crop will have around 3.5% of its dry weight as nitrogen. Contact your local BSES extension officer to discuss the fastest way to have your legume sample analysed.

**STEP 4:** Calculate nitrogen content of crop tops. You can now use the nitrogen concentration figures (approximately 3.5% dry weight or the results from your analysis) to calculate the nitrogen content of the legume crop. For example, a soybean crop of 5 t/ha (or 5,000 kg/ha) dry weight will contain around 175 kg/ha of nitrogen in the tops (5,000 x 3.5/100).

**STEP 5:** Add nitrogen in roots, etc, and calculate total. You should also allow for the nitrogen remaining in the legume crop’s roots, decayed nodules, root exudates and in the soil immediately surrounding. Research from a number of sources is showing this amount is approximately 30% of that contained in the plant tops. If we apply this to the example in step 4 where 175 kg/ha as calculated for the tops, an additional 53 kg/ha (175 x 30/100) will be in the below-ground parts. The total nitrogen contributed by this legume crop would be 228 kg/ha (175 + 53 kg/ha).

You can now estimate quite closely how much nitrogen your legume crop will return to the soil. In this case, if you normally apply nitrogen fertiliser to your plant crop at a rate less than 228 kg/ha (and it should be less!), you do not need to apply any nitrogen fertiliser! If you do, it could adversely affect your sugarcane crop’s CCS.

**Source:** BSES Bulletin Issue 2 (2004).
Want to squeeze the most out of your fertiliser?

If you’re looking to improve productivity, maintain soil health and take the guess work out of fertiliser decisions, then one of the best ways is to soil test using Nutrient Advantage services. Developed in collaboration with the Department of Natural Resources, CSR, BSES and Queensland Government, the Nutrient Advantage soil interpretation program helps to identify available soil nutrients and reserves.

Soil testing can show how much the soil has available to contribute to the sugarcane crop and helps identify the type and quantity of fertiliser needed.

Put your soil in the hands of Nutrient Advantage to help improve your yield potential.

For details from the fertiliser specialists, contact your local Incitec Pivot Distributor. Freecall 1800 009 832

www.incitecpivot.com.au