FACTORS AFFECTING POTASSIUM NUTRITION OF SUGARCANE IN SOUTH AFRICA

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Abstract

In the South African sugar industry during the past three decades, considerable research has taken place in the field, laboratory and glasshouse with regard to the potassium requirement of sugarcane. The value of potassic fertilizer for cane production is reviewed using field experimental data. Correlations established between cane and sucrose yield on the one hand and soil and leaf analyses on the other are discussed. Whilst soil and leaf analyses are used as a guide for assessing the K requirement of sugarcane, various soil and climatic factors can markedly influence the availability of potassium to sugarcane thus affecting the reliability with which K recommendations can be made on certain soils. Several of these factors are discussed in detail which include clay mineralogy of the soil, exchangeable K as an index of K availability, non-exchangeable K and rate of K release, K-fixation, amount of subsoil K, antagonism between ions in the soil solution, and soil temperature and moisture content. Taking these factors into account, various proposals are made for improving the current system of recommendations for potassium based on soil and leaf analyses.

Introduction

Consumption of potassium (K) fertilizer by the South African sugar industry is presently about 30 000 tons K per annum, costing about R27 million, which is more than double the amount spent in 1981. This sharp increase in cost may be coupled with the fact that South Africa is almost totally dependent on foreign supplies for its potash requirements. The amount of fertilizer K that is being applied to sugarcane should therefore be examined more closely to establish whether it is being used as efficiently as possible. This paper reviews the field, laboratory and glasshouse work that has been carried out on K by the South African Sugar Association Experiment Station over the past three decades. Various factors that influence the availability of K to sugarcane, thus affecting the reliability with which K recommendations can be made on certain soils are discussed.

The response of sugarcane to applied K

Early trials

The Experiment Station established 31 3N × 3P × 3K exploratory factorial trials in 1950 which marked the most important phase in sugarcane nutrition under local conditions. In 1956, these trials were superceded by another series of 53 4N × 2P × 3K regional fertilizer trials (RFT). The results of these trials were reported in detail by Du Toit,[3] reviewed in 1969 by Stewart,[21] and again more recently by Meyer and Wood.[16] The various response curves obtained from the trials were used by Thompson[22] to consider the economics of fertilizer usage for sugarcane. The main results from these trials may be summarised as follows:

- for plant cane, nine out of 31 exploratory and 18 out of 53 RFT trials showed a significant response to applied K. The combined average response to the 93 kg K ha^{-1} treatment was 5,5 tc ha^{-1} while a further 93 kg K ha^{-1} gave little additional response
- the response to K treatment in ratoon cane was greater than than for plant cane. In 15 out of 31 exploratory and 24 out of 53 RFT trials, significant responses were obtained to applied K. In the RFT trials, the average responses to the 140 kg K ha^{-1} and 280 kg K ha^{-1} treatments were 13 and 17 tc ha^{-1} respectively. The difference in the response to applied K between plant and ratoon cane is shown by the response curves in Figure 1.
- in the lighter textured soils, responses to K treatment increased progressively in succeeding ratoons. In the heavier soils, responses to applied K in succeeding ratoons were smaller due to the build-up of residual K from previous applications
- useful correlations were obtained between the response to applied K and soil and leaf analytical data. Based on the results that were obtained when a 1N ammonium acetate extraction procedure was used, significant responses could be expected when the exchangeable K content of the soil was below 125 ppm or when, on a dry matter basis, the K content of the third leaf fell below 1,10% K.

Recent trials

Since the exploratory and RFT series of trials more than 70 trials have been conducted. Many of these trials are still in progress but the results so far may be summarised as follows:

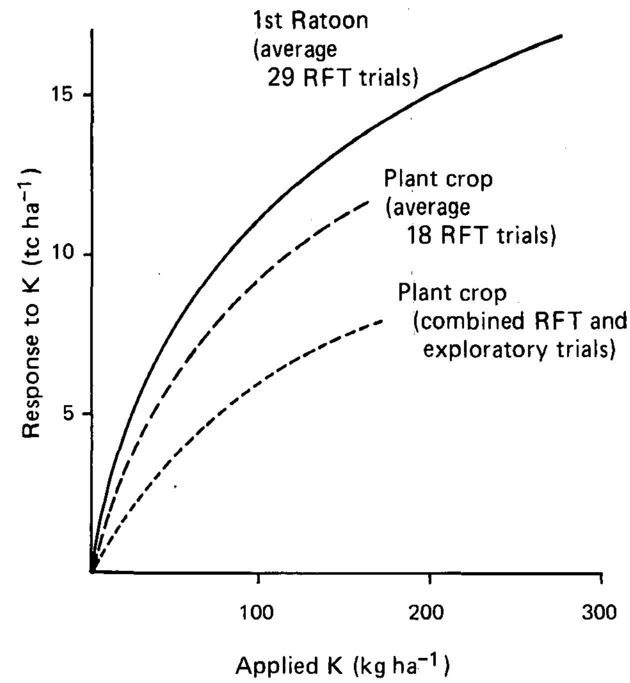

FIGURE 1 Potassium response curves for plant and ratoon cane crops.

Long term trials: these have been conducted at Shakaskraal on a Longlands form soil (plant and 12 ratoons), and at Pongola on a Hutton form soil (plant and 10 ratoons). Although the exchangeable K in the Hutton form soil was almost double the required threshold value, small but significant responses, in terms of tons sugar, were measured in the second and successive ratoon crops. Where a yield response was obtained to applied K, cane quality also improved. An important conclusion from this trial was the need to increase the soil threshold value to 200 ppm when the soil clay content is higher than 40% (Moberly[17]). In the Longlands fine sandy loam, a significant response was obtained to 175 kg K ha^{-1} in 12 ratoons which was consistent with the deficient level of K in the soil. The average response for the 12 crops was 24 tc ha^{-1}. In general, the response to the 175 kg K ha^{-1} treatment was greater with successive ratoons up to the sixth ratoon.

Swaziland trials: eight N/K factorial trials have been established in Swaziland to determine the K requirement of irrigated sugarcane under a range of soil conditions. The results to date are not conclusive but they have produced some unexpected responses (Moberly[18]). The trial on the Kwezi (Arcadia form) soil produced a significant response of 22 tc ha^{-1} to an application of 300 kg K ha^{-1} despite a soil exchangeable K level of 348 ppm. In contrast, the crop on the light textured Betusile (Dundee form) soil with an apparently deficient K level of 83 ppm did not respond to applied K. At the other trial sites, small responses were measured on the Canterbury and Vimy soils (both Bonheim form) confirming that the threshold value should be raised to about 200 ppm where the clay content of the soil is more than 40%. In this series of trials, third leaf K data showed a clear pattern for winter cut crops with values declining from August to a minimum in September and October then rising during November to a maxmimum in January and February (Figure 2). Possible reasons for this effect are discussed later (section on soil K-fixation). These data indicate that recommendations for the age of the crop at the time of sampling and the months in which sampling should be carried out, should be reconsidered (Leibbrandt[12]).

Coastal and midlands trials: a number of dryland N trials have been converted into rates of K trials, which are mainly located on Inanda and Hutton form soils in the midlands and on Mayo, Glenrosa and Kroonstad form soils in the coastal lowlands of Natal.

To date, the results generally support the criteria on which current K recommendations are based. There has been little indication from the response curves that rates higher than 250 kg K ha^{-1} could be justified. The accumulation of K was not as great in the Glenrosa and Kroonstad form soils as it was in the Mayo and Inanda forms. The former soils generally required between 100 and 200 kg K ha^{-1} to raise the exchangeable K level by 10 ppm compared with between 30 and 50 kg K ha^{-1} for the latter soils.

Soil analysis and crop response to K

Soil threshold values based on soil texture

The critical value used by the Experiment Station's Fertilizer Advisory Service was 112 ppm for all soils but this was modified in 1982 to accommodate soil texture. The availability of K in a range of soils was assessed by continuous cropping in a glasshouse experiment at the Experiment Station and it appeared that a significant correlation existed between the clay content of the soil and the threshold value for K (Wood and Burrows[24]). Because of this correlation, early exploratory and RFT trial data, and the results from the recent trials were re-assessed (Meyer[15]). The yield responses were calculated by subtracting the yield obtained when no K fertilizer was used from the yield obtained when the maximum amount of K was used. The response data from more than 100 trials were classified according to three soil textural categories: light (less than 15% clay), medium (15 to 30%), and heavy (more than 30% clay). The responses were arranged in decreasing order of exchangeable K. A summary of the average responses to applied K in each textural group is given in Table 1.

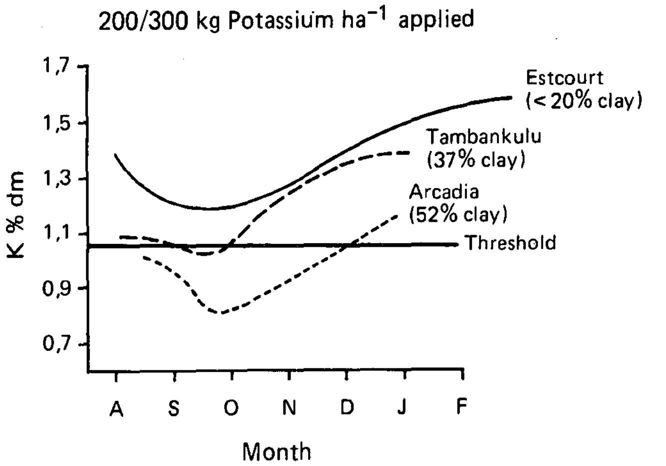

FIGURE 2 Third leaf K values of ratoon crops grown on different soils.

Table 1

Summary of responses to applied K in relation to soil textural class and soil exchangeable K intervals

Soil exchangeable K interval (ppm)	Light (less than 15% clay)				Medium clay loams (15-30% clay)				Heavy (more than 30% clay)			
	No. of responses		Average response		No. of responses		Average response		No. of responses		Average response	
	Total	Number significant	tc ha^{-1}	ts ha^{-1}	Total	Number significant	tc ha^{-1}	ts ha^{-1}	Total	Number significant	tc ha^{-1}	ts ha^{-1}
Less than 45	11	10	23,8	3,9	3	3	34,0	5,3	0	-	-	-
46 to 67	13	9	13,7	2,1	11	11	15,2	2,4	3	2	12,8	2,0
68 to 112	12	8	10,0	1,8	19	15	13,2	1,7	12	8	8,6	1,4
113 to 157	3	1	7,8	0,8	8	3	4,4	0,8	10	8	11,8	1,9
158 to 222	-	-	-	-	3	0	1,3	0,3	9	4	3,8	0,5
223 to 290	-	-	-	-	1	0	4,0	0,5	5	3	7,9	1,3
More than 290	-	-	-	-	-	-	-	-	14	2	3,4	0,7
Total	39	28	-	-	45	32	-	-	53	27	-	-

On light textured soils, 28 of 39 responses to applied K were statistically significant and of these, 27 coincided with pre-treatment soil K levels below 112 ppm. The average response to applied K declined with increasing soil K levels.

On the medium textured soils a threshold value of 112 ppm K discriminated between the K deficient and non-K deficient soils as 32 out of 45 responses obtained were significant and of these, 20 were associated with soil K levels below 112 ppm. Regression analysis confirmed that the response to applied K was inversely related to plant available K (Figure 3).

Responses on the heavy textured soils were variable and not well correlated with pre-treatment soil K levels. Of the 53 responses, 27 were significant and only 10 of these coincided with soil K values less than 112 ppm. The remaining 17 significant responses were associated with soil K levels that ranged from 112 to 549 ppm. Most of the significant responses were associated with soils derived from dolerite or Lower Ecca shale and the common soil forms Arcadia, Bonheim, Milkwood and Shortlands which have strongly structured diagnostic top and/or subsoil horizons (vertic, melanic, pedocutanic, red structured B).

These results generally confirmed those obtained from the exhaustive cropping trials in the glasshouse, which showed the 1N ammonium acetate extraction to be the most reliable procedure for use on light to medium textured soils. An interim threshold value of 150 ppm was introduced for the heavy textured soils but the recent results from Swaziland indicate that this value is still not adequate for Arcadia, Bonheim, Milkwood and Shortlands form soils. It is now proposed that the threshold value be increased from 150 to 225 ppm K for these structured clay soils as the probability of correctly predicting a response would improve from 0,64 to 0,78. The threshold values that best fitted the response data, based on textural class and common soil forms, are shown in Table 2.

Leaf analysis and K requirement

Foliar diagnosis based on the analysis of the central portion of the top visible dewlap leaf has been useful in evaluating the K status of the crop. An assessment of the exploratory and RFT trial data indicated that a response of at least 13 tc ha^{-1} could be expected when the value of K in the third leaf fell below 1.0% (Du Toit[4]). Between the values of 1,0 and 1,25% K responses were variable and above 1,25% responses to K were unlikely. The critical value currently used for leaf potassium is 1,05%, and this compares favourably with standards established by workers in other countries. However, low leaf K/high soil K anomalies have been reported from various areas within the South African sugar industry and the merits of introducing a seasonal correction factor for irrigated cane and the use of nutrient ratios are being investigated.

Factors affecting the availability of K

Results of recent field experiments indicate that problems still exist in predicting correctly the K requirement of sugarcane. Although soil and leaf analysis have been used fairly successfully, Wood[23] noted that various soil and climatic factors can influence the availability of K to cane, thus affecting the reliability with which K recommendations can be made. Recent studies at the Experiment Station have emphasised the importance of several of these factors when considering the K nutrition of cane in South Africa.

Clay mineralogy

Secondary clay minerals, formed during the soil weathering process, affect the ability of most soils to hold K and other cations that are potentially available to the crop, as they account for the cation exchange capacity (CEC) of the soil.

Table 2

Proposed threshold values based on soil texture and some important soil forms

Textural class	Representative soil forms	Soil K threshold value (ppm)
Light (Less than 30% clay)	Cartref, Glenrosa, Fernwood, Longlands, Hutton (light)	112
Medium (more than 30% non-swelling clays)	Inanda, Kranskop, Hutton (heavy)	150
Heavy (more than 30% mainly swelling clays)	Arcadia, Rensburg, Milkwood, Bonheim, Shortlands	225

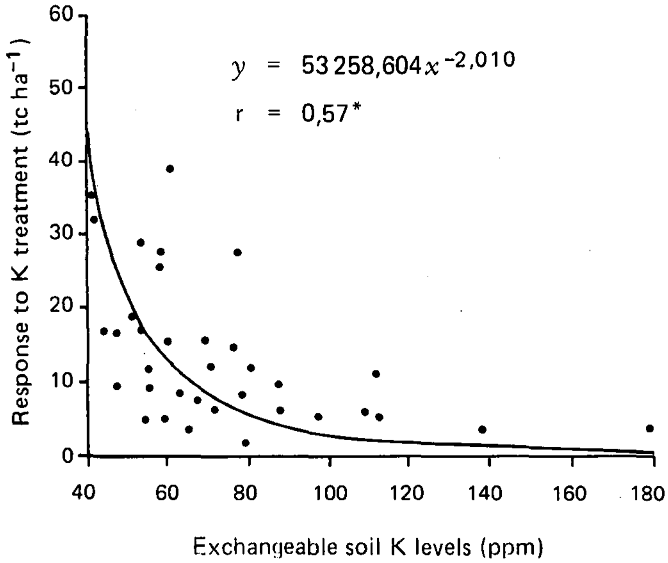

FIGURE 3 Sugarcane response (tc ha^{-1}) in relation to exchangeable soil K levels in medium textured soils.

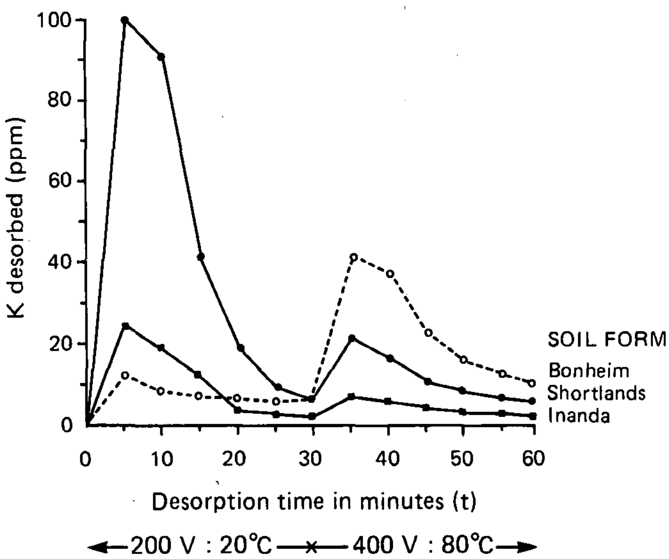

FIGURE 4 EUF-K desorption curves for three different soils.

Soils containing a high proportion of K selective 2 : 1 lattice clay minerals such as vermiculite and montmorillonite (smectite) will generally hold more K than the more strongly weathered soils which contain a high proportion of kaolinite, a 1 : 1 lattice clay mineral of low K selectivity.

Differences in clay mineral composition can affect K release from the soil and this is depicted by the three electroultrafiltration (EUF) K desorption curves shown in Figure 4. In EUF an external electric field, at various voltages and temperatures, is used to extract K ions from an aqueous soil suspension. The K desorbed at five minute intervals can be plotted for the various soils where the course of K desorption depends on the type and amount of clay minerals present.

The Bonheim form soil from Swaziland has a large 2 : 1 clay mineral component and only a relatively small amount of K was desorbed at 200 V and 20°C over 30 minutes (45 ppm K). K desorption greatly increased when the voltage and temperature were raised to 400 V and 80°C respectively, and according to Németh[19,20] this indicates the presence of clay minerals with sites for selective adsorption of K in the inner-lattice. The large amounts of K desorbed in the EUF 30–60 minute fraction (140 ppm K) indicate that the soil has a high buffer capacity as well as the ability to maintain K at an adequate level during cropping over a long period. By contrast, the Shortlands form soil from the coast lowlands region of Natal has a substantial 1 : 1 clay mineral component of low K selectivity, so a large amount of available K was desorbed in the EUF 0–30 minute fraction (277 ppm K), while a much smaller amount of K was released in the EUF 30–60 fraction (72 ppm K). However, some K reserves were apparent, probably from the smectite component of this soil. In the Inanda soil from the midlands region of Natal, the clay mineral is predominantly kaolinite and most of the soil K tended to be desorbed in the EUF 0–30 minute fraction (65 ppm K), and only a small amount of additional K was released in the EUF 30–60 minute fraction (25 ppm K).

Similar EUF-K desorption curves were plotted for 38 sugarbelt soils with widely differing characteristics. From these curves it was apparent that, based on clay mineralogy, large differences exist in the capacity of soils to supply K on a long term basis. The Arcadia, Bonheim, Milkwood and Rensburg form soils were found to contain four to five times more potentially available K than the Griffin, Hutton and Inanda form soils. This implies that the tables currently used for determining the K requirement of cane for a full crop cycle of plant and four ratoons should be modified to account for these differential release rates between soil forms.

Exchangeable K as an index of K availability

Haysom[8], expressed doubt that the level of soil exchangeable K as a single value forms a sound basis for forecasting cane fertilizer requirements as for a given level of exchangeable K some soils exhibit a greater response to applied K fertilizer than others, even under similar climatic conditions. Hunsigi and Srivastava[11] stated that exchangeable K in itself was a poor index of K availability for long duration crops like sugarcane or in a continuous cropping system.

Soil K measured by 1N ammonium acetate, EUF and 1N nitric acid extraction procedures has been compared with K availability during exhaustive cropping of a wide range of sugar industry soils for a number of years. Wood[25] reported on the relative efficiency of the various extraction procedures in predicting the K supplying power of 44 soils as measured by cumulative K uptake by forage sorghum (babala) grown in pots. It was concluded that for soils in which 1 : 1 lattice clays predominate and which have a relatively low content of K selective clay minerals, ammonium acetate exchangeable K and the EUF-K (0-30 minute fraction) can satisfactorily predict K availability to the plant. This would apply to the majority of soils in the Natal Midlands and also to many soils in the coast lowlands area of Natal. In soils containing a high proportion of 2 : 1 lattice clays and K selective clay minerals, such as many of those in the Swaziland lowveld, nitric acid extractable K provides a better measure than does exchangeable K or EUF-K, of the ability of the soil to supply K on a long term basis.

Non-exchangeable K and rate of K release

Non-exchangeable K renews the supply of K to the soil and it is in equilibrium with the exchangeable K. It is also important in supplying K to plant roots. In a recent review on the behaviour of non-exchangeable K in soils, Martin and Sparks[13] stated that the most important aspect of non-exchangeable soil K is the rate at which it is released to exchangeable and solution forms which are readily available for plant uptake. The rate and magnitude of release are primarily dependent on two factors: (a) the level of K in the soil solution and (b) the type and amount of clay minerals present. Although non-exchangeable K reserves can be assessed, it has not yet been possible to determine satisfactorily the rate at which these reserves can replenish K in equilibrium with the soil solution. This is important in predicting the K supplying power of soils as it can influence crop response to applied K.

K-fixation

In recent N/K fertilizer trials, particularly those in the Swaziland lowveld, potash applications have sometimes either failed to increase leaf K content, or these increases have been relatively small following substantial applications of K fertilizer. This could be because some of these soils exhibit strong K-fixing properties, as many of them contain a high proportion of K selective clay minerals.

Patterns of leaf K content of samples taken from cane grown on three Swaziland soil forms that received the same K treatment are shown in Figure 2. An initial high exchangeable K content was exhibited by the Arcadia soil form (348 ppm k), but despite this K uptake from the 200 kg K ha^{-1} treatment on this soil was inhibited to a far greater extent than it was on the Tambankulu (150 ppm K) and Estcourt (144 ppm K) soil forms. Preliminary results from a laboratory investigation, in which the K-fixation of soils in the Swaziland trials was assessed by interpolation from K adsorption isotherms, confirmed that the Arcadia form soil was more strongly K-fixing than the Tambankulu which in turn was stronger than the Estcourt. Comparison of the K adsorption isotherms given in Figure 5 indicates that about four times more K was required to increase the concentration of K in the soil solution of the Arcadia soil than the Estcourt soil. These results are consistent with the leaf K uptake patterns obtained under field conditions (Meyer and Wood[16]).

Although the Arcadia form soil has a higher exchangeable K level than the Estcourt soil, the K concentration in the soil solution in the latter soil (29 ppm) was almost 15 times greater than in the former soil (2 ppm). These findings agree with the results published by Grimme[6] which imply that soils with a high exchangeable K content and a high K-fixation capacity need more K than those soils with a lower exchangeable K content, because of a lower K concentration in the soil solution. This could also account for the unexpectedly large response of 22 tc ha^{-1} to the 600 kg ha^{-1} KCl applied to the Arcadia form soil.

Subsoil K

A factor which has received insufficient attention when K fertilizer recommendations are made for cane is the contribution which the subsoil makes to the available K requirement of the crop. Routine soil testing is generally restricted to the topsoil (0 to 200 mm) though roots can also take up nutrients from greater depths. Grimme *et al*[7] found that as moisture content of a loess topsoil decreased together with nutrient uptake rates, up to 50 % of the daily K requirement of the crop could be supplied by the subsoil.

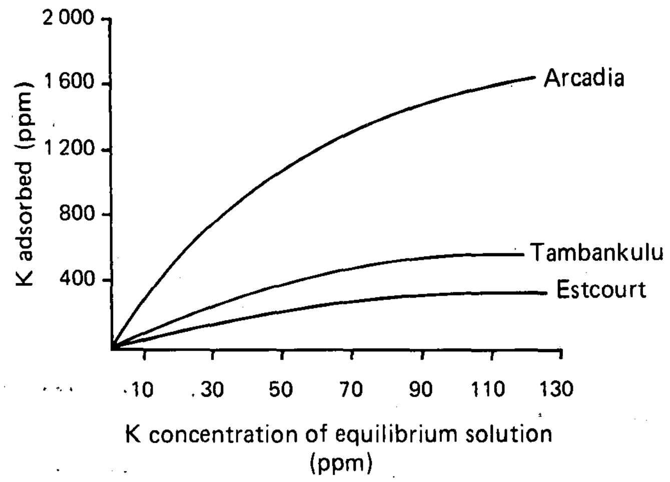

FIGURE 5 K adsorption isotherms for three Swaziland soils.

Work at Mount Edgecombe has confirmed that amounts of exchangeable K in the subsoil can vary with soil form and clay mineralogy. Table 3 shows values for subsoil K extracted by various procedures for a range of soil forms. Considerable amounts of crop available K were present to depth, together with substantial K reserves (EUF-K 30-60 minutes and HNO_3^-K) in soils containing a high proportion of K selective clay minerals, such as the Bonheim, Milkwood and Shortlands forms. Conversely the sandier soils, and those containing mainly 1 : 1 clay minerals, such as the Fernwood, Dundee, Katspruit, Griffin, Hutton and Kranskop forms, generally had relatively small amounts of exchangeable K and K reserves were low.

Antagonism to K uptake

Humbert[9] has reported that "high calcium and magnesium saturation of many neutral and alkaline soils in the tropics unquestionably limits the quantities of K that can enter into sugarcane plants. Deficiencies of K often exist with luxury consumption of Ca and Mg". Evans[5] comments that antagonism is very marked in certain cane areas of British Guiana where K deficiency is induced by high magnesium (Mg) levels.

Numerous leaf analyses have shown that in the highly calcium (Ca) and Mg saturated soils of Swaziland, Eastern Transvaal, Pongola, and other irrigated areas of the lowveld, K uptake by the cane plant is limited, particularly during the early stages of growth of winter cut cane (May to August), despite apparently adequate amounts of soil exchangeable

Table 3

Subsoil potassium extracted by various methods for a range of sugarbelt soils

Soil form	Clay %	Depth mm	NH_4OAc-K* (Exch-K) ppm	EUF-K (0–30) ppm	EUF-K (30–60) ppm	** HNO_3^-K ppm	Clay minerals
Fernwood	3	300- 600	28	18	18	112	Mainly 1 : 1 lattice clays (low K selectivity)
	2	600- 900	29	12	13	108	
Dundee	4	300- 600	25	12	18	280	
	13	600- 900	25	16	22	380	
	4	900-1200	19	24	15	285	
Katspruit	6	300- 600	22	14	21	129	
	21	600- 900	28	27	55	403	
Kroonstad	19	300- 600	42	13	13	170	
	35	600- 800	94	11	28	245	
Hutton	47	300- 600	33	17	21	108	
Kranskop	32	300- 600	92	78	28	272	
Griffin	59	300- 600	87	41	35	364	
Mean			43	24	22	238	
Bonheim	57	300- 600	119	31	71	1210	Mainly 2 : 1 lattice clays (high K selectivity)
	55	600- 900	83	14	41	1140	
Milkwood	59	250- 500	122	13	52	980	
Shortlands (Shortlands)	59	300- 600	122	26	70	820	
	62	600- 900	72	14	34	700	
	67	900-1200	79	22	39	615	
Shortlands (Glendale)	61	300- 600	159	38	111	900	
	52	600- 900	128	42	75	617	
Mean			111	25	62	873	

* NH_4OAc-K (Exch-K) = Ammonium acetate (Exchangeable-K)
** HNO_3^-K = K extractable in nitric acid

K. From August to November, when the ratoon crop is between one to five months old, leaf K values often fall below the threshold value of 1,05 % K, while Ca and Mg values are excessive (0,4 to 0,7 % respectively).

It is considered that the nutrient imbalance in the soil solution will cause Ca and Mg ions in excess of those required by the plant to move to the surface of the root by mass-flow in the transpiration stream at the expense of the K ions, which move to the root largely by diffusion on a chemical gradient (Barber[1]). Therefore, to increase the amount of K delivered by mass-flow, soil K concentration would need to be greatly increased by means of K fertilization.

As the crop develops, Ca and Mg levels in the leaf usually decline while K levels increase to above the threshold value. In the Eastern Transvaal, however, leaf K values sometimes change very little as the cane grows older, while leaf Mg remains high. Leaf blade Mg values between 0,1 and 0,35 % are generally associated with good cane growth, but higher values are usually accompanied by low leaf K values. Leaf K and Mg values from cane cut between May and August 1982 in Swaziland, Pongola and the Eastern Transvaal, were examined on two occasions: once when the cane was between one and four months old and again when it was from five to seven months old. Figure 6 shows that a significant negative correlation existed between leaf K and leaf Mg values. Of 40 leaf samples examined with Mg values above 0,35 %, only 12 were associated with a K value between 0,8 and 1,0 %, while 28 were associated with K values less than 0,8 %. The regression curve shows that the leaf K values increased above the threshold value of 1,05 % once the leaf Mg values declined to about 0,25 %. The leaf Mg values in the cane from the Eastern Transvaal remained high during both sampling periods, and K uptake was depressed.

Soil temperature and moisture

The interaction between soil temperature and moisture content is also important in the uptake of K by crops. These two factors influence chemical and biological reactions in the soil and the physical movement and availability of K. There is also evidence that K uptake by the plant is more sensitive than the uptake of other nutrients to changes in soil temperature, moisture content, aeration and compaction. K may also be more susceptible than other cations to Ca and Mg antagonism due to excessive Ca and Mg saturation.

Studies with maize indicated that K uptake was half as great at 15°C as it was at 29°C (Ching and Barber[2]). It was also found that root length of young maize plants was eight times greater at the higher temperature. Other workers have shown that an increase in soil temperature decreases the uptake of Ca and Mg (Mederski and Stackhouse[14]). With a range in soil temperature of about 15°C between June and January not uncommon in the sugarbelt this may affect K uptake, particularly where soils are over-irrigated during the winter months.

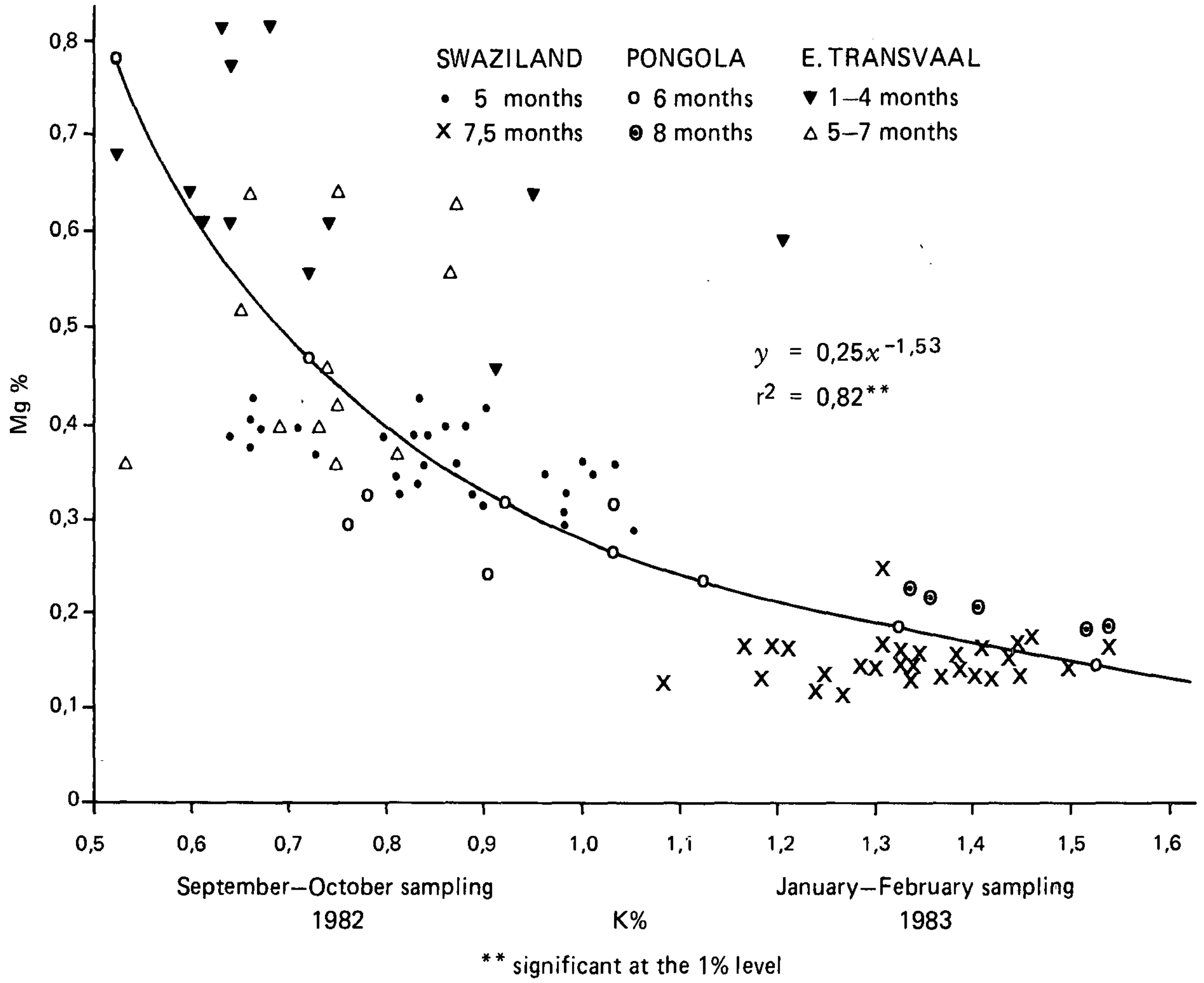

FIGURE 6 Changes in the relationship between third leaf K and Mg values after a winter harvest on estates in Swaziland, Pongola and the Eastern Transvaal.

In Hawaii, K deficiency symptoms have been reported in cane growing in heavy clay soils well supplied with K but poor in structure, dense from compaction and with a high Ca saturation (Humbert[10]). The difficulty experienced by the crop in obtaining adequate K may be accentuated by a low soil temperature and a high soil moisture status through over-irrigation. The Ca antagonism and the slow rates of gas exchange result in a decrease in the oxygen level at the root surface which is then too low for effective absorption of K.

Conclusions

While soil and leaf analyses have been used successfully to determine the correct amounts of fertilizer required, it is evident that various soil and climatic factors can influence the availability of K to cane which will affect the reliability of K recommendations. For example, the ammonium acetate extraction procedure for exchangeable K is reliable for predicting K availability on the light to medium textured soils (about 70 % of the area under cane), while in heavier textured soils in which 2 : 1 lattice clay minerals predominate, nitric acid extractable K provides a better measure of the ability of the soil to supply K on a long term basis.

Recent results from fertilizer trials have indicated that the current threshold value of 150 ppm K is not adequate for soils, such as the Arcadia, Bonheim, Milkwood and Shortlands forms which contain more than 40 % clay and a high proportion of K-selective clay minerals. However, more evidence to support the proposed increase in threshold value to 225 ppm K for soil forms with mainly vertic or melanic topsoils is still required.

Table 4

Current whole cycle fertilizer recommendations based on different clay categories

All soils with less than 30 % clay

Soil potassium (kg ha^{-1})	More than 250	250	225	200	175	Less than 150
Plant cane - potassium required (kg ha^{-1})	Nil	75	100	125	150	175
Potassium chloride required (kg ha^{-1})	Nil	150	200	250	300	350
Subsequent ratoons - whole cycle advice (kg ha^{-1})	125 K				175 K	

All soils with more than 30 % clay

Soil potassium (kg ha^{-1})	More than 340	340	275	225	Less than 175
Plant cane - potassium required (kg ha^{-1})	Nil	100	150	175	250
Potassium chloride required (kg ha^{-1})	Nil	200	300	350	400
Subsequent ratoons - whole cycle advice (kg ha^{-1})	150 K		200 K		

Whole cycle fertilizer recommendations currently used for K based on soil categories with less than 30 % clay content, and those with more than 30 % clay are shown in Table 4. A similar table for melanic and vertic soils is being prepared and will be completed once additional field trial results are obtained.

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