
EXTENSION AND ADOPTION OF THE 'SIX EASY STEPS' NUTRIENT MANAGEMENT PROGRAM IN SUGARCANE PRODUCTION IN NORTH QUEENSLAND

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Abstract

In tropical north Queensland, the need for accelerated adoption of best-practice nutrient management has become more urgent because of increasing pressures for profitable cane production to be achieved in combination with environmental awareness. The latter of these contributory factors is driven primarily by the proximity of sugarcane-producing areas to the World Heritage-listed Great Barrier Reef. The SIX EASY STEPS program was developed to enable easy adoption of best-practice nutrient management principles on-farm and to promote sustainable nutrient use in the Australian sugar industry. This system, aimed at sustainable sugarcane production, encourages growers to use knowledge of soils, nutrients and the sugarcane crop to make informed decisions about their fertiliser inputs. Although growers usually have an inherent understanding of these concepts, a short-course program is being used to promote the development and use of appropriate nutrient management plans for targeting nutrient inputs. This paper reports on an assessment of this educational process which is linked to specific follow-up and grower-interactive activities. In general, it has been found that growers and their advisers value the opportunity to attend the short-course program. However, development of individual nutrient management plans will probably not be progressed by growers without further input from extension officers. The use of participative on-farm strip trials that compare usual grower nutrient management practices to those promoted by the SIX EASY STEPS, is a useful and practical means of demonstrating the worth of best-practice nutrient management to growers.

Introduction

During the past 15 years, Australian sugar industry scientists have been modifying nutrient management guidelines for sugarcane production. Led by BSES Limited, the Australian sugar industry's principal research, development and extension (RD&E) organisation, the changes have included refined nutrient application rates and tighter recommendations on timing and placement of nutrient applications.

The impetus for revamping nutrient management recommendations arose from the increasingly narrow profit margins of sugarcane production and rising environmental awareness by the industry. No longer could nutrient advice concentrate only on sugarcane yields but would also have a very strong focus on sustainability which includes aims at profitable cane production in combination with minimal impact on the agricultural and wider environments.

The new sustainability guidelines, therefore, encompass optimising sugarcane production and profitability while minimising nutrient losses due to volatilisation, denitrification, leaching and soil erosion.

The new sustainability guidelines have been encompassed in the SIX EASY STEPS strategy (Schroeder *et al.*, 2010) which is being rolled out to Australian sugarcane growers under a one-day short-course extension program called 'Accelerating the adoption of best-practice nutrient management'. The course provides canegrowers with the information and tools on how to develop sustainable nutrient management plans for each block on their farms.

This paper provides an historical summary of nutrient use within the Australian sugar industry and describes the concept of sustainable nutrient management in the context of environmental and government pressures to limit nutrients into the Great Barrier Reef Lagoon.

It also provides a summary of the development, operation, attendance and impact of the SIX EASY STEPS program.

History of nutrient use

Early BSES Limited sugarcane technologists recognised the need to devise balanced nutrition strategies (Maxwell, 1901). The BSES Limited fertiliser advisory service to growers commenced in about 1940. An upsurge in sugarcane nutrition research began in the 1970s (Schroeder *et al.*, 1998) resulting in a set of broad, generalised recommendations across regions and soil types (Calcino 1994, Wood *et al.*, 1997, Calcino *et al.*, 2000).

While useful, the recommendations afforded little recognition of differences in soil type, and in particular the nitrogen (N) mineralisation potential of soils. The need to refine nutrient recommendations to minimise adverse environmental impacts while maintaining profitability and soil fertility was recognised in the late 1990s.

The resulting SIX EASY STEPS nutrient recommendations are now standards accepted by industry and government.

In the past, canegrowers have generally over-fertilised especially with N. Schroeder *et al.* (2002) showed that on average across the industry:

- 80% of growers surveyed applied rates of N fertiliser on fallow plant cane in excess of BSES Limited recommendations. The majority of these applied more than 50 kg N/ha above the recommended rates.
- 45% applied rates of N on replant cane (cane planted soon after the destruction of the previous crop without an intervening fallow) in excess of recommendations.
- 44% applied rates of N on ratoon cane in excess of recommendations.

These percentages did not vary much between mill areas, with the exception of Innisfail and Babinda. Most growers in these areas applied recommended rates or lower.

Risk aversion has been a major factor motivating growers to apply nutrients, especially N, above recommended rates (Thorburn *et al.*, 2003). Extra N was seen as economical insurance to protect profits against unforeseen environmental impacts during the 12- to 14-month growing period.

This type of approach was not sustainable, as N and phosphorus (P) are the two agricultural nutrients that have the potential to adversely impact on water quality and, ultimately, coral reefs.

However, data supplied by Incitec Pivot Limited (the major manufacturer and supplier of fertilisers to the Australian sugar industry), indicate that N and P application rates have shown a downward trend over the last decade (Tables 1 and 2).

The company compiles annual estimates of nitrogen and phosphorus use in Australia's main sugarcane districts. While imperfect, these figures provide possibly the most reliable picture of temporal and spatial fertiliser usage by Australian canegrowers.

Since 1996, the average nitrogen application rate across the Australian industry has fallen by 20% (Table 1). During the same period, the average phosphorus application rate across the Australian industry has fallen by 30% (Table 2).

Table 1—Nitrogen application rates (kg N/ha) across Australian sugarcane growing regions 1996–2007.

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Wet Tropics	169	151	138	144	151	149	147	137	145	142	143	145
Herbert	213	198	209	204	183	201	205	191	155	153	149	151
Burdekin	272	246	247	269	233	229	234	219	223	213	218	212
Central	225	232	214	233	176	175	166	171	174	172	176	165
South Qld ¹	161	155	155	150	148	148	120	121	144	136	150	161
NSW ²	164	166	164	159	173	155	150	148	155	148	158	139
Average	206	197	190	199	179	177	171	166	169	165	169	164

Source: Garry Kuhn, Product Stewardship Manager, Incitec Pivot.

¹South Queensland; ²New South Wales.

Table 2—Phosphorus application rates (kg P/ha) across Australian sugarcane growing regions 1996–2007.

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Wet Tropics	28	25	22	19	23	24	20	21	20	21	24	20
Herbert	28	26	25	21	21	30	26	24	16	16	18	17
Burdekin	28	26	25	21	21	30	26	24	16	16	18	17
Central	28	30	26	24	18	20	14	15	14	13	19	19
South Qld	24	27	26	21	24	27	19	21	25	23	26	26
NSW	30	31	24	19	26	25	20	21	26	23	23	18
Average	27	27	24	21	21	23	19	19	19	19	21	19

Source: Garry Kuhn, Product Stewardship Manager, Incitec Pivot.

The accuracy of the data is supported by regional surveys by BSES Limited such as the Wet Tropics Tully/Murray River catchment application figures (McMahon and Hurney, 2008). That survey found that growers are currently applying, on average, 141 kg N/ha, 22 kg P/ha and 107 kg K/ha. These rates are consistent with current BSES Limited recommendations based on the SIX EASY STEPS program (Schroeder *et al.*, 2009). The survey also revealed that nutrient application methods take into consideration potential losses from the soil that include leaching, run-off and gaseous losses (such as volatilisation and denitrification). The majority of the survey respondents were also aware of, and actively implementing, sustainable farm-management practices on-farm.

Unfortunately, in some catchments and on some individual farms throughout the industry, the average N and P application rates are still above industry recommendations. Additionally, in some locations, the timing and placement of nutrient applications needs to be improved to reduce adverse off-site impacts. The nutrient management practices outlined in the SIX EASY STEPS program are regarded by authorities and industry as the best way to achieve these targets. (Anon., 2009)

Sustainable nutrient use, the environment and government

As indicated above, BSES Limited and its partners (CSR Sugar and the previous Queensland Department of Natural Resources and Water (NRW)) working within projects funded by the Sugar Research and Development Corporation (SRDC) and the Cooperative Research Centre for Sustainable Sugar Production (Kingston and Lawn, 2003) undertook research aimed at enhancing the sustainability of the Australian sugar industry well before two recent key government initiatives. In January 2009, the Australian Government commenced its \$200 million Reef Rescue Plan, and in mid-2009 the Queensland State Government introduced legislation to control the use of nutrients in sugarcane production in areas adjacent to the Great Barrier Reef ecosystems. Although applied in different ways, both initiatives are designed primarily to improve the quality of water draining into the Great Barrier Reef lagoon.

The Great Barrier Reef was officially listed as a World Heritage Site in 1981 as an example of superlative natural phenomena. The Great Barrier Reef World Heritage Area is the world's largest coral reef ecosystem and one of the most complex natural systems on earth. The Reef extends 2000 km along the Queensland coast, comprises 2900 individual reefs including 760 fringing reefs (Johnson and Marshall, 2007), and covers an area of 35 million hectares. It directly contributes over \$5.8 billion annually to the gross domestic product of the Australian economy and supports approximately 63000 jobs (Jones, 2009; Rudd *et al.*, 2007; Anon, 2005). Many coastal communities which evolved as the sugar industry developed in the late 19th century colonisation of Queensland rely heavily on the sugar industry and Great Barrier Reef tourism for their future.

Sugarcane cropping has been identified as posing a high risk of nutrient transport in Reef catchments primarily due to the area under production (Furnas, 2003) and the location of the industry adjacent to the Reef. CSIRO, Great Barrier Reef Marine Park Authority and James Cook University have conducted modelling which has identified run-off hot spots and determines the temporal and spatial aspects of the delivery of pollution to the Reef. These include areas of high fertiliser use (Maughan *et al.*, 2007) particularly in the Wet Tropics region of north Queensland.

Along the Queensland coast, 31 river catchments drain into the Great Barrier Reef. Sugarcane is grown in approximately half the catchments comprising seven in the Wet Tropics (Mossman to Tully), one in the Herbert (Ingham), three in the Burdekin (Ayr), four in central Queensland (Proserpine to Sarina) and one in south Queensland. Very little cane production occurs in the south Queensland catchment.

In October 2007, 14 months before being elected to government, the Federal Australian Labor Party issued a policy document titled 'Labor's Reef Rescue Plan' whose aim was to 'tackle climate change and improve water quality in the Reef through a range of activities' (Rudd *et al.*, 2007). The policy document stated there was a growing body of scientific evidence linking the declining health of the Great Barrier Reef to poor water quality. Following Labor's election, the five-year Reef Rescue Plan was implemented on 1 January 2009 to improve farming practices in the Great Barrier Reef catchment. Included in those practices was improved nutrient management on sugarcane farms.

At the Queensland state government level, the Great Barrier Reef Protection Bill which took effect from 1 January 2010 aims to reduce the levels of farm fertiliser, pesticide and sediment harming the Reef (Jones 2009).

Given the pressure and incentives from State and Commonwealth governments and the sugar industry's desire and commitment to reduce its environmental footprint, the SIX EASY STEPS nutrient management program is having a major role in improving the industry's sustainability while satisfying the community's expectations of the industry.

Development of the SIX EASY STEPS workshops

The SIX EASY STEPS workshop program (Schroeder *et al.*, 2010) was developed as a district-specific, interactive, practical and interesting short course specifically for canegrowers (Schroeder *et al.*, 2006a). This integrated nutrient management tool incorporates the recent refinements to nutrient recommendations for the Australian industry and has been strongly supported by the industry.

The program consists of the following six components:

1. Knowing and understanding your soils
2. Understanding and managing nutrient process and losses
3. Regular soil testing
4. Adopting soil-specific nutrient management guidelines
5. Checking on the adequacy of nutrient inputs (e.g. leaf analyses)
6. Keeping good records to modify nutrient inputs when and where necessary

The program provides:

- guidelines for the implementation of balanced sugarcane nutrition to optimise productivity and profitability without adversely affecting soil fertility or the environment i.e. sustainable sugarcane production
- skills for growers to develop their farm nutrient management plans

A key message of the workshops is that soil test analyses are crucial to providing the necessary information on which to develop the most appropriate nutrient management strategy for individual farms.

The new nutrient recommendations focus on regional environments and soil characteristics. Management guidelines are soil specific by recognising soil attributes such as colour, texture, chemical properties and position in the landscape.

The SIX EASY STEPS program also promotes the development and implementation of fertiliser strategies for a full crop cycle. The 'whole of crop cycle' fertiliser recommendation approach is compatible with a more strategic, longer-term attitude to nutrient management promoted by industry research, development and extension organisations.

Before rolling out the SIX EASY STEPS program to the industry, BSES Limited sought input from extension staff and growers. The final product incorporated suggestions to enhance the program and improve its effectiveness to grower stakeholders.

With the extension of the SIX EASY STEPS nutrient management program, Australian canegrowers are now in a far better position to better understand their soils, their nutritional requirements and techniques to avoid adverse off-site impacts.

Operation of SIX EASY STEPS workshops

A SIX EASY STEPS workshop lasts for approximately six hours. Attendance numbers are restricted to maximise interaction between the workshop presenters and the usual nine to 15 attendees. Each participant receives a workshop manual to keep for future reference. The manual provides detailed information on all the material covered during the workshop including a laminated, one-page nutrient recommendation sheet which lists advised inputs based on soil analyses.

The cornerstone of the workshop is a computer-based presentation that comprehensively covers all aspects of the SIX EASY STEPS approach to nutrient best management practice. The workshop is designed to be as interactive as possible. Attendees are strongly encouraged to ask questions and offer observations relating to their own experiences for discussion by the group. Working in small sub-groups with the assistance of the presenters, participants work through several exercises to reinforce information presented earlier in the workshop. Participants are given a certificate of attendance upon completion of the workshop. The certificate is regarded favourably when the grower applies for funding to adopt strategies to reduce off-site environmental impacts.

The first SIX EASY STEPS workshop was held in south Queensland in 2005. With the introduction of the Commonwealth Government's Reef Rescue Program on 1 January 2009, the roll-out of the workshops across all catchments adjacent to the Great Barrier Reef became a priority for BSES Limited extension officers and scientists.

Funding to conduct the workshops is being provided by the Australian Government under the Reef Rescue Plan. Operating in conjunction with these workshops, partial funding is also being provided by the government to enable growers to implement on-farm activities that will lead to improved water quality on the Great Barrier Reef by reducing the run-off of nutrients, pesticides and sediments from agricultural land. (Rudd *et al.*, 2007).

Attendance and impact of the SIX EASY STEPS workshops

A total of 3842 growers from north to central Queensland produce sugarcane in the catchments that drain into the Great Barrier Reef (CANEGROWERS Brisbane, pers. comm. 2009).

The South Queensland contribution to Reef run-off is very small and is not included in the following discussion.

To 30 June 2009, approximately 630 growers had voluntarily attended a SIX EASY STEPS workshop. This 16% of the total grower number is estimated to represent approximately 30% of the area producing cane. In addition, about 100 extension staff, natural resource management representatives, sugar industry productivity officers and agribusiness advisers also attended workshops.

SIX EASY STEPS workshops were rolled out across north Queensland in February 2008, one to two years later than in the rest of the industry. Detailed records of attendance at north Queensland workshops show that 40625 ha or 31% of the area under sugarcane cropping has been represented at SIX EASY STEPS workshops (Table 3).

Table 3—Details of attendance at SIX EASY STEPS workshops in north Queensland (Wet Tropics and Herbert).

Region	Catchments in region	Number of grower attendees	Number of other attendees	Number of workshops	Proportion of area under cane represented (%)
Mossman	Daintree Mossman	24	1	2	54.9
Tableland	Barron Mitchell*	10	0	1	40.5
Mulgrave	Barron Russell-Mulgrave	59	8	5	62.4
Babinda-Innisfail	Russell-Mulgrave Johnstone	88	18	8	52.4
Tully	Tully Murray	37	11	5	28.5
Herbert	Herbert	25	4	2 [^]	11.3
Total		243	42	23	31.3

* Mitchell catchment does not run to Great Barrier Reef lagoon

[^] Several earlier workshops not included

To assess the immediate impact of the workshops on grower attitudes, a short survey was conducted at the conclusion of the last 14 workshops. The results confirmed a very strong positive opinion of the value of this extension activity among participants across all six regions (Table 4).

Table 4—Results of 14 SIX EASY STEPS workshop attitudinal surveys conducted across all regions in north Queensland.

Question	Number of respondents		
	Yes	Partly	No
Was the course useful?	175	2	0
Would you recommend the course to other growers?	175	1	0
Was the course too difficult to understand?	3	32	130
Is there anything you would like changed or dropped from the course?	10		160

When participants at the last ten workshops were asked to provide an overall assessment of the workshop, the average score of the 119 respondents was 9.1 out of 10. Forty per cent of respondents rated the workshop at the maximum score of 10.

In 2009, a survey of 88 canegrowers in all regions across Queensland who had completed a SIX EASY STEPS workshop was conducted (RWUEI 2009, T Anderson pers. comm.). The survey

assessed on-farm practical changes that had been implemented as a result of attendance at a workshop. The survey results confirmed that the initial positive impact of the workshops translated into the adoption of sustainable practices. Some of the survey results include:

- Ninety-five per cent of growers had taken a soil test in the previous two years to determine the most appropriate nutrient management program for a particular cane field or area of the farm.
- Sixty-one per cent changed the type of fertiliser they used to a more economical or nutritionally appropriate product.
- Fifty-eight per cent reduced fertiliser rates. The confidence they gained from the course to reduce fertiliser rates without fear of loss of productivity was stated as a significant factor in the decision to reduce nutrient inputs.
- Almost all growers who grew an alternative crop reduced fertiliser inputs in the following plant cane crop.

The reasons for the success of the workshops are believed to be due to several factors. Canegrowers are increasingly aware of the environmental issues due to over-fertilising and inappropriate timing and placement of fertiliser applications. The sugar industry understands that government and community pressure on the industry, whether warranted or not, has to be addressed through appropriate nutrient management strategies. The workshops were developed in close cooperation with growers and extension staff to produce a product that is relevant, interactive, interesting and useful. Active participation in the workshops is seen as the key to their success.

Training program support

The SIX EASY STEPS training program is supported by a range of initiatives that are currently under way or planned (Schroeder *et al.*, 2010). These include:

- a workshop reference manual
- regional soil reference booklets (Wood *et al.*, 2003, Schroeder *et al.*, 2006b, Schroeder *et al.*, 2007a, Schroeder *et al.*, 2007b) which include soil-specific nutrient management guidelines for cane production in each district
- nutrient management plans which will include farm maps with soil overlays
- replicated on-farm strip trials (Salter *et al.*, 2008) to compare SIX EASY STEPS nutrient recommendations with growers' own current fertiliser strategies
- the NutriCalc calculator to determine nutrient requirements based on soil test results
- two new decision support tools for minimising off-site movement of nutrients (Moody *et al.*, 2008): 'Soils Constraint and Management Package' (SCAMP) that utilises soil analytical data to identify soil constraints to long-term sustainability and 'SafeGauge for Nutrients'.
- trials to determine the nutrient requirements of new farming systems (Wood *et al.*, 2008)

Conclusion

The development and delivery of the SIX EASY STEPS program and implementation of the program's nutrient recommendations and management practices have been significant achievements for the Australian sugar industry. The program is successfully addressing industry, community and government targets relating to sustainable nutrient use in the sugarcane production system.

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(QPIF) and the Australian Department of the Environment, Water, Heritage and the Arts (DEWHA). Under the Reef Rescue Program, the Australian Government provided partial funding through Terrain Natural Resource Management to assist with the delivery of some of the SIX EASY STEPS workshops.

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**VULGARISATION ET ADOPTION DES ‘SIX ETAPES FACILES’ POUR LE
PROGRAMME DE GESTION DES ENGRAIS DANS LA PRODUCTION
DE LA CANNE DANS LE NORD DU QUEENSLAND**

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**MOTS-CLES: Gestion des Engrais,
SIX ETAPES FACILES, Récif.**

Résumé

DANS LE NORD du Queensland tropical, la nécessité d’adopter une meilleure pratique pour accélérer la gestion des engrais est encore plus urgente en raison des pressions exercées pour atteindre une production de canne rentable tout en prenant compte de l’environnement. Ce dernier facteur dépend principalement de la proximité des planteurs de cannes avec la Grande Barrière de Corail reconnue par le Patrimoine Mondial. Le programme de SIX ETAPES FACILES a été développé pour permettre l’adoption de meilleures pratiques de gestion en éléments nutritifs sur les fermes et pour

promouvoir l'utilisation durable d'engrais dans l'industrie sucrière australienne. Ce système vise à une production durable de la canne, encourage les planteurs à mieux connaître les sols, les éléments nutritifs et la culture de la canne afin de prendre des décisions en toute connaissance de cause sur leurs apports d'engrais. Bien que les producteurs ont généralement une connaissance inhérente de ces principes, un cours de courte durée est proposé pour promouvoir le développement et l'utilisation des plans de gestion appropriés des éléments nutritifs afin de cibler les apports d'engrais. Cette présentation rapporte l'évaluation de cette méthode d'éducation qui est liée à des activités spécifiques et encourage des interactions entre les planteurs. En général, il a été constaté que les planteurs et leurs conseillers ont apprécié la possibilité de suivre ce cours de courte durée. Toutefois, la gestion individuelle ne va probablement pas progresser sans une aide supplémentaire des officiers de vulgarisation. La mise en place d'essais par bande sur les fermes avec la participation des planteurs qui comparent les pratiques de gestion des éléments nutritifs habituels à celles qui sont préconisées par les SIX ETAPES FACILES, est un moyen utile et pratique de démontrer une meilleure gestion des engrais aux planteurs.

EXTENSIÓN Y ADOPCIÓN DEL PROGRAMA DE MANEJO DE NUTRIENTES 'SIX EASY STEPS' (SEIS PASOS FÁCILES) EN LA PRODUCCIÓN DE CAÑA DE AZÚCAR EN EL NORTE DE QUEENSLAND

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PALABRAS CLAVE: Manejo de Nutrientes, SIX EASY STEPS, Arrecife.

Resumen

EN EL NORTE tropical de Queensland, se ha hecho urgente la necesidad de adoptar rápidamente las mejores prácticas para el manejo de nutrientes debido a las presiones crecientes en cuanto a la producción rentable de caña de azúcar en combinación con el cuidado del ambiente. El último de estos factores se debe a la proximidad de las áreas de producción de caña con la Gran Barrera del Arrecife que ha sido declarada Patrimonio Mundial. El programa de los 'Seis Pasos Fáciles', Six Easy Steps, en inglés, se desarrolló para permitir la fácil adopción de los principios de las mejores prácticas de manejo de nutrientes en el campo y para promover el uso sostenible de los nutrientes en la agroindustria azucarera australiana. Este sistema, orientado a la producción sostenible de caña, insta a los productores a usar el conocimiento de los suelos, nutrientes y el cultivo de caña para tomar decisiones documentadas sobre el uso de sus fertilizantes. Aunque los productores de caña generalmente tienen un conocimiento básico de estos conceptos, se está utilizando un curso corto para promover el desarrollo y uso apropiado de planes de manejo de nutrientes. Este trabajo reporta un estudio que se hizo de este proceso educativo que tiene un seguimiento específico y actividades interactivas para los productores de caña. En general, se ha encontrado que los productores y sus asesores valoran la oportunidad de atender este programa. Sin embargo, el desarrollo de los programas individuales de manejo de nutrientes no progresará sin el apoyo de los oficiales extensionistas. El uso de ensayos de franjas demostrativas donde se compara la práctica usual del productor y las prácticas promovidas por el programa Six Easy Steps, es un medio práctico y útil para demostrar el valor de un programa de mejor manejo de nutrientes a los productores.