A COMPARISON OF FERTILISER ADVISORY PRACTICES IN THE AUSTRALIAN AND SOUTH AFRICAN SUGAR INDUSTRIES

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Abstract

Fertiliser advisory practices in the Australian and South African sugar industries have developed over many decades. Research outcomes and industry/management decisions have had major impacts on the current fertiliser advisory systems in each case. This paper compares the fertiliser advisory practices in the two industries, in terms of attitudes to soil classification, nutritional norms, advisory services, nutrient surveys, and the nutritional research and development programmes. It also provides a brief geographic and productivity overview of the two industries. Although many similarities exist, a number of important factors have resulted in substantially different approaches being followed in each country. In the Australian sugar industry, fertiliser recommendations are based on general production functions and/or critical values. In contrast, the South African system is more soil and region specific and is based on managing nutrients and soils according to their chemical and physical properties. Access to a reliable fertiliser advisory service, ongoing nutrient monitoring, and research and development aimed at appropriate fertiliser advice is considered essential for sustainable cane production in both countries. Opportunities for co-operative research are highlighted.

Introduction

Many similarities appear to exist between the Australian and South African sugar industries, primarily due to the nature of the crop and the fact that both lie predominantly on the east coasts of their respective continents in the southern hemisphere. Practical experiences and/or research outcomes achieved in one country are quite often applicable or at least worth considering in the other. However, some inherent differences also exist, and conditions and circumstances are not always as similar as might be expected. These differences not only relate to the basic elements required for good sugarcane production, such as climate, distribution of soils and availability of water, but may also be attributed to other factors which include industry and/or management decisions, socio-economic issues in each country and the relative positions of the industries in the world sugar market.

Within this framework, fertiliser advisory practices have been influenced by agronomic, geographic, edaphic, climatic, environmental and economic factors. The fertiliser advisory systems that have developed over many decades in the two industries are thus somewhat different, despite similar objectives of developing and maintaining suitable nutritional recommendations for sugarcane. By initially describing the general differences between the two industries, this paper compares the fertiliser advisory practices and respective nutritional research programmes.

General descriptions of the industries

Australia

The Australian sugar industry covers an area of some 500 000 hectares and stretches from Grafton, New South Wales (29°30') in the south to Mossman (16°30') in north Queensland (Figure 1). Although this covers a distance of about 2 100 km, the individual sugar producing regions (Northern Queensland, Burdekin, Mackay-Proserpine, Southern Queensland and New South Wales) are often separated by relatively large distances into distinct areas or pockets. The north Queensland region, from Ingham to Mossman, is in the wet tropics. This is a high rainfall area (Table 1) and Babinda, in particular, has an annual average rainfall in excess of 4 400 mm. Irrigation of the crop is rare, apart from inland areas on the Atherton Tablelands. Ayr (Burdekin), on the other hand, is positioned within the dry tropics with an annual average rainfall of about 1 100 mm. In this area, as well as in southern Queensland and northern NSW, irrigation/supplementary irrigation is considered essential for sugarcane production. The central (Mackay-Proserpine) area receives approximately 1 700 mm rainfall per annum. Annual mean temperatures increase from south to north, and the central region and Burdekin regions receive the highest average sunshine hours per day (Table 1).

During the 1996 season, the 39 600 000 ton sugarcane crop harvested (Anon, 1997b) from 399 000 hectares by about 7 000 growers, yielded 5,4 million tons of sugar. This represented an increase of about 15% since 1991. In excess of 80%

of the total sugar production is sold on the world sugar market.

South Africa

The South African industry is about three quarters of the size of the Australian sugar industry in terms of area under cane (Anon, 1996b). Approximately 47 000 farmers grow sugarcane from Northern Pondoland in the south (31°30') to Malelane (26°) in Mpumalanga in the north. About 45 000 of these are designated as 'small scale' growers who produce about 10% of the total annual sugarcanecrop. The remaining producers are either commercial growers or miller-cum-planter operations. Apart from being more compact than the Australian sugar industry, the South African industry is also less fragmented. Approximately 70% of the total sugarcane crop is grown in a fairly continuous 400 km strip on the east coast, from Port Shepstone in the south to Mkuze in the north (Figure 1). Rainfall varies from about 1 000 mm in the south to 1 300 mm on the Zululand coast (Table 1). Most of the cane is grown under rainfed conditions. The remaining regions consist of the midlands which is situated above an altitude of 300 m, and the northern irrigated areas comprising Pongola and Mpumalanga, where irrigation is considered essential, as the annual long term rainfall is approximately 600 mm (Table 1). The average sunshine hours per day are substantially less than those measured in Australia.

During 1996-97, the 20 950 835 tons of sugarcane harvested from 300 944 hectares yielded 2,27 million tons of sugar, of which 80% was sold on the local market.

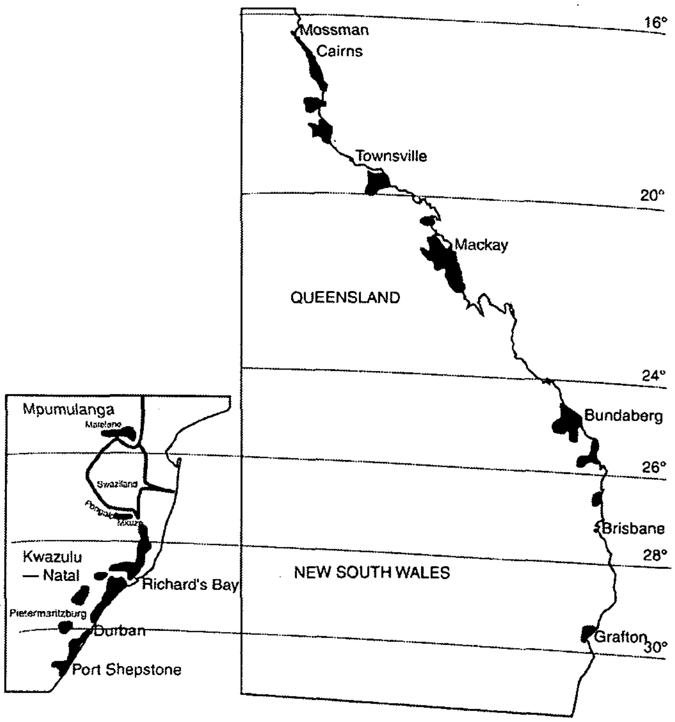

Figure 1. The South African and Australian sugar industries.

Table 1. Summary of meteorological information for the Australian and South African sugar industries: long term means.

Region	Mean temperatures (°C)		Sunshine hours	Average annual rainfall (mm)
	Max	Min		
Australia (Queensland Bureau of Meteorology)				
North	28,9	20,7	7,4	2 550
Burdekin	28,7	19,7	8,4	1 080
Central	26,3	18,9	8,4	1 680
South	25,5	15,7	8,0	1 110
NSW	25,0	13,3	8,0	1 375
South Africa (SASEX Meteorology Department)				
Mpumulanga	29,5	15,5	7,2	620
Zululand	27,0	16,3	7,0	1 320
N Coast	25,7	15,0	6,8	1 010
S Coast	25,0	14,3	6,0	1 000
Midlands	23,9	11,1	6,5	1 140

Soil classification

As early as 1901, scientists at the Bureau of Sugar Experiment Stations (BSES) realised that it was important to assess the fertility status of the sugar industry soils using suitable soil test procedures for estimating plant available nutrients (Maxwell, 1901). Furthermore, it was recognised that fertiliser needs should be linked to basic soil properties such as texture, colour, chemical composition and native vegetation (Maxwell, 1901). The classification of soils for determining relevant agronomic practices continued for the next few decades, albeit in an *ad hoc* fashion, and resulted in some important information relating to on-farm management (Bates, 1934; King, 1935). Apart from the soil based system for sugarcane crop management developed by CSR in the Herbert River district (Wood and Bramley, 1996; Wood *et al.*, 1997), it appears that little attempt was made by the industry to systematically categorise soils for research and/or fertiliser advisory purposes. Soil and land use surveys of the sugar belt have largely been conducted by state departments and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Soils (Cannon *et al.*, 1992; Holz and Shields, 1985; Murtha and Smith, 1994; Thompson *et al.*, 1981; Wilson and Baker, 1990). However, as the mapping scale in most cases is greater than 1:50 000, the information is inconsistent with the identification of soils within individual farms and/or cane fields (Wood *et al.*, 1997).

Prior to the development of the Australian Soil Classification System (Isbell, 1996), soils in the industry have been classified and/or named according to a range of methods/criteria in the different areas according to local preferences (Murtha, 1986; Northcote, 1971; Stace *et al.*, 1968; Stephens, 1962; Wilson, 1990). It appears that this diversity has, at least in part, been responsible for the lack of a soil property based approach to cane nutrition, and the apparent inability of growers to relate the soils on their farms to a classification system.

The early scientists at the South African Sugar Association Experiment Station (SASEX) also recognised that the classification of soils was invaluable in relation to sugarcane nutrition (du Toit, 1969). However, in contrast to Australia, a systematic soil survey of the entire South African sugar belt was undertaken by SASEX at a scale of 1:6 000 to evaluate the diversity of soils and the extent to which they could be grouped together (Beater, 1957; Beater, 1959; Beater, 1962). This survey provided useful information regarding the physical and chemical properties of soils, established a framework for advisory purposes and ensured that results of trials could be logically extrapolated to the rest of the industry (du Toit, 1969). With the establishment of the binomial soil classification system in South Africa (MacVicar *et al.*, 1977), which is used by the major agricultural industries for soil classification and survey purposes, 30 different soil forms (types) have been identified in the sugar belt (Meyer, 1984). Growers are generally conversant with the system, primarily due to the success of a concerted educational drive by SASEX (Anon, 1990) over a number of years. Generally, soils in the industry can be classified into four main groups based on colour and texture. Basic classification forms an important framework for the nutrition and advisory functions at SASEX, as it recognises that the management of nutrients should be soil specific (Moberly and Meyer, 1984; Meyer, 1996).

Basis for nutrition advice and fertiliser recommendations

Fertiliser advice in the Australian and South African sugar industries is based on the results of large numbers of nutrition trials conducted in the field and glasshouse over the past 50 to 60 years. The early NPK trials of Kerr and von Stieglitz (1938), which were located at 85 sites, formed the basis of the nutritional norms in the Australian industry. Similarly, nutrition research in the South African industry commenced during the 1950s with a series of 31 3x3x3 and 53 4x2x3 NPK fertiliser trials (du Toit, 1959). In both cases, subsequent research has been driven primarily by industry requirements and the need to confirm or modify the established nutritional critical values and norms for fertiliser advice (Chapman, 1968; Chapman, 1971a; Chapman, 1971b, Chapman, 1994; Meyer *et al.*, 1997; Meyer *et al.*, 1989; Wood, 1987; Wood and Meyer, 1989). Substantial differences have arisen in applicable nutritional norms and the basis for recommendations.

Nutritional norms

Despite the early separation of soil types, the Australian sugar industry's nutritional norms have evolved into a set of general recommendations for use across soils and regions (Wood *et al.*, 1997). These have been collated into a users' manual by Calcino (1994). The N, P and K norms and recommended rates are summarised in Table 2. Nitrogen recommendations are based on general production functions with no formal recognition of the N mineralisation potential of soils. However, reductions in N applications are recommended for 'rich land' and 'dry land' soils. In terms of the other nutrients (P, K, Ca, Mg, Zn and Cu), advice is based on conventional soil analyses, but with little account of soil properties (Schroeder *et al.*, 1998). Lime requirement is based on soil Ca values (Kingston and Aitken, 1996; Ridge *et al.*, 1980).

Table 2. N, P and K norms and recommended rates used in the Australian sugar industry (after Calcino, 1994).

Nutrient	Criteria/soil critical values (samples taken to a depth of 250 mm)		Recommended rate (kg/ha)			
Nitrogen	Broad soil type and crop		Burdekin and Mareeba		All other districts	
	[1]All soil types (except dry land and/or rich land)	Fallow plant Replant and ratoon	135-150 210-250		120-150 160-200	
			All districts			
	Dry land and/or rich land	Fallow plant Replant and ratoon	80 120			
	Nitrogen rates for plant cane can be reduced following a heavy legume crop and when growing vigorous cane varieties which are prone to lodging.					
Phosphorus	Critical value (0,005 M H_2SO_4) = 20 mg/kg		High yield (>120 t/ha)		Lower yield (<120 t/ha)	
			Plant	Ratoon	Plant	Ratoon
	Soil P (mg/kg)					
	<6		80	40	80	25
	6-10		80	40	40	25
	11-20		40	40	25	25
	21-40		20	20	20	20
	>40		20	nil	20	nil
Potassium	Critical value (0,02 M HCl) = 0,24 cmol(+)/kg		Plant		Ratoon/replant	
	Soil K (cmol(+)/kg)	[2]Nitric acid K (cmol(+)/kg)				
	<0,24	<0,2	100		120	
	<0,24	0,2-0,6	80		100	
	>0,24	>0,6	Reduced rate		Reduced rate	

[1]Dry land: areas receiving less than 1 200 mm of annual rainfall and no irrigation. Rich land: usually recent alluvial or peaty soils.
[2]Nitric acid K = 1 M HNO_3 soluble K.

By contrast, the South African norms have developed into a more finely tuned system with critical values reflecting soil chemical or physical properties (Table 3). Nitrogen recommendations are based primarily on the N mineralising potential of soils, which is based on soil colour, texture, structure and organic matter content (Meyer *et al.,* 1986). Rates of applied N also vary according to crop class, region, soil depth and availability of irrigation. Phosphorus recommendations are based on two critical values for plant and ratoons crops respectively, with applications of P fertiliser at rates in excess of those normally recommended by the Fertiliser Advisory Service for the high P-sorbing soils of the KwaZulu-Natal midlands (Wood and Meyer, 1989). Potassium recommendations are based on four different critical values which reflect clay content, location and base saturation of soils (Donaldson *et al.*, 1990; Anon, 1996a). Liming advice is based on an aluminium saturation index which is variety specific and, for humic soils, an Al:S ratio is used to modify lime requirement (Schroeder *et al.*, 1995).

Advisory service

Fertiliser advice to cane growers in Australia was originally provided by the BSES soil testing service located in Brisbane (Sedl, 1967) and was later extended to Mackay in 1957 (Haysom, 1969). This service not only provided fertiliser advice based on soil tests but also provided the basis for monitoring the soil fertility status in the industry. After its closure in 1973, after some 36 years, the function was taken up by commercial laboratories and/or fertiliser companies. The CSR leaf testing service which provided fertiliser advice to the various CSR mill districts during the 1960s (Farquhar, 1967) was also discontinued in the mid-1970s. At present, there is limited use of soil testing by growers, and leaf analysis for advisory purposes is rare. It is estimated that the intensity of soil sampling is in the order of 160 ha per sample on an annual basis. Advice is generally provided by fertiliser companies, with secondary advice from industry sponsored extension staff. Queensland primary producers continue to have access to a government operated water analysis service to assess suitability for irrigation.

SASEX has run a fertiliser advisory service (FAS) for the industry since 1954 (Schroeder *et al.*, 1992; Meyer *et al.*, 1997). The aim is to analyse soil, leaf, irrigation water and fertiliser samples submitted by growers from the industry and provide fertiliser recommendations, salinity/sodicity assessments and specialist advice on sugarcane nutrition (Schroeder and Southey, 1996). The FAS continues to be the main provider of fertiliser advice to the industry through the provision of 'whole cycle' fertiliser recommendations. According to this system, nutritional advice for a plant and four successive ratoon crops is based on the results of analysis of soil samples collected prior to planting (Wood, 1987). Leaf analysis is then used to evaluate the adequacy of this advice according to locally established critical values. As such, both soil and leaf analyses are considered essential tools for ensuring balanced cane nutrition (du Toit, 1959; Schroeder *et al.*, 1994), and providing cost effective and environmentally friendly fertiliser recommendations (Anon, 1994). The annual intensity of soil sampling is approximately 30 ha per sample. This figure reduces to 20 ha per sample when both soil and leaf samples are considered. In general, the FAS is used mainly by commercial growers and miller-cum-planter operations, with very few samples being received directly from small scale farmers.

Recently, the South African industry has sought to establish the FAS as a self sufficient service based on a 'user-pays' principle. A study aimed at evaluating the viability of this service found that the overall benefits of retaining the FAS as part of SASEX outweighed the cost to the industry (Schroeder and Southey, 1996).

Nutrient surveys

A soil fertility monitoring program was established following closure of the BSES soil testing service to provide a replacement means of studying the factors influencing cane nutrition (Chapman, 1985). Two hundred and forty sites were selected to represent the soils in the Queensland sugar belt. In particular, it has become apparent that most soils used for long term cane production have above adequate levels of soil P due to widespread use of excessive P fertiliser (Wood *et al.*, 1997). In addition, N is often applied at rates above those recommended (Chapman, 1985; Kingston and Linedale, 1987), obsevations supported by results of a survey of fertiliser usage in the north Queensland area (Webster *et al.*, 1996).

In South Africa, SASEX has a large database of soil and leaf analysis results from samples submitted to the FAS by growers. A nutrient information retrieval system (NIRS) was designed to evaluate nutrient trends in the industry on a regular basis (Meyer *et al.,* 1989). Over the years, it has been found that fertiliser practices have generally not resulted in unfavourable or unbalanced soil and/or leaf nutrient concentrations (Meyer *et al.,* 1989). However, the fertility status of soils in some areas of KwaZulu remains poor, particularly with regard to P. Incidences of K deficiency in some of the irrigated areas (Meyer *et al.*, 1989) have been noted, as has evidence of soil acidification in various parts of the industry (Schroeder *et al.*, 1994).

Research and development programmes

Australia

Research in Australia into the nutritional aspects of sugarcane was for many years the sole domain of BSES. The focus of this research changed over the years according to the needs of the industry (Schroeder *et al.*, 1998). Nowadays, the effort has spread to include agricultural research providers such as the universities, the CSIRO, State Departments in Queensland and New South Wales, the Yield Decline Joint Venture and the Co-operative Research Centre for Sustainable Sugar Production (CRC-SSP). The latter is an unincorporated joint venture established in 1996. It is supported by the industry, public research and development, and education funding or in-kind contributions (Anon, 1997a). In particular, a review of the basis for current fertiliser recommendations was identified as an important issue for consideration within the activities of the CRC-SSP (Schroeder *et al.*, 1998).

Table 3. N, P and K norms and recommended rates used in the South African industry (after Anon, 1996a).

Nutrient	Criteria/soil critical values (samples taken to a depth of 200 mm)	Recommended rate (kg/ha)				
Nitrogen	Soil mineralisation potential	Plant				
		Rainfed (R)		Irrigated (I)		
	Low	120		140		
	Moderate	100		120		
	High	80		80		
	Very high	60		60		
		Ratoon				
		Coastal		Midlands		Lowveld
		R	I	R	I	I
	[1]Low	160	180	160	160	200
	Moderate	140	160	120	140	160
	High	120	120	120	120	[2]120/140
	Very high	100	100	100	100	N/A

Nutrient	Criteria/soil critical values	Recommended rate (kg/ha)			
Phosphorus	Plant: Critical value (0,01 M H_2SO_4) = 31 mg/kg	Plant			
		All areas except Midlands	Midlands		
			P-sorption capacity		
	Soil P (mg/kg)		Weak	Mod.	Strong
	4	80	60	[3]60	[3]60
	4-9	70	60	[3]60	[3]60
	10-13	60	60	[3]60	[3]60
	14-18	50	50	[3]60	[3]60
	19-22	40	40	50	60
	23-26	30	30	40	60
	27-31	20	20	30	50
	32-49	20 (optional)	20 (optional)	20	40
	50-58	nil	nil	20	30
	>58	nil	nil	20	20
	Ratoon: Critical value (0,01 M H_2SO_4) = 11 mg/kg	Single ratoon			
		All areas except Midlands	Midlands		
			P-sorption capacity		
	Soil P (mg/kg)		Weak	Mod.	Strong
	<7	30	30	40	50
	7-13	20	30	40	50
	13-22	nil	20	30	40
	23-31	nil	nil	20	30
	>31	nil	nil	nil	nil

Nutrient	Criteria/soil critical values	Recommended rate (kg/ha)			
Potassium	<30% clay: Critical value (1 M amm acetate) = 112 mg/kg >30% clay: Critical value (1 M amm acetate) = 150 mg/kg [4]>40% clay: Critical value (1 M amm acetate) = 225 mg/kg [5]>40% clay: Critical value (1 M amm acetate) = 325 mg/kg	Clay %			
		<30	>30	[4]>40	[5]>40
	Soil K (mg/kg)				
	<67	175	200	200	250
	67-78	150	200	200	250
	79-89	125	175	200	250
	90-100	100	175	200	250
	101-112	75	150	200	250
	113-122	nil	150	200	250
	123-150	nil	100	200	250
	151-175	nil	nil	175	250
	176-200	nil	nil	150	250
	201-225	nil	nil	100	250
	226-266	nil	nil	nil	250
	267-288	nil	nil	nil	200
	289-310	nil	nil	nil	150
	311-325	nil	nil	nil	100
	>325	nil	nil	nil	nil

[1]Assuming a soil depth >400 mm (rates are reduced by 20 kg/ha in each case if soil depth <400 mm).
[2]Depending on ratoon – older ratoons (>4) would receive the higher rate.
[3]Supplementary P fertiliser required (100-160 kg P/ha) depending on the soil test value and the P-fixing capacity.
[4]Northern irrigated areas: medium base status (Ca+Mg <4 000 mg/kg), summer and winter cycle; high base status (Ca+Mg >4 000 mg/kg), summer cycle only
[5]Northern irrigated areas: high base status soils (Ca+Mg >4 000 mg/kg), winter cycle only.

The review was prompted by the perception that growers were generally not following the BSES nutrition advice, but rather adopting their own approaches to on-farm fertiliser management (Johnson, 1995; Webster *et al.*, 1996). Nutritional research, advice and on-farm management appears to be moving away from being predominantly aimed at production issues, to a system which will ensure sustainable sugar production. This implies that inputs are managed to sustain soil fertility and minimise off-site effects, but yet ensure profitable sugarcane production (Wood *et al.*, 1997). It has therefore been recognised that the general nutrition norms, which have been used across soils and regions, are no longer fully applicable in the Australian context (Schroeder *et al.*, 1998). Opportunities for more precise targeting of inputs have been identified (Wood *et al.*, 1997). These include linking nutrient management to basic soil properties (colour, texture, structure and depth), and re-establishing soil and leaf analysis as important tools for diagnostic and advisory purposes (Schroeder *et al.*, 1998). Improving N use efficiency continues to receive much attention (Keating *et al.*, 1997) as does the recycling of nutrients in relation to trash retention. While aspects of soil acidity and acidification are still under investigation (Kingston and Aitken, 1996; Noble *et al.*, 1997), the need to re-assess the industry's K norms has been identified (Schroeder *et al.*, 1998). Apart from research that is conducted within the various organisations, a 'nutrition working group' has been established within the CRC-SSP to consider research and advisory aspects of sugarcane nutrition/ soil fertility across organisations.

South Africa

Research into sugarcane nutrition, as in the past, continues to be almost entirely conducted within SASEX, and is funded by the industry. The annual programme of work reflects the needs of the industry, but is ultimately aimed at maintaining efficient fertilisation practices to ensure sustainable sugarcane production. The current programme comprises 29 projects that are divided into four sections: agronomy nutrition, nutrient information management, nutrient-stress interactions, and nutrient acquisition and utilisation. In terms of the above, the greatest emphasis is directed towards improving N use efficiency, but aspects of soil acidity, soil degradation and K and Si nutrition continue to receive attention (Meyer, 1996). One of the primary aims of nutrition research has been the fine-tuning of norms for specific circumstances in order to reduce the quantities and cost of fertilisers applied (Landell Mills Commodities Studies Ltd, 1993). To this end, criteria used for interpreting soil and leaf analyses are continually being reviewed and updated in order to take cognisance of changes in cultural practices, cane varieties and economic optima (Anon, 1994).

Conclusions

While this paper has highlighted a number of similarities between the two industries, in terms of a largely agronomic approach to determining the fertiliser requirement of cane, distinct differences in sugarcane yields, the development of nutritional norms and the bases for fertiliser recommendations have become evident.

During 1996-97, the average yield in Australia was about 99 tons cane/ha harvested (or 13,5 tons sugar/ha), which is substantially more than the 69 tons of cane/ha (or 7,5 tons sugar/ha) achieved in the South African industry. Although these differences may largely be attributed to the differences in climate (temperature, rainfall and sunshine hours), the general low fertility status and management of soils in the KwaZulu areas of the industry also contribute to the lower overall production in South Africa. The recently instituted interaction between the SASEX and KwaZulu-Natal Department of Agriculture extension services will hopefully lead to better nutrition and increased yields within the small scale grower community.

In terms of nutritional norms and fertiliser recommendations, the emphasis in Australia appears to have been placed on fertilising the crop with little regard for soil properties. The fertiliser recommendations are, at present, based on production functions and/or general critical values, with virtually no matching of fertiliser rates to regional climatic and soil conditions. Although this system is easy to implement on an industry basis, it is imprecise and promotes inefficient use of fertiliser. Furthermore, it is at variance with the philosophy of sustainable agricultural production. By contrast, the South African fertiliser recommendations tend to be more climate and soil specific, with substantial emphasis on managing soils according to chemical and physical properties. This philosophy is reflected in the more finely tuned nature of the critical values and the recommended nutrient application rates. The concept of 'whole cycle' fertiliser recommendations recognises the importance of complementary soil and leaf analysis for advisory and diagnostic purposes.

In terms of sustainable sugar production, a reliable and easily accessible fertiliser advisory service is considered fundamental to ensuring that nutrients are appropriately managed on the farm and at industry level. The South African industry should therefore actively preserve and promote the service currently provided by SASEX, particularly among the small scale growers. In Australia, growers need to be encouraged to make greater use of soil (and leaf) analysis for advisory purposes. This is needed to address the present issue of over fertilisation in some cases, and in terms of the future nutritional norms that are likely to be more soil and variety specific.

Nutrient monitoring is extremely important in terms of assessing the effects of fertiliser usage and management practices on the crop, soils and the broader environment. Due to the relatively large number of soil and leaf samples analysed each year at SASEX, the NIRS provides useful information in this regard. The concept of using a series of 'permanent' soil nutrient monitoring sites, as undertaken in the Australian industry, has much merit as the effects of changes in on-farm management practices can be reliably assessed, provided there are appropriate standards of quality assurance.

In both industries, continuing research into the nutritional aspects of cane production is evidence that our knowledge in this regard is still incomplete. Changes in attitudes – particularly in relation to the environment, the needs associated with ensuring sustainable sugar production, changing varieties and a movement towards the use of green cane trash blanketing – need to be addressed to ensure that nutritional norms and fertiliser recommendations remain appropriate. Although the conscious effort that has been made to facilitate co-operative research across organisations in the Australian industry is most noteworthy, interaction with other agricultural industries should also be considered. Similarly such interactive research/ consultation would be relevant within the South African industry, where nutrition/soil fertility research related to sugarcane production continues to be conducted almost entirely at SASEX.

Despite the differences between Australian and South African industries, they share a common goal of achieving sustainable sugarcane production. Co-operative research and the sharing of experiences relating to soil management could well be advantageous to both countries. Soil degradation, soil acidification, changing nutritional needs, and the pursuit of environmentally friendly and cost effective recommendations are examples where interaction could result in mutually beneficial outcomes.

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