SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL MEETING, 1969

The annual meeting of the Association will be held at the Experiment Station at 10 a.m. on Tuesday, 2nd December, 1969.

The programme will be:

9.45 - 10.00	Tea
10.00 - 10.15	Report of the Committee, 1968/69
10.15 - 10.30	General
10.30 - 11.15	Potassium and sugarcane - a review by M.J. Stewart.
11.15 - 12.00	An overseas visit by J.N.S. Hill.
12.00 - 12.45	The necessity for flowering control in the industry by D. Coetzee.
12.45 - 14.00	Lunch at Huletts Country Club
14.00 - 14.45	Chemical ripening of sugarcane by P. Moberly.
14.45 - 15.30	Leaf scald and Fiji disease by G.M. Thomson
15.30 - 16.15	The function of an estate agronomist by R. Wyatt

Printed by PenPrint (Pty.) Ltd. – Durban

SOUTH AFRICAN
SUGAR INDUSTRY
AGRONOMISTS'
ASSOCIATION

REVIEW PAPER No.5

Potassium and sugarcane

Reprinted from
The S.A. Sugar Journal,
Vol. 53 No. 2.
FEB. 1969

9 HARDY, F. and G. RODRIGUEZ, (1949). *Tech. Commun. Bur. Soil Sci. Harpenden* 46.
10 HAUCK, F. W. and W. E. DICKINSON, (1954). The science and practice of the use of Potash in sugarcane culture. *Asoc. de Tecnicos Azucareros de Cuba.* Boletin Oficial XIII. 3: 37.
11 HODNETT, G. E. (1956). Responses of sugarcane to fertilizers. *Emp. J. Exp. Agr.* 24: 1-19.
12 HUMBERT, R. P. (1963). The Growing of Sugarcane. *Elsevier Pub. Co.* p 188.
13 HUMBERT, R. P. (1963). The Growing of Sugarcane. *Elsevier Pub. Co.* p. 199.
14 HUMBERT, R. P. (1963). The Growing of Sugarcane. *Elsevier Pub. Co.* p. 230.
15 INNES, R. F. and T. CHINLOY, (1951). The effects of fertilizers on sugarcane. 1. Potash. *Proc. Brit. W. Ind. Sug. Tech.* 1951. p. 56-72.
16 LACAILLE, R. (1966). Potassium and potassic manuring. *Agric. Dig.* 9: 25.
17 LOCSIN, C. L., R. J. GUILLERMO, and F. T. TABAYOYONG, (1956). Potash fertilization tests on sugarcane in the Victorias district. A review. *Sug. News*, 32: 69-84.
18 MAUD, R. R. (1958). Plant nutrient derivation from soil minerals. *Proc. S. Afr. Sug. Technol. Ass.* 32: 114-115.
19 ROBINSON, J. B. D. (1951). A brief review of sugarcane manuring in Barbados. *Proc. Brit. W. Ind. Sug. Tech.* 1951. p. 73-7.
20 SAINT, S. J. (1933-38). Manurial trials with sugarcane. *Agric. J. Barbados*, 1933-1938.
21 SAMUELS, G. (1965). Sugarcane fertilizer usage in Puerto Rico 1944-1964; *Proc. 12th Congr. int. Soc. Sug. Cane Technol.* Puerto Rico. p. 217.
22 SAMUELS, G. and P. LANDRAU, (1955). The influence of potassium on the yield and sucrose content of sugarcane. *Proc. Soil Sci. Soc. Amer.* 19: 66-9.
23 SAMUELS, G. and P. LANDRAU, *et al* (1955). The method of foliar diagnosis as applied to sugarcane. *Univ. Puerto Rico. Agric. Exp. Stn. Bull.* 123: 12.
24 SHAW, M. E. (1963). Some aspects of the potash nutrition of sugarcane grown on a heavy clay soil in Jamaica. *Fertilité*, 19: 21.
25 STURGIS, M. B. and D. S. BYRNSIDE, (1955). LSU fertilizer recommendations for sugarcane for 1955. *Sug. Bull. N. Orleans*, 1955. 33: 140.
26 VAN DILLEWIJN, C. (1952). Botany of Sugarcane. *Chronica Botanica*, p. 233-257.
27 WALKER, B. (1961). The effect of soil type on the response of sugarcane to potash fertilizer in British Guiana. *Potash Review, 1961. Subject 27, 33rd suite. Potash Institute, Berne, Switzerland.*

leaf analyses are used to check on fertilizer needs for ratoons. However, leaf sampling can be carried out only under certain limited conditions. Thus, a representative sample, comprising approximately 40 leaves should be taken from each field or sub-section only between November and April, when the crop is 4-9 months old, the weather favours active growth, and at least 6 weeks has elapsed since the application of fertilizer. Standards for estimating K fertilizer recommendations shown in Table XII, have been developed by the S.A.S.A. Experiment Station, based on experimental work conducted since 1950.

CONCLUSIONS

The potassium requirements of sugarcane crop are high, and good responses to applied fertilizer are therefore, to be expected. However, a number of factors affect the behaviour of potassium in the soil, and the ability of the crop to exploit these reserves. Potassium which occurs naturally in the soil as a constituent of primary and clay minerals is made available to the plant as a result of natural weathering. Soils, however, vary in their ability to liberate potassium, depending on the lattice structure of the minerals and their behaviour under dry and wet conditions. Furthermore, application of fertilizer to soils which have a high fixing capacity can result in the potassium being rendered unavailable to the plant. In addition compact soils restrict root growth and therefore the ability of the crop to exploit the available potassium.

Experiments cited in this paper show that in many parts of the South African cane belt, sugarcane responds to applications of potassic fertilizer. Furthermore, responses can be expected when the exchangeable K content of the soil is less than 125 ppm, or when, on a dry matter basis, the K content of the third leaf falls below 1.10% K. As a general rule, statistically significant increases in yield are unlikely to be obtained from applications of fertilizer providing more than 100 lb. K per acre. But there are situations where a good response can be obtained from rates of up to 200 lb. K per acre. Furthermore, responses to potassic fertilizer are found to increase progressively in succeeding ratoons, a phenomenon which may be associated with soil compaction and consequent restrictions in root growth.

It is interesting to note that responses to comparable levels of applied potassic fertilizer are recorded in a number of overseas sugarcane producing countries. Recommendations and commercial rates of application in these countries rarely exceed 100-125 lb. K per acre, the most notable exception being Hawaii.

Threshold levels of exchangeable soil K used to determine fertilizer requirements are slightly lower in other countries (65-100 ppm K) than in South Africa (125 ppm K). On the other hand, the critical K level of the third leaf blade, which in South Africa is 1.10%, compares closely with standards established by workers in Jamaica and Mauritius, where the same plant tissues are used.

TABLE XII

Standards for estimating K requirements from soil and leaf analyses.

(a) **Soil analysis. Standards for fertilizer application.** (N. Ammonium acetate extractant.)

Soil level PPM K	Recommended rates of muriate of potash in lb./acre
125	Nil
100	200
75	300
50	400
25	500

(b) **Leaf analysis. Standards for fertilizer application.** (3rd leaf blade. Dry weight basis.)

Leaf level % K	Recommended rates of muriate of potash in lb./acre.
1.10	Nil
1.00 – 1.10	200
0.90 – 1.00	300
0.80 – 0.90	400

Much of the sugarcane in Natal is rain-grown and crop responses are therefore markedly influenced by variations in weather, as well as by differences in soil type and topography. This is true also for non-irrigated fertilizer trials, and it influences the interpretation of results in terms of field practice. However, methods of applying fertilizer to commercial fields are still relatively inexact, hence for advisory purposes efforts to achieve a very high degree of accuracy are not necessary.

In the prevailing circumstances soil and leaf analysis standards established by the Experiment Station of the South African Sugar Association can be accepted as being reasonably accurate and reliable. If, however, further experiments are to be carried out in order to refine standards of interpretation, a sophisticated and well controlled series of trials must be planned to accommodate the variability of the environment. It will also be necessary to develop more effective and accurate methods of applying fertilizer to commercial fields, in order to exploit these refinements.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the assistance of Dr. G. D. Thompson and Mr. C. Whitehead in editing this paper.

REFERENCES

1 BIRKETT, L. S. (1954). A review of fertilizer and manurial experiments on sugar cane in British Guiana, 1930-1953. *Sug. Bull., Georgetown*, No. 22: 41-54.
2 BISHOP, R. T. (1967). Unpublished report.
3 BONNET, J. A. (1953). Potassium content of Puerto Rican soils as related to sugarcane growing. *J. Agric. Univ. Puerto Rico*, 37: 183-94.
4 DU TOIT, J. L. (1956). Plant Nutrition. *Rep. Exp. Stn. S. Afr. Sug. Ass.*, 1956/57: 4.
5 DU TOIT, J. L. (1957). Plant Nutrition. *Rep. Exp. Stn. S. Afr. Sug. Ass.*, 1957/58: 5.
6 DU TOIT, J. L. (1959). Plant Nutrition. *Rep. Exp. Stn. S. Afr. Sug. Ass.*, 1959/60: 18.
7 DU TOIT, J. L. (1960). Plant Nutrition. *Rep. Exp. Stn. S. Afr. Sug. Ass.*, 1960/61: 15-16.
8 HALSE, C. G. and G. D. THOMPSON, (1960). Yield data for experiments, harvested at Illovo, 1958-1959. *Proc. S. Afr. Sug. Technol. Ass.* 34: 141.

Potassium and sugarcane

By M. J. Stewart

SUMMARY

THE OCCURRENCE and availability of potassium in different soils and under different conditions is discussed, together with the influence on these, and on sugarcane, of added potassic fertilizers.

The established value of potassic fertilizers for cane production in countries overseas is reviewed, and correlations between yield and soil and leaf analyses noted. Research in this field carried out in South Africa, is summarised. Correlations established between cane and sucrose yields on the one hand, and soil and plant analyses on the other, are discussed in detail. It is concluded, that in South Africa, soil and leaf analyses can be used to provide, with a reasonable degree of accuracy, recommendations for field application of potassic fertilizer.

INTRODUCTION

Investigations carried out in several countries have shown that sugarcane takes up substantial quantities of potassium. Indeed, the crop's need for potassium is about twice that for nitrogen and three times that for phosphorus.

Data published by Van Dillewijn (1952)[26] infers that one ton of millable cane removes from the soil approximately 1.5 lb. N, 0.5 lb. P, and 3 lb. K. Estimates such as these may vary considerably, especially in the case of potassium. Thus, the amount removed can be as little as 0.6 lb. K per ton of cane where there is a deficiency of the element, or as great as 6.0 lb. K per ton when, in soils containing large amounts of potassium, luxury consumption has occurred. In view of this, one might expect regular responses to potassium fertilizer where soil K levels appear to be marginal, but such expectations are not always realised. Before reviewing potassium fertilizer practice, therefore, reference has been made to soil conditions which affect the behaviour of this nutrient element.

Maud (1958)[18] states that potassium occurs naturally in the soil in one or more of the following forms: (a) as a constituent of primary minerals such as feldspars and micas, in which form it has a very low availability; (b) associated with clay minerals as exchangeable K; (c) within the clay mineral lattice as non-exchangeable K; and (d) as water soluble K salts in the soil solution.

Potassium in the soil solution is readily available to the plant, and is maintained in equilibrium with the exchangeable form. Exchangeable potassium occurs as the monovalent cation which can be absorbed on both inorganic and organic soil colloids. It is taken up by plants either as a result of direct root contact, or indirectly through transfer by the soil solution. Non-exchangeable potassium, however, is not available to the plant as it is firmly bound between the micaceous minerals of the soil complex.

Mineral weathering causes potassium to migrate from the bound state to an exchangeable position on the soil colloid. This transfer of potassium from its non-exchangeable to an exchangeable form, is dependent on the rate of soil weathering.

Soils vary in their ability to liberate potassium, according to the lattice structure of the minerals and their behaviour under dry and wet conditions. Secondary minerals such as montmorillonite *and illite are said to have an open* structure with strong potassium fixing powers. In contrast, kaolinite, feldspars and organic matter have a closed conformation which minimises the absorption of potassium *within the lattice.*

Lacaille (1966)[16] considers that 90-98% of soil potassium exists as an immobile silicate complex in primary feldspars and micas and within clays, the balance being *represented* by *non-exchangeable* interlattice potassium and exchangeable surface-adsorbed potassium. If, however, the total potassium content of a soil is high, then the small percentage *available to the plant is still* relatively large in relation to its requirements, and the level will be maintained as a result of continuous weathering. Conversely, if the total potassium content of a *soil is low, then only a small* amount is likely to be available to a crop at any one time.

Heavy applications of potassium fertilizers may tend to reverse the natural weathering process, resulting in a transfer from water soluble and exchangeable forms to non-exchangeable potassium. This may involve only a very small percentage of the applied fertilizer element, due to the natural buffering effect of soils with a favourable colloidal content. Thus, soils with a high clay content are usually richest in potassium whereas very sandy soils invariably have a low content. Unfortunately, the greater availability of potassium apparent in heavy compact soils can be misleading, because associated impervious conditions restrict root growth and limit aeration. These in turn prevent the crop from obtaining a regular supply of potassium throughout the growing season. Good soil structure and adequate root room are of fundamental importance in promoting the healthy root growth which is needed for maximum utilization of available potassium.

No discussion of potassium would be complete without reference to the base exchange cap*acity of soil, and the relative* importance of soil cations other than potassium. Although the correct balance of cations cannot be accurately defined, it is nevertheless certain that a close re*letionship exists* between potassium, calcium and magnesium, and that an excess or deficiency of any one affects the uptake of the others. If growing conditions are favourable and potassium is *freely available to the crop*, sugarcane will take up more than its essential requirement of the nutrient. This surplus absorption by the plant is known as 'luxury consumption' and it is commonplace in sugarcane production.

POTASSIC FERTILIZERS

The use of potassic fertilizers in agriculture has increased dramatically in the last three decades, and this is particularly true in the case of sugarcane.

All commercial potassic fertilizers contain potassium in a water-soluble form, and they are classified according to the nature of the salt and its potassium content. The most important potassic fertilizers are:

(1) Muriate of potash (potassium chloride) 50%K
(2) Sulphate of potash (potassium sulphate) 40% K
(3) Sulphate of potash-magnesia (potassium and magnesium sulphates) 21.6% K,

and all three types of carrier are commercially available in the Republic of South Africa.

The domestic unit price of sulphate of potash is just over 70% more than that of muriate, while that of potash-magnesia is double the unit price of muriate. It is considered, therefore, that if any advantage is to be gained from applications of sulphur or magnesium, they can be supplied more economically from other sources. Potassium fertilizer practice is therefore based on the use of muriate of potash and this is the case in most other cane growing countries.

THE USE OF POTASSIC FERTILIZER OVERSEAS

Puerto Rico

In Puerto Rico, Samuels and Landrau (1955)[22] who studied the *effects of potassium on the yield* and sucrose content of sugarcane in some 200 fertilizer trails, found that the omission of potassium, reduced cane yields on average by 7%. They also found that responses to potash increased in later ratoons. Hauck and Dickinson (1954)[10] reported that variable responses were obtained from potassium treatments on different soil types in Puerto Rico. However, on those soils on which a positive response was recorded, the best results were obtained from an application of 125 lb. K per acre. Bonnet (1953)[3] noted that except in old ratoons, no advantage was gained by applying dressings of potash in excess of 100 lb. K per acre. More recently, Samuels (1965)[21] reported that the average amount of potassium used per acre per crop, between 1958 and 1964, was 80 lb. K. Leaf analysis and crop logging were developed by Samuels *et al* (1955)[23] along the lines employed in Hawaii. These techniques are now used to assess crop requirements on many of the larger estates and holdings in Puerto Rico.

Jamaica

In Jamaica, Innes and Chinloy (1951)[15] carried out experiments with potassium carriers and found that responses varied with soil type. An average dressing of 100 lb. K per acre induced responses which varied by more than 50% on different soil types. Furthermore, responses to potassium increased progressively from plant cane through the subsequent ratoons. The response curve, plotted from the experimental data only, commenced to level out when rates of application were in the region of 200 lb. K per acre. This was much higher than the average rate

the range up to 100 lb. K per acre. Although, as shown in Table XI, higher levels of application *may* induce additional positive response, this occurs at a diminishing level. Except for the apparently poor correlation with soil analyses, these results are in reasonable agreement with those obtained in previous trials.

Most of the independently organised experiments were located on soils derived from Table Mountain sandstone, dwyka, dolerite, Ecca shales and *recent sands.* Unfortunately, no relationship could be discerned between soil type and response to the treatment with K. This, almost certainly, is due to the greater immediate influence of *different management factors* and such other aspects of environment as variation in rainfall regimes. In these circumstances attempts to use the results of a range of independently organised trials, to *either corroborate* existing findings or to provide overall recommendations, must be subject to severe criticism. It is obvious, that future work should, so far as possible, be conducted according *to minimum standard specifica*tions, so that such features as row spacing, gross and net plot sizes, guard areas, treatment levels, harvesting procedures and ancillary measurements, are standard*ized. For nutritional studies, it is* particularly important that methods for soil and foliar sampling should be standardised, that all samples should be analysed using the same laboratory techniques, and that where feasible they should be conducted in one central laboratory, preferably at the Experiment Station at Mount Edgecombe.

EVALUATION OF CROP REQUIREMENTS

It should, by now, be clear to the reader that complex interactions of chemical and physical factors in soils affect the availability of potassium to a crop. It has been shown that soil analyses, when correlated with data from field trials, provide a useful guide to the potassium requirements of cane crops. It has also been pointed out that the complex relations which govern the supplying power of the soil and the ability of the sugarcane plant to adsorb this element, limit the degree of accuracy obtainable in predicting fertilizer requirements.

We have seen that in South Africa, reasonable correlations have been established between soil analytical data and sugarcane crop responses. Similar work has been carried out overseas, and it is of interest to examine these findings in relation to our own.

In the West Indies, Hardy and Rodriguez (1949)[9] report that the threshold value for exchangeable K in the soil is 65 ppm in sands and loams, and 95 ppm in clays and silts. Hodnett (1956)[11] considers 66-75 ppm K to be the critical level for K in Trinidad soils. According to Humbert (1963)[13] consistent responses to potassic fertilizer can be expected in Hawaii when exchangeable K levels fall below 75 ppm; above 100 ppm there appears to be little likelihood of a significant response to potassic fertilizers. Locsin *et al* (1956)[17] reported that in the Philippines significant increases in cane and sugar yields were obtained when potassic fertilizers were applied to soils in which the exchangeable K was below 95 ppm. Responses were variable where K levels ranged from 95 to 120 ppm and above 120 ppm K, *no statistically significant re*sponses were obtained.

Soil and Leaf Analyses

In South Africa, Bishop (1967)[2] in an unpublished paper presented to the South African Sugar Industry Agronomists' Association, discussed the reliability of predicting yield responses to potassic fertilizers, based on soil and leaf analyses, and yield results for the 3^3 and 4 x 2 x 3 factorial trials. He concluded that responses could have been predicted correctly in 74% of the experiments, incorrectly in 16% while predictions for the remaining 10% would have been of doubtful value. It is encouraging to note that interpretation of soil and leaf analyses for potassium fertilizer recommendations is so reliable. Bishop (*loc. cit*) considered leaf analysis to be potentially more reliable than soil analysis as a basis for making fertilizer recommendations, and gave two main reasons.

(1) The coefficients of variation for different nutrients in the third leaf blade are usually very much less than those for available nutrients in the soil. This was shown in a growth analysis experiment where the C.V. for third leaf K was 14.4% while for available soil K it was 21.8%;
(2) Leaf analysis can reflect fertilizer use by the standing crop, whereas soil analysis may not. In the growth analysis experiment referred to, the average exchangeable soil potassium in samples from plots which received 166 lb. K per acre was 51 ppm, whereas samples from the control plots which received no potassium contained 48 ppm. However, the mean leaf analysis data distinguished more clearly between the two treatments, the values being 1.18% and 0.93% K for fertilized and control plots respectively.

In spite of these comments there is sufficient evidence from the exploratory and regional fertilizer trials to show that soil *analyses are meaningful*, and that a threshold value of 125 ppm for available soil potassium is reasonably consistent. Responses are unlikely to occur in soils which contain more than this amount of *available* K.

Leaf and soil analysis are in fact complementary one to the other. Both should be used and the results recorded, so that fertilizer recommendations can be based on current and *historical data*. It may be that soil analyses can be limited to the plant crop, while

TABLE X

The interaction between nitrogen and potassium in terms of sucrose % cane and tons sucrose per acre from a 5^2 factorial trial.

lb. K per acre	LB. N PER ACRE											
	0		100		200		300		400		Mean	
	Suc. % cane	Tons suc. per acre	Suc. % cane	Tons suc. per acre	Suc. % cane	Tons suc. per acre	Suc. % cane	Tons suc. per acre	Suc. % cane	Tons suc. per acre	Suc. % cane	Tons suc. per acre
0	17.34	4.88	16.56	4.30	16.18	4.01	15.84	3.86	15.72	3.56	16.33	4.12
83	16.98	5.54	18.26	7.64	17.30	7.33	16.31	6.08	16.38	5.92	17.04	6.50
166	17.28	5.14	17.25	8.06	17.59	7.25	17.18	7.41	17.60	7.96	17.38	7.17
249	18.08	6.21	17.45	7.26	17.66	6.76	17.66	8.17	17.10	7.28	17.59	7.14
332	17.44	5.15	17.64	7.76	17.10	7.94	17.02	8.50	17.37	6.24	17.32	7.12
Mean	17.43	5.38	17.44	7.60	17.17	6.66	16.80	6.80	16.83	6.19	17.13	6.41

depression in sucrose % cane has been observed following application of 166 lb. K per acre, when the soil analysis showed 155 ppm exchangeable K.

Interactions between nitrogen and potash were observed in a number of the regional fertilizer trials, but those in a 5^3 factorial trial, planted on Table Mountain sandstone soil with a low potash level of 64 ppm K, are cited as a good example. In this trial, the application of nitrogenous fertilizer in the absence of potash steadily decreased the sucrose % cane. However, the addition of potash counteracted this trend, producing a good response, in terms of sucrose % cane, at high levels of N application, matched by a corresponding increase in cane yield. Together, these gave the progressive increase in sucrose yields shown in Table X. The results of this trial prompted du Toit (1959)[6] to observe that the best ratio of N to K seems to lie between 1:1 and 1:1.5. Current thinking would support the opinion that a 1:1 ratio is closer to average requirements.

Miscellaneous experiments

In recent years, the results of a number of additional fertilizer trials have been made available to the S.A. Sugar Industry Agronomists' Association. Most of these originated from local sugar estates. Using the data so provided, an attempt has been made to relate crop responses to amounts of available soil K, treatment levels and soil types. Results from more than 40 experiments were examined and data from 36 of these, containing details of soil analyses, have been reported. Yield data have been analysed statistically from only 21 crops, derived from 12 of the experiments. Of these, statistically significant responses to treatment with potassium were recorded on only eight occasions.

To simplify the segregation of the results listed in Table XI, only two classes of soil have been considered, namely those containing less than 100 ppm available K, and those containing more than 100 ppm K. Treatment levels have been averaged to simplify comparisons, as potassium increment levels vary with each trial and in some cases zero levels have been omitted. Three categories were chosen: up to 100 lb., 100-200 lb., and over 200 lb. K per acre.

It will be seen that positive responses were obtained in 83% of cases where up to 100 lb. K per acre was applied. An additional positive response to applications of between 100 and 200 lb. K per acre was obtained 54% of the time. In the limited number of experiments where more than 200 lb. K was applied per acre, 60% of the crops harvested gave positive additional responses.

The poor correlation between crop response and available soil potassium is more apparent than real. In only 16% of the recorded experiments did soil analyses show a potassium level greater than 125 ppm available K. The response trends within this range of trials are not, therefore, out of line with results from the reported 3^3 and 4 x 2 x 3 factorial series, where it has been established that potash responses can be expected only from soils containing less than 125 ppm K.

The highest average mean response of 4.6 tons cane per acre was obtained as a result of applying potassic fertilizer within

TABLE XI

Summary of trials submitted to the S.A.S.I.A.A. showing responses obtained in 36 experiments from the use of different amounts of K.

Treatment lb. K per acre	Type of response	No. of observations			Tons cane/acre		
		Up to 100ppm soil K	Over 100ppm soil K	Total	Up to 100ppm soil K	Over 100ppm soil K	Mean
100 lb. or less	Positive	24	23	47	4.0	5.2	4.6
	Negative	4	6	10	−2.8	−2.2	−2.4
	% Positive	86	79	82	—	—	—
100-200 lb.	Additional Pos.	25	21	46	2.3	1.5	1.9
	Additional Neg.	23	16	39	−3.3	−2.3	−2.9
	% Positive	52	57	54	—	—	—
200 lb. and over	Additional Pos.	10	5	15	3.0	1.5	2.5
	Additional Neg.	7	3	10	−1.6	−0.9	−1.4
	% Positive	59	63	60	—	—	—

of application used on a recorded 35% of the commercial fields, reaped in 1951, which received just under 100 lb. K per acre.

The value of leaf analysis has been established by a number of workers in Jamaica, and they have secured a good correlation between potassium levels in the leaf and responses to potassic fertilizer. In general, a significant response to potassium can be expected if the K content of the third leaf blade falls below 1% on a dry weight basis.

Shaw (1963),[24] in recent investigations of the behaviour of potassium in some heavy soils in Jamaica, showed how important root development is for normal crop nutrition. He found that levels of exchangeable potassium in the soil were not low enough to explain the deficiencies indicated by leaf analysis. Although clay fixation might have accounted for the restricted uptake of potassium, he concluded that deterioration of soil tilth had limited crop root development, and that this was the principal cause of inadequate potassium nutrition. This claim was supported by the fact that potassium uptake declined progressively in the ratoons, as the soil structure deteriorated.

British Guiana

In British Guiana, Birkett (1954)[1] observed that very limited responses had been obtained as a result of applying potassic fertilizer, and that applications as large as 200 lb. K per acre did not, on average, increase yields by more than 10%, compared with the controls. More recent results from British Guiana, reported by Walker (1961)[27] show that responses to potassium vary with soil type. A 13% increase in sugar yield was achieved on sandy soil as a result of applying 225 lb. K per acre, but on a clay soil, responses were less than half of this.

Barbados

In Barbados, early work by Saint (1933-38)[20] was confirmed by Robinson (1951),[19] when he found that about 100 lb. K per acre was an adequate dressing for sugarcane. Here again, responses varied according to soil type, a good response being obtained on red soils, but little or no response on black soils.

Louisiana and Florida

Information from Louisiana indicates that applications of potassic fertilizer increase the sucrose content of cane juice, but Sturgis and Byrnside (1955)[25] note that average recommendations do not exceed 50 lb. K per acre. In Florida, however, where cane is grown on highly organic soils, potassium is not freely available to the crop. Consequently, potassium is a major nutrient requirement and is applied at rates as high as 125 lb. K per acre.

Hawaii

The Hawaiian sugar industry has been conscious of the importance of potassium for many years, and fertilizer consumption on the islands increased substantially after the last world war. This situation was the outcome of much research, and the correlation of data derived from many trials employing soil and tissue analysis. Humbert, Clements and Lyon (1963)[14] report that they introduced a crop logging technique, designed to follow the nutrient status and growth of the crop throughout each cycle. The 3-6 leaves and sheaths are sampled at 35-day intervals from the time the cane is 2-3 months old until harvest. A potassium index, which is the percentage K in sugar-free, dry sheaths, should be 2.25% or more when potassium nutrition is adequate. When the index is lower than this critical value, potassium fertilizer is applied 4-6 weeks after planting and again at regular intervals until the index reaches a satisfactory level. In this way amounts as large as 400 lb. K per acre may be applied to crops harvested at 24 months of age – quantities which are very much higher than those employed in any other part of the world. The age of the cane when harvested undoubtedly influences the amount of potassium required, but the high fixation rates of some Hawaiian soils has also been said to have an important influence on rates of application. Humbert (1963)[12] reports that in the dark-magnesium and the grey hydromorphic clay soils, where drainage and aeration are problems, the cane is unable to absorb adequate quantities of potassium, even though the level of exchangeable potassium in the soil may be high.

THE USE OF POTASSIC FERTILIZER IN SOUTH AFRICA

Since 1950, more than 100 formal fertilizer trials have been laid down in the coastal area of the sugar belt of South Africa, the results from numerous crops being correlated with leaf and soil analyses in order to assess fertilizer requirements.

Exploratory Trials

In 1950, a number of 3^3 NPK factorial fertilizer trails were laid down in Natal by the S.A.S.A. Experiment Station. By 1956, sufficient data had accumulated for du Toit (1956)[4] to draw certain conclusions. The standard K treatment levels in these trials were 0, 83 and 166 lb. K per acre. Of 28 plant cane experiments, 9 gave a statistically significant increase in yield due to application of potassic fertilizer, the average being 1.63 tons cane for 83 lb. K per acre. An average additional increase of only 0.28 tons cane per acre was recorded when the potassium application was doubled. In 21 ratoon trials, 10 showed a statistically significant response to application of potash. The results are given in Table I, and they indicate that the response to potassium in ratoons is greater than that in the corresponding plant crops. However, as in the case of the plant crops, only a relatively small additional yield increase occurred following the application of twice the amount of K.

Fifteen of the explanatory trials were harvested during the following season and the results, as shown in Table II, confirmed that treatments with 83 lb. K per acre gave the greatest yield response. It can also be seen from the same table that in those experiments where significant yield responses were obtained, the K content of the third leaf increased considerably due to application of 83 lb. K per acre. The potassium content of the millable cane obtained from these trials is shown in Table III, and it is interesting to note that in experiments where significant responses were obtained, cane which had not received applied potash contained only 34 lb. K per acre. In contrast, cane from untreated plots in the remaining experiments contained 99 lb. K per acre.

By 1957-58, du Toit (1957)[5] using the results from these exploratory trials, had established correlations between soil and leaf analyses on the one hand, and crop responses on the other. These showed that a response to potassium can be expected in soils containing less than 100 ppm of available K, particularly in ratoons. On heavy soils, responses were commonplace when available K was between 100 and 200 ppm, but there was little likelihood of a response when the level was above 200 ppm K. Leaf analysis was considered to give a better indication of possible potassium deficiency. When the level of K in the third leaf falls below 1 % on a dry matter basis, then there is greater likelihood of obtaining a response to application of potassium salts. A response is very unlikely to materialise when leaf content on a dry matter basis is greater than 1.25 % K.

During the 1957 season, ten exploratory trials were harvested as second ratoon crops. Five of these showed statistically significant responses to applications of 'potassium', as shown in Table IV.

It should be noted, that while a response of 12.5 tons cane per acre was obtained from one increment of 83 lb. K per acre, this was increased by only an additional 0.30 tons of cane per acre when the rate of application was doubled. The potassium content measured in the third leaf in 5 trials, increased to a much greater extent in treatments receiving 83 lb. K per acre where statistically significant yield responses were obtained. Little improvement was found in similar treatment plots, where yield responses were not statistically significant.

Another trial, designed to measure the effects of four levels of application of 'potassium', ranging from 0 to 300 lb. K per acre, was harvested in the same season. The results confirmed the earlier conclusion that applications in excess of 100 lb. K per acre do not contribute to a statistically significant increase in yield.

Six exploratory trials were harvested as third ratoon crops, during 1959 and the results, together with all the previous crop yields from these experiments, are compared in Table V. It is interesting to note that crop responses to 83 lb. K per acre increased in the successive ratoons. Furthermore, the results indicated that, while responses of 83 lb. K per acre were consistently good, the application of an additional 83 lb. K per acre did not appear to be justified from an economic standpoint.

4 x 2 x 3 Regional Trials

Following the 3^3 NPK exploratory trials, 40 regional fertilizer trials (known as RFT's) were planted. These were of NPK 4 x

TABLE I

Yield increases due to potassium fertilizer treatments in 21 plant crops and in their ratoons, in a series of 3^3 NPK trials.

Lb. K/acre	Average yield response, t.c.a.	
	Ratoon crops	Cor. plant crop
83	3.9	2.1
166	4.6	2.1

TABLE II

Mean yields of cane and the K contents of the 3rd leaf under different potash regimes (Fifteen 1st ratoon crops in a series of 3^3 NPK trials.)

Class of trials	No. of trials	Yield, tons cane/ac			K % dry 3rd leaf		
		0 lb. K/ac	83 lb. K/ac	166 lb. K/ac	0 lb. K/ac	83 lb. K/ac	166 lb. K/ac
Significant responses obtained . . .	5	29.6	35.6	38.2	0.90	1.25	1.38
No significant responses obtained . .	10	40.2	41.8	39.7	1.14	1.25	1.28
All crops	15	36.6	39.7	39.2	1.07	1.25	1.30

TABLE III

Mean amounts of K per acre in millable cane subject to different levels of application of potassic fertilizer. (Fifteen 1st ratoon crops in a series of 3^3 NPK trials.)

Class of trials	lb. K in millable cane/acre		
	0 lb. K/ac	83 lb. K/ac	166 lb. K/ac
Significant responses obtained . . .	34.0	58.0	91.4
No significant responses obtained . .	*99.4*	*105.9*	*120.8*
All crops	77.6	90.0	111.0

TABLE IV

Mean yields of cane and 3rd leaf K content where different amounts of potassium have been applied in the 3^3 NPK trials. (Ten 2nd ratoon crops in a series of 3^3 NPK trials.)

Class of trials	No. trials	Yield, tons cane/ac			K % dry 3rd leaf		
		0 lb. K/ac	83 lb. K/ac	166 lb. K/ac	0 lb. K/ac	83 lb. K/ac	166 lb. K/ac
Significant responses obtained . .	5	31.5	44.0	44.3	0.75	1.11	1.22
No significant responses obtained . .	5	40.7	41.8	43.0	0.94	1.14	1.22
All crops	10	36.1	42.9	43.6	0.85	1.13	1.22

2 x 3 design, and the potassium treatments for the plant crop were the same as those employed in the exploratory trials, namely 0, 83 and 166 lb. K per acre. In the ratoons, however, the treatments were 0, 125 and 250 lb. K per acre. The average response to application of potassium in the plant cane crop was slightly better than in the earlier exploratory trials, as shown in Table VI.

During 1960, 18 of the regional fertilizer trials were harvested as ratoon crops. In nine of these, statistically significant responses were obtained to an application of potassic fertilizer, the pattern of response being similar to that for the plant stage, although, as seen in Table VII, the magnitude of the responses was greater in the ratoons. The yield data confirm that the fertilizer dressing containing 83 lb. K gives a much better return per unit of nutrient applied than the heavier dressing. However, du Toit (1960)[7] found that the response to an application of 125 lb. K per acre could be spectacular. Furthermore, he showed that 250 lb. K per acre could, with advantage, be applied to many soils, particularly those derived from Table Mountain sandstone and granite.

By, 1961, 35 regional fertilizer trials had been harvested both as plant cane and ratoons. Of these, 24 were located on soils containing less than the accepted minimum amount of available K. The average responses in plant and ratoon crops in these 24 experiments, expressed as tons cane per acre are shown in Table VIII. These indicate that when the available potassium content of the soil is less than 125 ppm, good yield responses can be expected in plant and ratoon crops from the application of potassic fertilizer containing respectively up to 166 lb. and 250 lb. K per acre. Where, however, the soil contains more than 125 ppm available K per acre, responses are seldom obtained, and when they do occur they are confined to very shallow soils.

In 11 R.F.T. trials, harvested as ratoons during 1962, good responses were again recorded for the first 125 lb. K per acre, whereas only slight improvements were obtained from the second increment of potassic fertilizer.

Halse and Thompson (1960)[6] reporting separately on an R.F.T. trial on a Table Mountain sandstone soil at Powerscourt, showed that *highly profitable responses* were obtained from the application of 83 and 166 lb. K per acre, the yield increments being *respectively 11.07 and 11.46 tons cane* per acre.

Sucrose % Cane

A statistically significant increase in sucrose per cent cane, due to treatment with potassic fertilizer, was recorded when the available potassium in the soil averaged only 45 ppm. This is shown in Table IX. In contrast, when the average exchangeable K in the soil was more than 200 ppm, and the K content of the dry third leaves obtained from control plots was 1.16 % no improvement in sucrose % cane occurred. Indeed, a statistically significant

TABLE V

Mean yields of cane and sucrose per acre where different amounts of potassium have been applied in the 3^3 NPK trials. (Plant to 3rd ratoon crops in 6 experiments of the 3^3 NPK series.)

lb. K per acre	Plant		1st ratoon		2nd ratoon		3rd ratoon	
	Tons cane/ac	Tons suc/ac	Tons cane/ac	Tons suc/ac	Tons cane/ac	Tons suc/ac	Tons cane/ac	Tons suc/ac
0	54.1	8.28	47.1	7.28	41.5	6.00	38.2	5.68
83	57.8	8.88	51.8	7.90	50.4	7.45	47.5	7.05
166	58.5	9.00	55.3	8.67	51.1	7.56	47.9	7.08

TABLE VI

Mean yields of cane and sucrose where different amounts of potassium have been applied.
(Plant crops in 40 regional fertilizer trials.)

lb. K per acre	Tons cane per acre	Tons sucrose per acre
0	45.0	6.73
83	48.4	7.30
166	50.1	7.61

TABLE VII

Mean yields of sucrose per acre where different amounts of potassium have been applied. (Plant and 1st ratoon crops of 18 regional fertilizer trials.)

Plant crop		First ratoon	
lb. K per acre	Tons sucrose per acre	lb. K per acre	Tons sucrose per acre
0	8.15	0	6.71
83	8.75	125	7.68
166	9.13	250	8.01

TABLE VIII

Mean response in tons cane per acre for 24 plant and corresponding ratoon crops, where available potassium in the soil at the time of planting was below 125 ppm.

Plant crop		Ratoon crop	
Response due to	Tons cane per acre	Response due to	Tons cane per acre
83 lb. K per acre	5.8	125 lb. K per acre	10.6
166 lb. K *per* acre	8.7	250 lb. K per acre	13.6

TABLE IX

The mean effects of potassium treatments on sucrose % cane in experiments on soils either low or high in available K.

lb. K per *acre*	Sucrose % cane	
	Mean *Soil K* 45 ppm	Mean Soil K 200 ppm
0	14.87	16.58
83	15.32	16.52
166	15.51	16.33

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL MEETING - 2 DECEMBER, 1969

FLOWERING OF SUGARCANE ALONG THE KOMATI RIVER

by D. Coetzee

1. INTRODUCTION

The first seed beds planted during the summer of 1963/64 flowered during the first winter and flowering has been a common occurence since.

Until recently it was generally believed that the areas below the Lebombo Mountains were particularly susceptible to flowering, presumably because cane flowered readily in North-eastern Swaziland and along the Komati River in the Transvaal. It was casually accepted that flowering was caused or had something to do with the early morning mists during winter.

The summer of 1968/69 was marked by a very low rainfall and high temperatures. During February and March the precipitation improved to almost normal and temperatures and evaporation decreased considerably. Most growers kept on irrigating normally during this period.

During the winter that followed cane flowered profusely in the whole area. Flowering was equally bad on the heavy soils along the Komati River, the heavy and sandy soils along the Crocodile and at Kaalrug, as well as the heavy soils in the Louws Creek Area. It was common to all altitudes from 500 to 1,500 feet above sea level and in rainfall areas from 2- inches p.a. to areas with an average rainfall of 45 inches per annum.

2. THE EFFECT OF FLOWERING ON YIELD

The grower observes the formation of pithy material in the stalks and that this progresses downwards in the stalk. This formation of pithy tissue is rapid, especially immediately after winter and some stalks may die completely within a period of six months after the emergence of the inflorescence.

It is however, difficult to determine the exact loss of sucrose per acre per month unless one resorts to proper experiments.

Table 1 shows the yields of plant cane and the first ratoon crop obtained from NCo 376 in the Komati Area, during the seasons 1967/68 and 1969. The plant cane did not flower but the first ratoons flowered freely.

TABLE 1: YIELDS OBTAINED FROM NCo 376 PLANT CANE AND THE FIRST RATOON CROP IN THE KOMATI AREA.

Plant Cane (1967/68)				First Ratoon (1969)		
Field	Age (Months)	* TCAM	Sucrose %	Age (Months)	* TCAM	Sucrose %
C3	18	4.69	12.54	23	3.46	10.98
B6	18	4.96	11.87	19	3.72	8.60
C5	19	4.12	12.35	22	3.14	10.48
B8	19	5.26	11.50	21	4.17	9.95
C8	19	4.48	11.70	21	4.14	9.47
B5	19½	7.78	13.76	19	7.97	9.91
B3	19½	4.01	14.29	16	3.40	10.03
	18.8	5.04	12.57	20.14	4.29	9.92

* Tons of cane per acre per month.

The arithmetical average shows that there is not only a decrease in yield of cane per acre per month from 5.04 to 4.29, but also a decrease in sucrose.

The decrease in the yield of cane can be attributed mainly to the flowering of the ratoon crop. The decrease in sucrose content of the cane may, to a certain extent, be due to flowering.

Table 2 shows the yield obtained from plant and first ratoon in NCo 310 in the Komati Area. These fields flowered considerably less than those planted to NCo 376.

TABLE 2: YIELDS OBTAINED FROM NCo 310 PLANT CANE AND FIRST RATOON CROP IN THE KOMATI AREA.

Plant Cane				First Ratoon		
Field	Age (Months)	* TCAM	Sucrose %	Age (Months)	* TCAM	Sucrose %
A5	20	2.82	14.40	20	2.82	12.91
A7	20	3.28	14.45	20	3.13	12.99
A8	20	3.17	13.88	19	3.40	11.29
A6	20	3.84	14.48	20	3.07	12.89
D1	22	2.95	13.55	20	2.96	13.49
D2	22	3.24	14.65	19	3.85	13.51
C6	17	3.42	12.66	16	3.87	12.57
	20.1	3.25	14.01	19.1	3.30	12.81

* Tons of cane per acre per month.

Table 2 shows that the first ratoon crops did not differ materially from the crop yielded by the plant cane. The lower sucrose content may be due to a number of factors but possibly mainly to the time of harvesting.

Comparing the average yields of cane obtained from NCo 376 and NCo 310 it appears that the ratoon crop was in accordance with expectations in the case of the latter, but that there was a considerable reduction in yield in the case of the former.

The application of water as well as the fertilizing programme was the same for both varieties.

3. OTHER OBSERVATIONS

Acting on the information received from, and with the assistance of the staff of the Research Station at Mount Edgecombe and based on the experience at Chiredzi in the Rhodesian Lowveld, drying off during the latter half of February and early March 1969, i.e. prior to and during the period of floral initiation, was practised by a number of growers in the area.

The successes gained were more or less in accordance with the available moisture of the soil. The fields that were heavily irrigated during this critical period flowered heavily. There was hardly any difference in the incidence of flowering between NCo 376 and NCo 310 under these wet conditions. Fields that were dried off almost to wilting point showed very few flowers or no flowers at all.

The application of a nitrogenous fertilizer (175 lbs. N per acre, applied during early February) seemed to depress flowering. The results obtained by aerial applications of the herbicide "Diquat" were also encouraging.

4. SUMMARY

The available information, although scanty, seems to indicate that:-

(a) flowering seriously suppresses the yield of cane;

(b) it is possible to control flowering by the judicious use or withholding of water from cane during the period of floral initiation;

(c) it is possible to control flowering by the use of a nitrogenous fertilizer or by a growth inhibitor.

(d) varieties differ in the incidence of flowering.

5. RECOMMENDATION

It is evident that severe losses may be suffered by growers due to flowering of cane. It has, therefore, become necessary to investigate varietal susceptibility in the irrigation areas and economical methods to control flowering in the established plantations by withholding water, the application of nitrogen, growth inhibitors, or other chemicals.

in vogue
why necessary, where
natural ripening in S.A. australia
mode of action

Why use chemicals

Natural ripening: Winter - drying off
Problem of low sucrose varies in diff. countries
Our problem - May June, Nov. Dec.

Where work is being done

Hawaii, C.S.R. Brisbane, Tate + Lyle, Puerto Rico

What chemicals - wide variation in mode of action, gibberellin + silica
What is required it seems is a chemical which will inhibit growth or stem elongation without reducing the rate of photosynthesis
Something in fact that will inactivate enzyme invertase & amylase to prevent the reversion of sucrose to reducing sugars.

Topping up - where we hope to effect ripening
Data from H.A. left. Page 2

What has been achieved

Reports from work in glasshouses
Hawaii: timing so important
australia: no response in terms of c.s.a.
DAS 13.29 - 18.96 but yield decreased
effect of CP 41845 adversely affected ratooning

Mr. Edgecombe

Chelated iron

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL MEETING - 2 DECEMBER, 1969

CHEMICAL RIPENING OF SUGARCANE

by P. Moberly

Why use chemicals?

The natural ripening process seems to be related to the inhibiting of stem elongation. Ripening occurs naturally with the ageing of cane, with the onset of winter or the imposition of moisture stress, i.e. "drying off". In the humid tropics "drying off" is almost impossible and, of course, there is no winter. The trend is to cut younger, upright crops to facilitate easier mechanical harvesting, and hence low sucrose problems exist to a greater extent there than they do in our industry. However, if and when a successful chemical ripener is found it would also be of great value to our industry particularly in the northern areas and to all parts of the industry at the beginning and end of our extended milling season. The long-term industrial average sucrose % cane in South Africa is: May 12.45, June 12.94, July 13.54, August 14.02, September 14.32, October 14.12, November 13.60, December 12.92, January 12.48.

The action of ripening chemicals

The function of a ripening chemical would be to suppress growth but not to affect the rate of photosynthesis. The more successful chemicals appear to inhibit the synthesis of enzymes, particularly invertase and amylase which catalyze the transformation of sucrose into invert sugars. The four centres at present actively engaged in research into the use of ripeners are the C.S.R. Co., Brisbane, the Experiment Station H.S.P.A., Tate and Lyle U.K. and the University in Puerto Rico. Basically this work involves the study of what groups of plant hormones exist in sugarcane and what causes these hormones to stimulate or inhibit enzyme synthesis. The action of some of the chemicals which have shown some measure of success, must vary very considerably because the chemicals themselves are so dissimilar. Trysben, a plant growth stimulant; Cycocel, a plant growth inhibitor and Endothal an anti-fungal agent are examples of chemicals which have apparently caused ripening to some extent.

The "topping-up" process

When considering the distribution of sucrose in a cane stalk it becomes fairly obvious that a chemical might be expected to affect ripening in the immature green top only. It is unlikely to change appreciably the purity in the lower parts of the stalk. The following data collected recently at Mount Edgecombe illustrate the changes in sucrose % cane in the top, middle and bottom portions of 16 month old N:Co.376 over a 7 week period, starting in June, 1969.

	2 wks	3 wks	5 wks	7 wks
Top third of stalk	6.4	6.6	8.3	9.0
Middle third of stalk	14.6	14.7	15.6	15.5
Bottom third of stalk	14.3	14.3	15.1	15.2

The achievements to date

To our knowledge, the success stories have eminated only from greenhouse trials. With the exception of the Hawaiians very few people have conducted field experiments until this year.

In Hawaii, under field conditions they found changes in purity of the following order:-

	Weeks after Spraying 4	5
Cycocel	-3.94	+5.72
Endothal	+5.72	+0.30

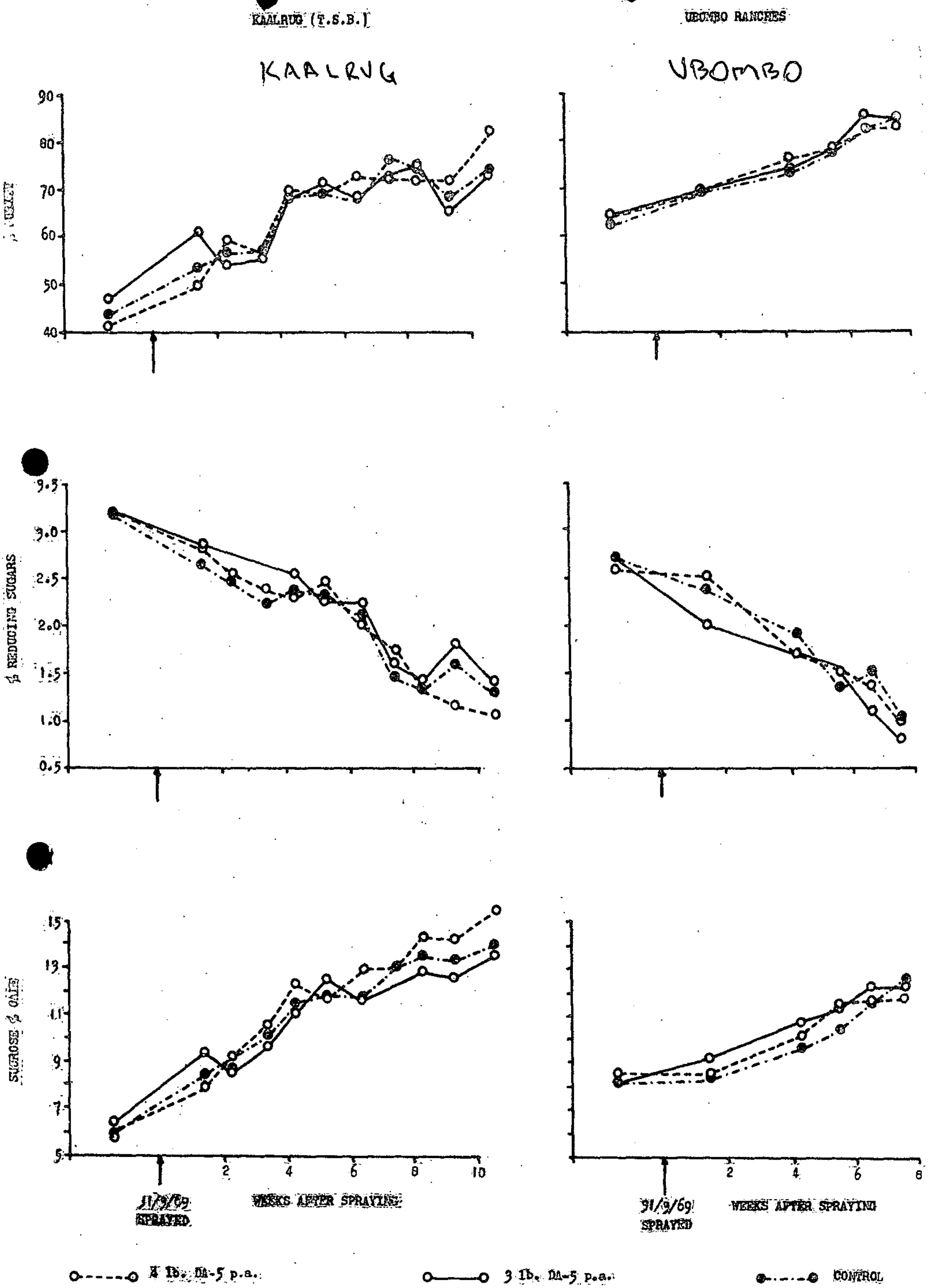
These data emphasize how important is the time of spraying in relation to the scheduled harvest programme.

The results of six field experiments carried out this year in Queensland have just recently become available. Monsanto's test product C.P. 41845 and Du Pont's D.A 5 were the chemicals tested by the Bureau of Experiment Stations. In some experiments there were trends towards increases in c.c.s. but no increase in t.s.a. due to a decrease in t.c.a. In one of the D.A.5 experiments at Fairymead using Q 57, a highly significant increase in c.c.s. occurred viz. from 13.29 to 13.96; but the yield in t.c.a., declined from 36.15 to 31.93. These effects were measured over a period of 8 to 12 weeks. Other effects observed from the foliar sprays have been side-shooting, red blotches on the leaves, leaf desiccation and, of some concern, is the adverse effect on the ratooning process as a result of spraying C.P.41845.

The Experiment Station, Mount Edgecombe has recently screened a number of the chemicals which have shown promise overseas. Amongst these are Cycocel, Trysben, Dalapon, Endothal, Paraquat and D.A.5. To date there have been no positive effects. However, this screening work was only initiated here last year and there are still many avenues of investigation viz. higher rates, split applications, varietal differences, age of cane, time of year etc. etc. Sucrose %, purity %, and reducing sugar % data, obtained from the air-spray experiments conducted at Kaalrug and Ubombo Ranches are shown graphically on the next page.

The future

In co-operation with Tate and Lyle U.K. and Plant Protection U.K., their promising ripening chemicals, tested under greenhouse conditions, will continue to be screened in small replicated experiments at Mount Edgecombe.



KAALRUG (T.S.B.)
UBOMBO RANCHES
KAALRUG
UBOMBO
% PURITY
% REDUCING SUGARS
SUCROSE % CANE
11/9/69
SPRAYED
WEEKS AFTER SPRAYING
31/9/69
SPRAYED
WEEKS AFTER SPRAYING
4 lb. DA-5 p.a.
3 lb. DA-5 p.a.
CONTROL

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

ANNUAL MEETING - 2ND DECEMBER, 1969

LEAF SCALD AND FIJI - TWO IMPORTANT SUGARCANE DISEASES

Of the bacterial diseases of sugarcane, leaf scald is considered to be the most important, while Fiji disease is one of the most serious in the virus group.

Until about one year ago neither of these diseases was known to occur in South Africa, but a field visit to a Swaziland estate in 1968 with subsequent laboratory investigation, revealed the presence of leaf scald in our industry.

Fiji disease is not known to occur nearer than the east coast of Madagascar and possibly is prevalent in Reunion.

1. Leaf Scald Disease

1.1 Cause

1.1.1. Leaf scald is a systemic vascular disease caused by the bacterium Xanthomonas albilineans (Ashby) Dowson

1.1.2 The existence of different strains of the organism is causing considerable concern.

1.2 Distribution

1.2.1 Leaf Scald is found in many sugarcane-growing countries and has been called the fastest-spreading major sugarcane disease in recent times.

1.2.2 Recent reports of the disease have come from Rhodesia, Barbados, Puerto Rico, Florida and Mocambique.

1.2.3 The disease has now been confirmed in Swaziland, Pongola, Eastern Transvaal and Natal.

1.2.4 Danger areas are high temperature, low rainfall districts.

1.3 Symptoms

Leaf Scald can occur in two phases.

1.3.1 Chronic phase (more easily diagnosed).

1.3.1.1 Sharp white lines in young leaves and spindles.

1.3.1.2 Sideshoots on otherwise normal stalks.

1.3.1.3 "Scalded" tops and sideshoots - inward and upward curling of the leaves.

1.3.1.4 Internal bright red streaks at nodes and at base of sideshoots.

1.3.1.5 N53/216 and N.6 show very good chronic phase symptoms. N:Co.310, N51/539, N51/168, N:Co.334 N50/211 and C.B. 36/14 do not always show good chronic phase symptoms.

1.3.1.6 Chronic phase symptoms are best seen in young cane (plant and ratoon).

1.3.2 Acute phase (difficult to diagnose)

1.3.2.1 Collapse of isolated stalks or complete stools for no apparent reason.

1.3.2.2 Normal chronic phase symptoms are not often present and diagnosis has to come from cultures.

1.3.2.3 Varieties which tend to show the acute phase, harbour the infection without showing detectable symptoms.

1.3.2.4 N:Co.310, C.B. 36/14 and N50/211 tend to show acute phase.

1.4 Transmission

1.4.1 Infected seedcane.

1.4.2 Mechanically on the knife at harvest or in seed preparation.

1.5 Control

1.5.1 Development of resistant varieties

1.5.2 Seedcane selection

1.5.2.1 Seedcane must be selected before planting in seedbeds.

1.5.2.2 Leaf Scald is not controlled by heat treatment.

1.5.2.3 Infected plants must be removed from the seedbed and burned.

1.5.3 Field hygiene

1.5.3.1 Where a low infection (up to 5%) makes it possible, diseased plants should be rogued and burned.

1.5.3.2 Higher infections may require early eradication of whole field, in which case cane should be burned, milled if possible and eradicated.

1.5.3.3 Eradicate all volunteer growth

1.5.3.4 Little danger of re-infection through the soil.

1.5.4 Restriction of movement of seedcane

1.5.4.1 Seedcane must not be derived from infected fields.

1.5.4.2 No seedcane should be distributed from infected estates.

2. Fiji Disease

Fiji is a major disease of sugarcane and takes its name from the Fiji Islands where it was first observed and studied in 1894.

2.1 Cause

Assumed to be a virus but has not been intensively investigated and little is known of its physical properties.

2.2 Distribution

2.2.1 Until 1954 only known to occur in eastern hemisphere - Fiji, Australia, New Britain, New Caledonia, Samoa, Phillipines, New Guinea, Solomon Islands and Thailand

2.2.2 In 1954 Fiji disease discovered on east coast of Madagascar in the variety M.134/32.

2.2.3 Recent report of the disease in Reunion not yet confirmed.

2.3 Symptoms

2.3.1 Extreme stunting and distortion of leathery-textured leaves.

2.3.2 Diseased leaves usually darker green than healthy leaves.

2.3.3 Galls on undersurface of leaf give positive diagnosis.

2.3.3.1 Galls can appear anywhere on undersurface - blade, midribs or sheath.

2.3.3.2 Galls vary in size - from microscopic to 5 cm long and 2-3 mm wide and 1-2 mm high.

2.3.3.3 In early stages galls are the same colour as leaves but later become paler and more easily seen.

2.3.3.4 Galls arise from a proliferation of the phloem cells. (c.f. pseudo - Fiji - a condition which also produces leaf galls but these arise from the leaf mesophyll. Pseudo Fiji is found in South Africa).

2.4 Transmission

2.4.1. Infected seedcane

2.4.2 Three species of the leaf hopper Perkinsiella -
P. saccharicida
P. vastatrix
P. vitiensis

2.4.3 P. saccharicida occurs in Southern Africa including Natal, Swaziland and Mocambique.

2.4.4 A fifth species P. insignis has been recorded in South Africa but P. saccharicida is by far the more common species.

2.5 Control

2.5.1 Resistant varieties.

2.5.1.2 Varieties screened by field tests using diseased controls as source of inoculum and natural transmission by leafhoppers.

2.5.1.3 Inconsistent results of field method has led to development of insectary method using test plants and infected leafhoppers.

2.5.2 Seedcane selection

2.5.3 Field hygiene

2.5.4 Restriction of movement of seedcane

As Fiji disease has not yet been found in Southern Africa we are not able to assess our varieties for their reaction to the disease. However, since there is a very real danger of the disease being found or introduced into this country and since an insect vector is already present, we have already taken steps to have our varieties screened elsewhere.

Preliminary results from Madagascar have indicated the following reactions in field trials.

<u>Very susceptible</u>	-	N:Co.310
<u>Susceptible</u>	-	N:Co.293, N.Co.376, N.50/211 N.51/168, C.B.36/14
<u>Resistant</u>	-	Uba, Co.281
<u>Very resistant</u>	-	Co.290

N51/539, N53/216, N.Co.334, N55/805, C.B.38/22 and N.6 have still to be tested but some doubt has been raised about the reliability of these tests since the vector population so necessary for field tests is decreasing.

The Experiment Station has come to an arrangement with the C.S.R. Co. in New South Wales, whereby our varieties will be tested by the insectary method on a regular basis. The first results from these tests should be available during 1970.

GMT/MG
21st November, 1969

SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ANNUAL MEETING - DECEMBER, 1969

THE FUNCTIONS OF AN ESTATE AGRONOMIST

by R. Wyatt.

Before I try and discuss the functions of an estate agronomist, let me at the outset say that what I have to say may meet with disapproval from many quarters both within and without this room. The opinions expressed by me today are entirely my own, and they are based on my own experiences over the last several years, during which time I have had the opportunity to study this peculiar animal called an Agronomist from all angles, ranging from a junior overseer to an Agricultural Manager. Gentlemen, I say this not to try and show off my experience, nor in an attempt to defend myself from my critics, but to back myself up when I say I am not merely speaking off the cuff on this subject, and that my ideas of an Agronomist have been built up over many years of close association with the science of Agronomy.

I would first like to discuss the actual duties of the estate agronomist in some detail, following which I will speak more generally on the responsibility level and relationship between the agronomist and other field staff on a large sugar estate. As I see it then, the functions of the agronomist, not necessarily in order of merit, are:-

1. Maintain close liaison with the Field Manager at all times in order to ensure correct communications and facilitate continuous awareness of all field activities and operations.

2. In conjunction with the Field Manager plan all field operations.

3. Discuss with the Field Manager all decisions involving major policy changes before these are put into practice so that minimum disturbance to current field operations occurs.

4. Order and distribute all fertilizer, herbicides and other chemicals used on the estate. Ensure an efficient, simple and streamlined flow of information covering all aspects of ordering, stocking, distribution and application rates.

5. Operate and control all sampling services, i.e. soil, leaf and cane, estate field laboratory and hot water treatment unit.

6. Plan and supervise the planting and maintenance of seed cane nurseries and also distribution and allocation of seed cane.

7. Conduct disease and insect pest inspections and supervise control or eradication of any disease or insect infestation.

8. Plan, plant, control and harvest all estate experiments. Emphasis should be on applied research as opposed to basic research and all trials should only be laid down after consultation with the Experiment Station and other research institutes and agronomists.

9. Measure and record all met. data.

10. Render assistance and advice, where applicable, to the irrigation department.

11. Maintain a complete system of field records.

12. Assist where necessary with planning of field lay-outs taking into account modern concepts of soil and water conservation.

13. Initiate and conduct special projects to supply information to management. This would include work on alternate crops to sugar cane.

14. Attend all Experiment Station field days, Agronomists' Association functions and S.A.S.T.A. proceedings. Make periodic visits to other Estates and the Experiment Station in order to exchange ideas with other agronomists and to keep abreast of all agronomic developments in the sugar industry.

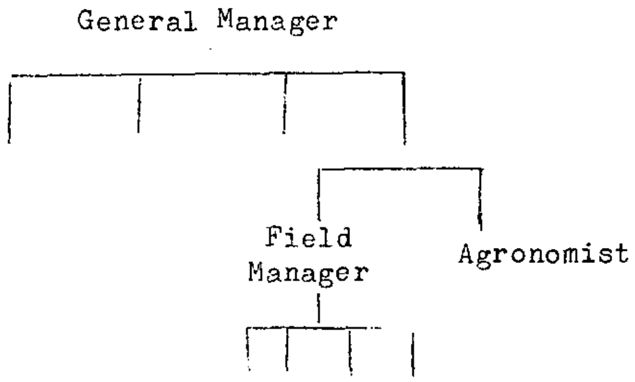
These 14 points then cover more or less the detailed functions of an estate agronomist as I see it. I have not attempted to work out how much time should be spent on the various functions of the Agronomy Department, mainly because I feel this will differ on each estate and also depend on both the size of the estate and the size of the Agronomy Department itself. Suffice to say that ample time should be allocated or set aside for experimental work and specialized projects as well as planning.

I would now like to go on to a more general discussion of the Agronomist relative to his co-workers on the estate.

Management at all levels tends to regard an agronomist as a specialist, with capabilities limited to the laying down of experimental trials and the giving of theoretical advice concerning such practices as fertilization, chemical weed control and disease eradication.

However, this is not entirely correct - firstly because an agronomist is by no means a specialist as far as agricultural science is concerned, and may be likened to the General Practitioner in medicine, trained to recognise a problem or ailment, but relying on specialist advice to positively identify, isolate and correct or eliminate the problem. Similarly, the agronomist relies to a certain extent on such specialists as the microbiologist and plant pathologist. Secondly, in this advanced age in which science plays a major role in farming activities, the agronomist must of necessity be intimately involved in the management of an agricultural enterprise. In this report, he must therefore be considered an integral part of the management team, especially on a large estate such as is found in the Sugar Industry.

The question that now has to be answered is how should the agronomist fit into the personnel establishment in order to fulfil his functions to the maximum benefit to the estate as a whole? At what level of responsibility and status can he ensure a smooth, efficient flow of communciations between himself, senior and junior management? In my opinion it is imperative that he has direct access to the General Manager and as such he must be considered of Departmental Head status, equivalent in rank to the Field Manager, as shown in the diagram below.



With the setup as shown the agronomist becomes an integral part of the management team, delegating his authority through the Field Manager. It is the agronomist today who to a large extent makes the policy decisions and the Field Manager who implements them. Working as a team, the agronomist should dictate the type of soil preparation required to prepare a field for planting, the variety to plant, the fertilizer to apply, the weed control necessary and the age and timing of harvest, while the Field Manager gets on with the job.

These two men have to work hand-in-glove together, and at all times each must know what the other is doing and why. The practical implications of a policy decision have always to be borne in mind by the Agronomist, while the Field Manager must accept the technical and theoretical background to the Agronomist's recommendations. Both must have direct access to the General Manager who acts as an arbitrator and final decision maker when, as frequently happens, major policy issues are at stake.

It is submitted that only when an estate is being run jointly by the Agronomist and Field Manager, as illustrated above, can we be sure of each being able to function at maximum efficiency. The Agronomist with his technical training and know-how is able to devote much of his time to study, planning of future policy and accurate record keeping, while the Field Manager, who is a man of proven ability regarding organization, leading, and delegation of duties, can devote his time to implementation and control of plans.