SUSTAINABLE NUTRIENT MANAGEMENT – DELIVERING THE MESSAGE TO THE AUSTRALIAN SUGAR INDUSTRY

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Abstract

Fertiliser guidelines in the Australian sugar industry have recently undergone substantial change. Over an eight-year period, the generalised fertiliser recommendations for use across regions and soils have been transformed into a set of site/soil-specific recommendations that are promoted within an integrated or 'whole of systems' approach. These developments are ongoing and ensure that nutrient advice is not only appropriate for specific circumstances and the range of farming systems that occur, but are importantly aimed at sustainable nutrient management.

This paper summarises the process that is being used to facilitate the delivery and adoption of an integrated approach to sustainable nutrient management in the Australian sugar industry.

Although symptoms of inefficient nutrient management are evident in some farming enterprises, sustainable nutrient management is considered an integral part of sugarcane production. A 'Six Easy Steps' approach was developed to facilitate the adoption of best-practice nutrient management on-farm. It is logic-based, allows growers to make informed decisions about their nutrient inputs, and provides opportunities for stepwise improvements to be made on-farm. This integrated approach encompasses the concepts of understanding soils and soil related processes, regular soil testing, adoption of soil-specific nutrient guidelines, leaf analysis and good record keeping. The system is being delivered to the industry by means of a three-tiered approach. Information is disseminated in printed form, within a training program, and using field trials for demonstration purposes. Further enhancements to the system are described, particularly in relation to potential nutrient losses and their impact on environmental and temporal risk.

Keywords: fertiliser guidelines, soil/site specific recommendations, sustainable sugarcane production

Introduction

Fertiliser applications for sugarcane production in Australia have traditionally been based on general guidelines for use across the industry (Calcino, 1994). These guidelines were obtained from the averaged results of a large number of yield calibration trials conducted on various soil types within several districts (Chapman, 1971a; Chapman, 1971b; Chapman, 1994). However, changing economic and environmental conditions, both local and international, have necessitated changes in attitudes to nutrient inputs on-farm. Apart from the need to reduce the overall cost of production and to maintain the long-term health of soils, the Australian sugar industry is under mounting pressure to improve environmental responsibility by minimising losses from applied fertiliser.

In reaction to these changes, fertiliser guidelines in the Australian sugar industry have also recently undergone substantial change. Over an eight-year period, the generalised fertiliser recommendations have been transformed into a set of site/soil-specific recommendations that are promoted within an integrated or 'whole-of-systems' approach to nutrient management (Schroeder *et al.*, 2003). These developments are ongoing and ensure that nutrient advice is appropriate for specific circumstances and cover a range of farming systems. Importantly they are aimed at attaining best-practice nutrient management on-farm. For comparative purposes, fertiliser recommendations in the South African industry take the form of 'whole cycle' advice. This type of advice is based on the analyses of soil samples collected prior to planting, and cover the nutrient requirements for a plant crop and four successive ratoons (Wood, 1987). Leaf analysis is then used to evaluate the adequacy of these recommendations. A combination of soil and leaf analyses is therefore considered essential for ensuring cost effective, environmentally responsible and balanced nutrient inputs (du Toit, 1959; Anon., 1994; Schroeder *et al*., 1994).

This paper highlights apparent symptoms of inefficiency and attitudes of some growers to nutrient management on-farm. It describes the process that are being used to deliver the integrated approach to the industry by using specific examples that relate to the Herbert, Bundaberg and Proserpine sugarcane districts. The paper also demonstrates the advantages of the new system in terms of productivity, profitability and environmental responsibility.

Symptoms of inefficient nutrient management

Despite about 30% of the average on-farm budget being allocated to fertiliser inputs, little effort has generally been made by growers to determine whether these nutrient inputs are appropriate for specific circumstances. Recently, it has been estimated that on-farm profitability may be improved by reducing fertiliser costs by an average Aus$60/ha or Aus$0.65/tonne of cane without affecting productivity. Apart from this apparent inefficiency, a number of other possible symptoms of inefficient nutrient management have been identified (Table 1). Although all of these symptoms may not occur on each farm, it is suggested that growers may recognise at least some of these within their own farming enterprises.

Table 1. Symptoms of inefficient nutrient management.

A perception that soils are all very similar.
An assumption that nutrients all react with the soil in a similar way once they are applied.
A belief that 'more fertiliser is better than less, and the extra is not doing much harm anyway'.
Lack of understanding of nutrient losses and their effects.
Use of generalised fertiliser recommendations across districts and soils.
Application of generalised fertiliser inputs on the farm by targeting the worst soil and fertilising the whole farm according to worst soil requirements.
Infrequent use of soil testing and leaf analysis.
Over-application of some nutrients (especially N and P).
Under-application of some nutrients (possibly K, S or others).
No check on the adequacy of fertiliser inputs.
Ongoing questions about nutrient management.
Few or poorly kept records.
Little modification of nutrient inputs from year to year and from crop cycle to crop cycle.
No adjustment to fertiliser application rates after mill by-products have been applied.
Nitrogen applications that are not reduced after a good legume fallow.

In attempting to determine the attitudes of growers to nutrient management, members of various regional nutrient management consultative groups (which included growers, miller representatives and industry advisers) were asked to describe what they understood by the term ‘best-practice nutrient management’. They were also asked to identify possible factors that could be impeding the adoption of best-practice nutrient management (Table 2).

Table 2. Consultative group responses to questions about ‘best practice nutrient management’.

Question: *What is meant by ‘best-practice nutrient management’?*
Responses: Right nutrient recommendation for the right variety and soil type. Right nutrient recommendation for the right variety at the right time to get the right result. Nutrient requirement to grow an optimum crop on a particular soil type with minimal off-farm impacts, but with maintenance of soil health (physical, chemical and biological). Nutrient requirement to maximise profitability with minimal off-site effects. Most efficient use of nutrients to maximise returns while ensuring soil health for sustainable production.
Question: *What impedes the adoption of best-practice nutrient management on-farm?*
Responses: Fear of the unknown or of crop loss. Risk – fertilisers traditionally a cheap form of insurance. Time constraints, ease of single application rates. Cost of products. Lack of recognition of best-practice management. Generic recommendations. Inability to apply variable rates. Equipment. Lack of appropriate mixtures. Lack of knowledge. Reluctance to change. Conflicting advice, recommendations not provided in ‘grower language’.

The responses indicated that the term ‘best-practice nutrient management’ meant different things to different people. However, it is encouraging that the issue of sustainability often formed the backbone of the various ‘definitions’. The range of responses to the question about impediments to the adoption of best-practice nutrient management indicated that this issue is complex. It also confirmed that an integrated solution or ‘whole of system’ approach is necessary to enable acceptance and adoption by growers.

Developments to facilitate improved nutrient management

Given the requirement for sustainable sugarcane production, in which optimum productivity and profitability need to be achieved in combination with environmental responsibility, an approach was necessary that could accelerate the adoption of best-practice nutrient management across the industry. The new approach is based on the premise that nutrient management guidelines should be linked to soil type (Meyer, 1984; Schroeder and Kingston, 2000; Bruce, 2002). As a result, modified nutrient recommendations have been developed using (i) knowledge of soil properties and processes (Nelson *et al*., 1999), (ii) past data (Wood *et al.*, 1997; Schroeder *et al*., 1998b; Schroeder and Wood, 2002), and (iii) results of recent field trials, glasshouse experiments and laboratory investigations (Schroeder and Wood, 2001; Wood and Schroeder, 2004). Simple pedo-transfer functions were developed to assist in extrapolating nutrient management guidelines to the industry as a whole.

These changes were then integrated into a 'whole-of-systems' approach to facilitate improved nutrient management on-farm. The delivery system, called the 'Six Easy Steps' was developed (Table 3) to provide a logical sequence for growers to undertake 'stepwise' improvements in managing nutrients within their farming enterprises. Each of the steps is described below.

Table 3. The concept of 'Six Easy Steps' to improved nutrient management.

Step	Components of the integrated approach to nutrient management
1	Knowing our soils.
2	Understanding and managing nutrient processes and losses.
3	Soil testing regularly.
4	Adopting soil-specific fertiliser recommendations.
5	Using leaf analysis to check on the adequacy of nutrient inputs.
6	Keeping good records and modifying nutrient inputs when and where necessary.

Knowing our soils

Unlike the situation in the South African sugar industry where soils are classified according to the commonly used binomial soil classification system (MacVicar *et al*., 1977; Meyer, 1984), soil classification in Australia has been more disjointed (Schroeder *et al.*, 1998a). Prior to the development of the Australian Soil Classification system (Isbell, 1996) soils in the Australian sugar industry were named and mapped by various state departments (e.g. Wilson and Baker, 1990; Donnollan *et al.*, 1998) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Soils (Holz and Shields, 1985; Cannon *et al*., 1992; Murtha and Smith, 1994). Various classification systems (Stace *et al*., 1968; Northcote, 1971; Murtha, 1986) were used, with soil names often being locally derived without direct reference to similar soils in other regions.

To facilitate better understanding and communication of soil type by growers and their advisers, the 'Six Easy Steps' approach uses a relatively simple method for 'classifying' soils. This involves identifying soils according to basic properties such as colour, texture, structure, depth and position in the landscape. This method builds on the principles originally used to map soils (at a scale of 1:5000) in the Herbert River district (Wood, 1986). Figure 1 illustrates an example of a sequence of soils found in a typical landscape in the Herbert River district.

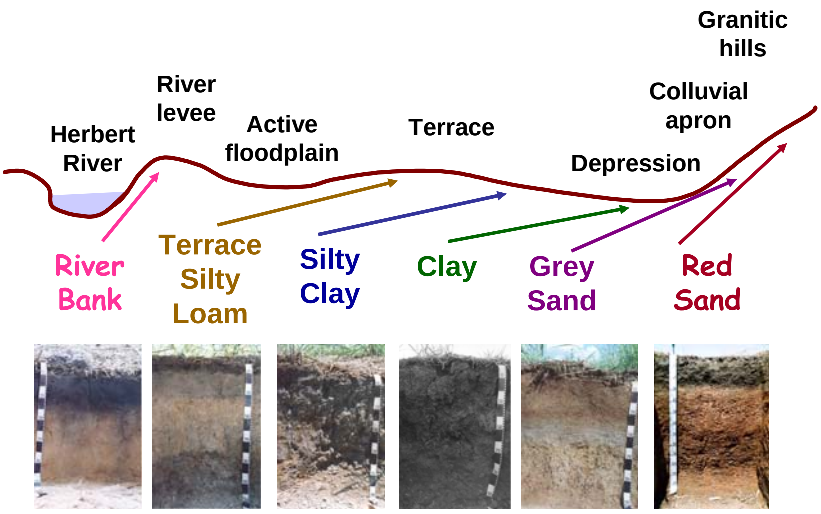

Figure 1. Example of a sequence of soils found in a typical landscape close to the Lower Herbert River (Wood *et al.*, 2003b).

Understanding and managing nutrient processes and losses

Based on a perception that growers do not fully understand basic soil chemistry (Table 1), important chemical properties and processes that occur in soils under sugarcane production are brought to the attention of growers within the 'Six Easy Steps'. These include descriptions of clay minerals, cation exchange capacity (CEC), organic matter, acidity and soil pH, sodicity, salinity and phosphorus sorption. The effects of nutrient transformations are illustrated and explained using nutrient cycle diagrams.

The 'Six Easy Steps' approach also introduces the concept of nutrient losses and/or potential loss pathways within the system. It recognises that some environmental risks are associated with fertiliser applications. The proximity of cane-growing areas to the Great Barrier Reef has increased pressure on the Australian sugar industry to take more active responsibility in caring for the environment. Nutrient losses that pose a risk are divided into a number of categories (Table 4), according to criteria described within the Australian fertiliser industry's FertCare® Level B accreditation course. Management options to minimise each identified loss are suggested. An example is shown in Table 5.

Table 4. Nutrient loss risk categories according to FertCare® Level B accreditation (Anon., 2004)

Risk category	Explanation
Leach	Nutrients that move below the rooting depth of crops as a result of water draining through the soil profile. This affects the quality of groundwater.
Run	Nutrients that move away from the point of application due to surface water movement. This can be in soluble form or attached to sediments.
Load	Nutrients or heavy metals that accumulate due to the application of fertiliser or other products, often due to high application rates.
Blow	Nutrients are lost by erosion or gaseous losses into the atmosphere.
Mine	Decline of soil fertility without replenishing the nutrients removed. Unwanted species (weeds) also contribute to mining of nutrients.

Table 5. Example of an identified nutrient loss showing the risk category and possible management options to minimise the risk of the particular nutrient loss.

Identified loss	Volatilisation of ammonia to the atmosphere can be substantial when urea is applied to the surface of a trash blanket.
Risk category	Blow
Management options	Apply urea just prior to rain or irrigation. Apply urea near row. Apply urea into soil below trash blanket. Apply a mixture of urea and ammonium sulphate. Use a urease inhibitor with the applied urea. Use polymer-coated granular urea. Delay urea application until the sugarcane is 50 cm tall. Use of other sources of N (e.g. CalAm, mill by-products).

Soil testing regularly

Regular soil testing is an essential part of the 'Six Easy Steps' approach, despite the frequency of sampling being relatively low in the past (Schroeder *et al.*, 1998a). This situation has however improved, with growers now often sampling their blocks of cane prior to planting or replanting. This change is probably associated with the soil samples being collected by productivity or grower services officers in districts such as Bundaberg, Proserpine and the Herbert.

Without access to an industry controlled fertiliser advisory service laboratory, (Schroeder *et al.*, 1998), the 'Six Easy Steps' recognises that there are four important aspects of soil testing (Table 6). It is stressed that each of these components needs to be carried out with care to ensure meaningful results. With increased use of soil testing, the provision of 'whole cycle' fertiliser advice, similar to that used in the South African sugar industry (Wood, 1987), could possibly be considered in future.

Table 6. Steps involved in soil testing.

Soil sampling steps		Description
1.	Sample collection	Collect soil samples according to the standard guidelines.
2.	Sample analysis	Submit samples to a reputable laboratory for analysis.
3.	Interpretation of results and calculation of nutrient inputs	Ensure sound interpretation of the results and appropriate fertiliser recommendations by having an understanding of the basic process, and getting advice from capable advisers or Extension Officers.
4.	Fertiliser applications	Apply fertilisers at the appropriate rates and keep records of actual nutrient inputs.

Adopting soil-specific fertiliser recommendations

As indicated earlier, the generalised fertiliser recommendations that had previously been used in the Australian sugar industry have been transformed into a set of soil-specific nutrient guidelines (Wood *et al.*, 2003a). Advances have been made in fine-tuning guidelines for all major nutrients (nitrogen (N), phosphorus (P) and potassium (K)), but only the changes applicable to N are illustrated here.

Nitrogen fertiliser recommendations have traditionally been based on general production functions without reference to soil type (Chapman, 1994). As a result of a reassessment and the quest for soil-specific recommendations, nitrogen fertiliser guidelines are now based on the combination of district yield potential and an N mineralisation index (Wood *et al*., 2003b). The term 'district yield potential' refers to the best possible yield averaged over a range of different soils in a district and recognises differences in the ability of regions to produce cane (Schroeder *et al.*. 2005). For example, the Burdekin region with its fertile soils, higher temperatures and access to water, has a higher yield potential than most other districts. These district yield potentials have been used to establish base N application rates according to a previously established relationship: 1.4 kg N per ton of cane is needed up to a cane yield of 100 tons/ha and 1 kg N per ton/ha thereafter (Keating *et al.*, 1997). In regions such as the Herbert, Bundaberg and Proserpine, the baseline N rate is set at 160 kg N/ha because the district yield potentials are estimated to be 120 tons cane per hectare. According to this modified system, the base N rate is then adjusted according to the N mineralisation index (Table 7), which is linked to soil organic carbon content (Walkley and Black, 1934). The use of the N mineralisation index is similar to that developed and used in the South African sugar industry (Meyer and Wood, 1994). According to that system, N recommendations are based on four N mineralisation potential categories that are linked to soil organic matter content (Meyer *et al.*, 1983; Meyer *et al.*, 1986).

After determining the appropriate N application rate within the modified system in Australia, further discounting is used to take other sources of N into consideration. These include N from legume fallow crops, harvested legume crops, application of mill by-products, mineral nitrogen remaining in soil after small crop production and nitrate and/or ammonium in irrigation water (Schroeder *et al.*, 2005).

Table 7. Nitrogen guidelines based on the N mineralisation index for areas where the estimated district yield potential is 120 tons/ha (Schroeder *et al.*, 2005).

N mineralisation index	Organic C (%)	Estimate of easily mineralisable (aerobic) N (kg/ha)	Baseline N rates (kg/ha)
VL	<0.4	<20	160
L	0.4 – 0.8	20-30	150
ML	0.8 – 1.2	30-40	140
M	1.2 – 1.6	40-50	130
MH	1.6 – 2.0	50-60	120
H	2.0 – 2.4	60-70	110
VH	>2.4	>70	100

Nitrogen from legumes is determined using information from the Sugar Yield Decline Joint Venture (Garside and Bell, 2001; Garside and Berthelsen, 2004). The amount of N available to sugarcane grown after legume crops is dependent on the type and quality of the legume crop, and whether the grain was harvested. This amount is then used to adjust the N fertiliser requirement for cane on soils with different N mineralisation potentials. Although soybean, cowpea and lablab are all grown in rotation with sugarcane (Bell *et al.*, 2003), examples of available N from soybean crops are shown here for illustrative purposes (Table 8). The effect of N from fallow crops on N requirement in subsequent sugarcane crops is shown in Table 9.

Table 8. Estimated N contribution from soybean fallow crops using information from the Sugar Yield Decline Joint Venture (Schroeder *et al.*, 2005).

Quality of the soybean crop	Estimated dry mass (tons/ha)	N contribution from a green manure crop (kg/ha)	N contribution if grain is harvested (kg/ha)
Good	6	270	90
Poor	2	90	30

Table 9. Effect of fallow management on N requirement (after Schroeder *et al.*, 2005).

	N application rates in relation to organic C (%) and N mineralisation index categories						
Organic C (%)	<0.4	0.4-0.8	0.8-1.2	1.2-1.6	1.6-2.0	2.0-2.4	>2.4
N mineralisation index category[1]	VL	L	ML	M	MH	H	VH
Crop:							
Replant cane	160	150	140	130	120	110	100
Plant cane after a grass/bare fallow	140	130	120	110	100	90	80
Plant cane after a good legume crop (N rate minus 270 kg N/ha (as indicated in Table 8))	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Plant cane after a poor soybean legume crop (N rate minus 90 kg N/ha (Table 8))	70	60	50	40	30	20	10
Plant cane after a good legume crop harvested for grain (N rate minus 90 kg N/ha (Table 8))	70	60	50	40	30	20	10
Plant cane after a good legume crop harvested for grain (N rate minus 30 kg N/ha (Table 8)	130	120	110	100	90	80	70
Ratoon after replant, or after a legume crop[2]	160	150	140	130	120	110	100

[1] N mineralisation index categories as indicated in Table 1.

[2] Data from the Yield Decline Joint Venture suggest that N applied to the ratoon sugarcane crops after a good legume crop should follow the normal guidelines and that no reduction be made despite the apparent excess of N being supplied to the plant cane.

Nitrogen originating from the application of mill by-products should also be taken into account and subtracted from the N requirement (Calcino, 1994). Despite variable N contents of mill by-products such as mill mud, mill ash and mud/ash mixtures (Barry *et al.*, 2002), guidelines indicate how much N is available to plant cane, and first and second ratoon crops, following application of the by-products at or prior to planting (Table 10).

Table 10. Nitrogen (kg/ha) supplied by mill by-products applied at 200-250 wet tons /ha at or prior to planting (Wood *et al.*, 2003b).

By-product	N (kg/ha) supplied		
	Plant cane	First ratoon	Second ratoon
Mill mud	100	50	25
Mud/ash mixture	60	30	15
Mill ash	0	0	0

Due to the high rates of N applied to small crops grown in rotation with sugarcane, soil testing for mineral N (ammonium and nitrate) is recommended under such circumstances. Any residual N in excess of the 'base-line' N expected from the usual mineralisation of soil organic matter needs to be discounted from the established N application rate. Estimates of 'base-line' mineral N according to the N mineralisation index categories are shown in Table 11.

Table 11. Estimate of the 'base-line' N found in soil after winter (Schroeder *et al.*, 2005). Values above these indicate residual N remaining after harvesting the small crops.

	N mineralisation index categories						
	VL	L	ML	M	MH	H	VH
Soil organic C (%)	0-0.4	0.4-0.8	0.8-2	1.2-1.6	1.6-2.0	2.0-2.4	>2.4
Estimate of mineral N at the end of winter (mg/kg)	5	10	14	18	20	22	24

Other sources of N that may occur in the sugarcane production system also need to be taken into account. These include N in ground water and/or irrigation water.

Using leaf analysis to check on the adequacy of nutrient inputs

Leaf analysis for commercial purposes has in the past rarely been used in the Australian sugar industry (Schroeder *et al.*, 1998c). More recently, the BSES Leaf Analysis Service was established to enable growers to have access to reliable and cost effective leaf testing for use within the 'Six Easy Steps' process. Apart from a diagnostic tool, leaf analysis offers a useful way of checking on the adequacy of their nutrient inputs and monitoring nutrient trends at block and farm scales (Meyer *et al.*, 1989; Schroeder *et al.*, 1993). The service provides leaf analysis reports that are grower-friendly, with results shown in bar-graphs representations that are relative to accepted third-leaf nutrient critical values.

Keeping good records and modifying nutrient inputs when and where necessary

Comprehensive record keeping is the final step in the 'Six Easy Steps' approach. It promotes the use of farm data to enable growers to make informed decisions about nutrient management, especially modifications to nutrient inputs for individual blocks of cane. This step also provides an automatic return to any of the previous steps within the framework.

Although no individual record keeping system is prescribed, it is suggested that details for individual blocks be kept separately, with details from consecutive years enabling trends to be identified easily. Records should include block details (number, soil and crop, year of planting and variety), soil analysis data, recommended nutrients or ameliorants and rates, actual nutrients or ameliorants and rates applied, leaf analysis data, and harvest and yield data. Inclusion of costs of fertiliser inputs and income from cane could enable simple economic analyses and determination of efficiencies at block level. Possible options for data storage include hard-copy systems, or computerised spreadsheet/database applications.

Delivering the integrated approach to improved nutrient management to the industry

The need for accelerated adoption of best-practice nutrient management in the Australian sugar industry has necessitated the delivery of the 'Six Easy Steps' to growers through a targeted approach. This includes the production of printed material, a multi-level training program and demonstration of changed nutrient management practices in field trials.

The printed material consists of regionally specific nutrient management booklets aimed at growers and their advisers, technical information detailing the modified nutrient management guidelines, and articles in semi-technical publications and scientific papers. An important development has been the production of a booklet entitled, 'Soil Specific Management

Guidelines for Sugarcane Production' for the Herbert River district (Wood *et al.*, 2003b). This booklet provides nutrient management recommendations for 24 different soils used for growing sugarcane in the Herbert River district, using the modified guidelines developed over the past few years (Wood *et al.*, 2003a). Based on the success of this publication, further regional specific booklets will soon become a reality for other districts in the Australian sugar industry, including Proserpine, the Johnstone Catchment and Bundaberg. Ultimately, it is hoped that such booklets will be available for all cane growing regions in Australia.

The training program is being delivered at three levels. The basic or individual components of the 'Six Easy Steps' are delivered to growers by oral presentations at 'shed meetings' (attended by 10-30 growers) or using poster presentations at 'field days'. More detailed information about the 'Six Easy Steps' is presented at half-day workshops using a workbook entitled, 'An integrated approach to sustainable nutrient management for sugarcane'. More advanced workshops are being presented to growers (12-16 attendees) with the aim of progressively developing growers' abilities to use the 'Six Easy Steps' to produce nutrient management plans for their farms. These workshops, entitled 'Accelerating the adoption of best-practice nutrient management' consist of three component workshops, each of which is presented over 4-5 hours. Attendance at all three component workshops is recommended to ensure continuity in acquiring and using new and previous knowledge to improve nutrient management on-farm. Understanding the full concept of the 'Six Easy Steps' and developing nutrient management plans is considered easier if the three component workshops (Table 12) are attended in sequence, even if this attendance is separated by a few weeks.

Table 12. Details of the regional workshops aimed at accelerating the adoption of best-practice nutrient management.

Workshop 1: Knowing our soils, and understanding and managing nutrient processes and losses. This workshop is aimed at establishing the need for improved nutrient management and providing a sound basis for soil-specific nutrient guidelines: • Best-practice nutrient management. • The 'Six Easy Steps' approach. STEP 1 – *Knowing our soils:* • Soil field properties and what they mean; soil chemical properties. STEP 2 – *Understanding and managing nutrient processes and losses:* • Nutrient availability and balanced nutrition.
Workshop 2: Adopting best-practice nutrient management. This workshop is aimed at progressing the 'Six Easy Steps' approach to ensure that the ingredients for successful nutrient management plans are in place. STEP 3 – *Soil testing regularly*. STEP 4 – *Adopting soil-specific fertiliser recommendations:* • Up-to-date soil and district-specific nutrient management guidelines. • Developing a nutrient management plan for a hypothetical farm.
Workshop 3: Developing nutrient management plans for your farm. This workshop is aimed at developing nutrient management plans for a grower's farm: • Consolidating the value of the 'Six Easy Steps' approach. STEP 5 – *Using leaf analysis as a check on the adequacy of nutrient inputs.* STEP 6 – *Keeping good records and modifying nutrient inputs:* • Initiating the development of an actual nutrient management plan for a specific farm.

The training program is proving to be popular with growers. About 150 growers have attended the half-day workshops in the Bundaberg/Isis districts over the past few years. The more advanced workshop is being delivered in areas such as the Herbert district, with further roll-out to other regions occurring in due course.

Discussion and conclusions

Although some symptoms of inefficient nutrient management have been identified in the Australian sugar industry, the concept of sustainable nutrient management is considered an integral part of sugarcane production in Australia. This means that best-practice nutrient management is directly linked to profitable cane production in combination with the maintenance of on-farm soil resources and care for the greater environment.

Impediments to the adoption of best nutrient management practices are complex, with contributing factors appearing to vary from farm to farm, and district to district. However, a concerted effort is being made to accelerate the adoption of a framework to achieve best possible adoption of sustainable nutrient practices for specific circumstances. The ‘Six Easy Steps’ approach is aimed at facilitating the adoption of a logic-based system on individual farms. It is underpinned by the need for a good understanding of soils and their properties, regular soil testing, the use of modified nutrient guidelines, leaf analysis and good record keeping.

In adopting this system, growers will be able to consider their own on-farm resources, make informed decisions about their nutrient inputs and be able to embark on stepwise improvements in managing nutrient inputs in their farming enterprises. Although the delivery of the ‘Six Easy Steps’ approach is occurring within the three-tiered training program, information is also being made available through the printed media and in oral presentations.

Further development of the concept of best-practice nutrient management is in progress. This includes the establishment of soil reference sites in various sugarcane districts to enable further extrapolation of soil-specific nutrient management guidelines at a district level. Surveys will also be conducted to enhance the understanding of growers’ perceptions to nutrient management and monitor changes in attitude. Work is also progressing on the development of a Soil Capability and Management Package (SCAMP) that will allow temporal ‘risk’ and climate forecasting to be incorporated into on-farm nutrient management strategies.

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