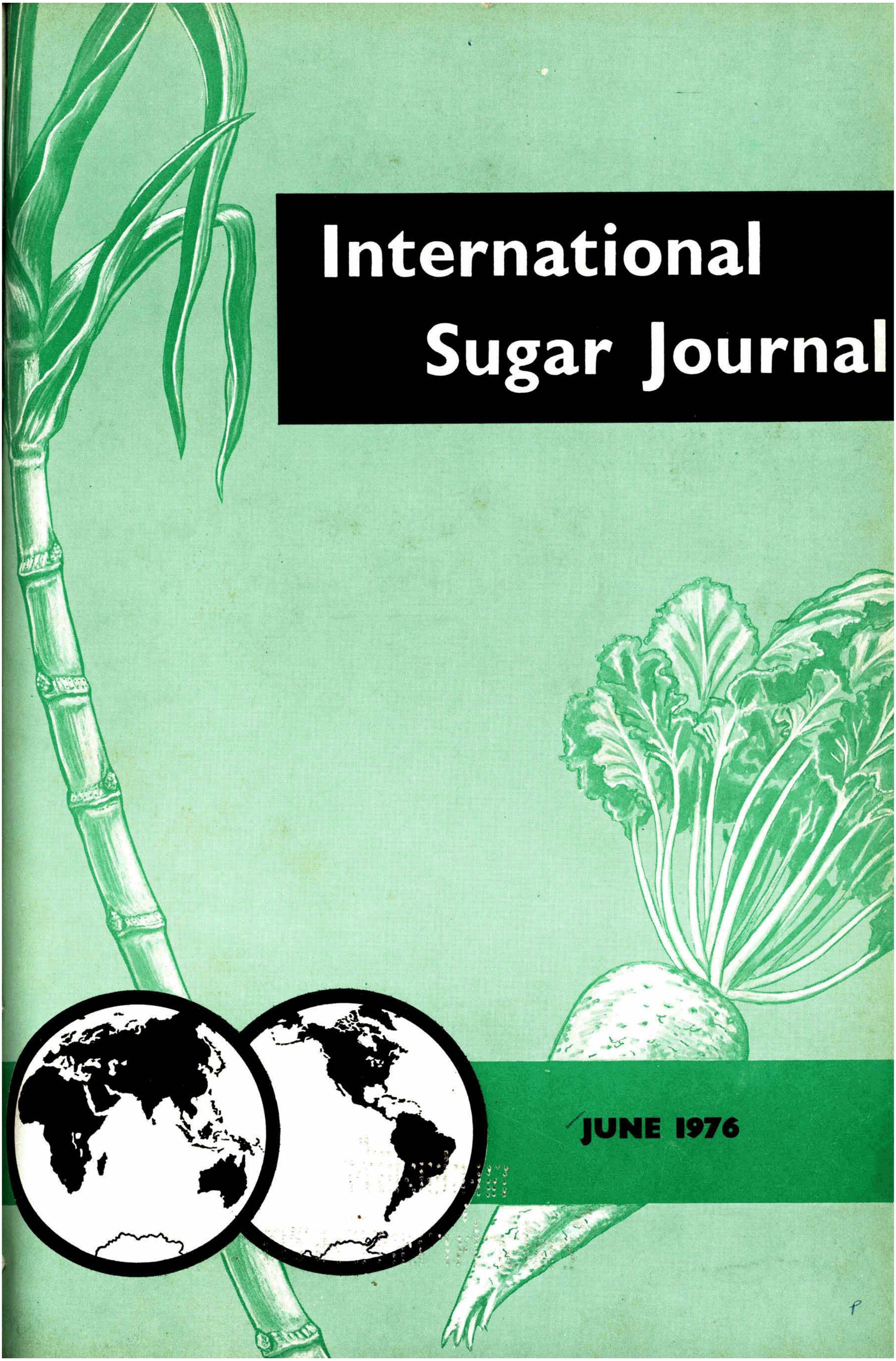
International Sugar Journal



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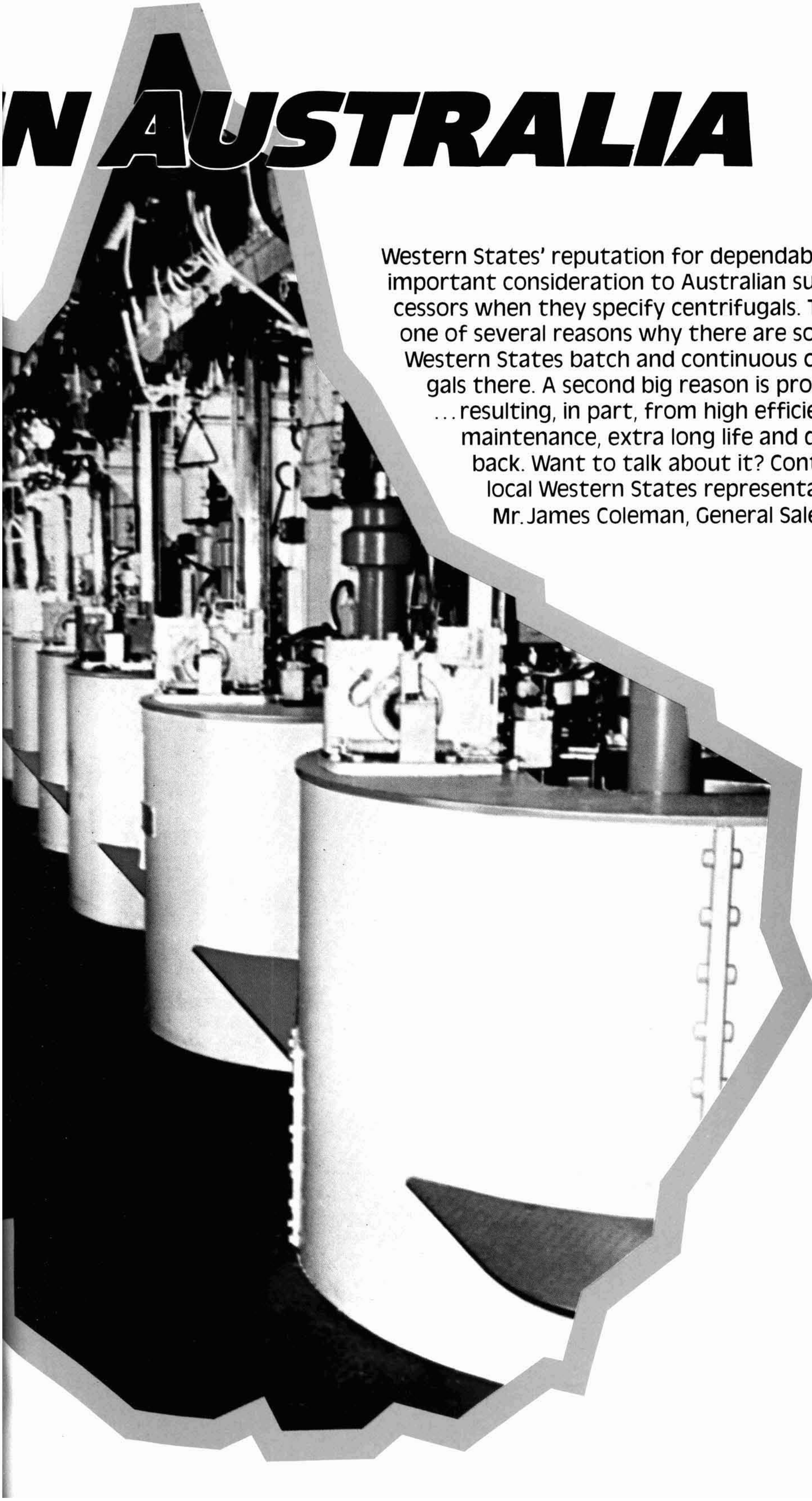

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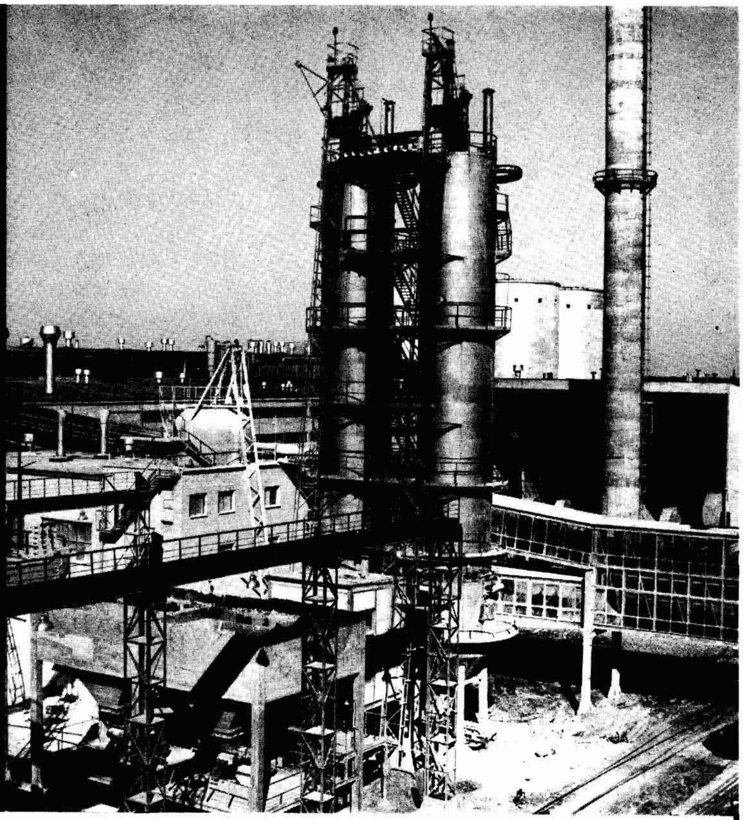

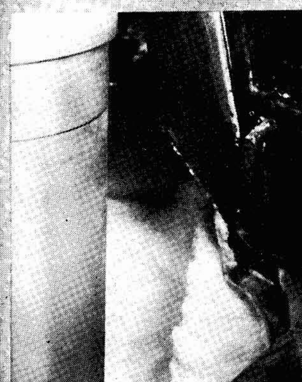

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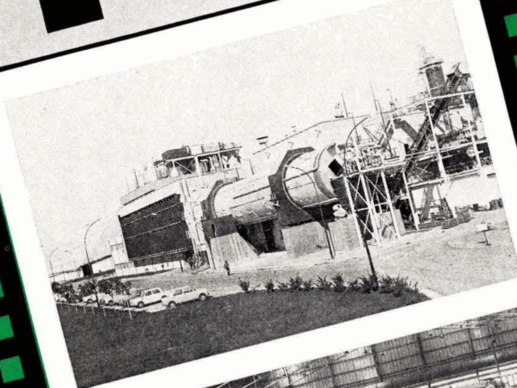

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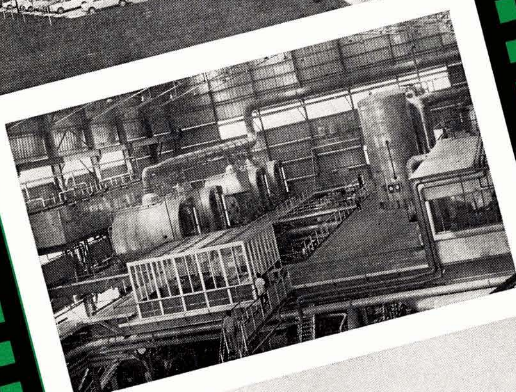

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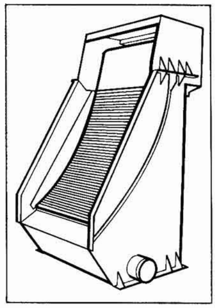

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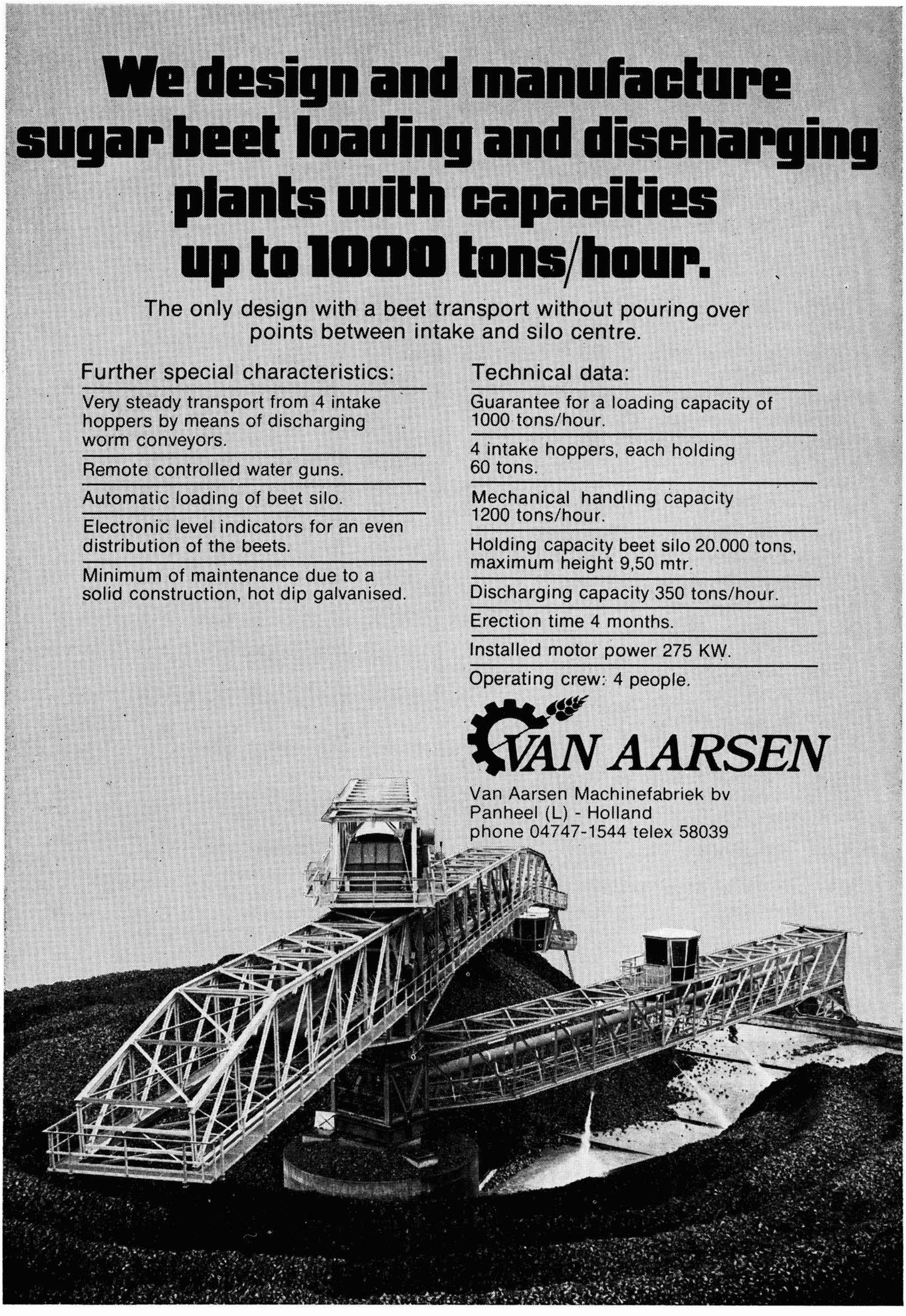
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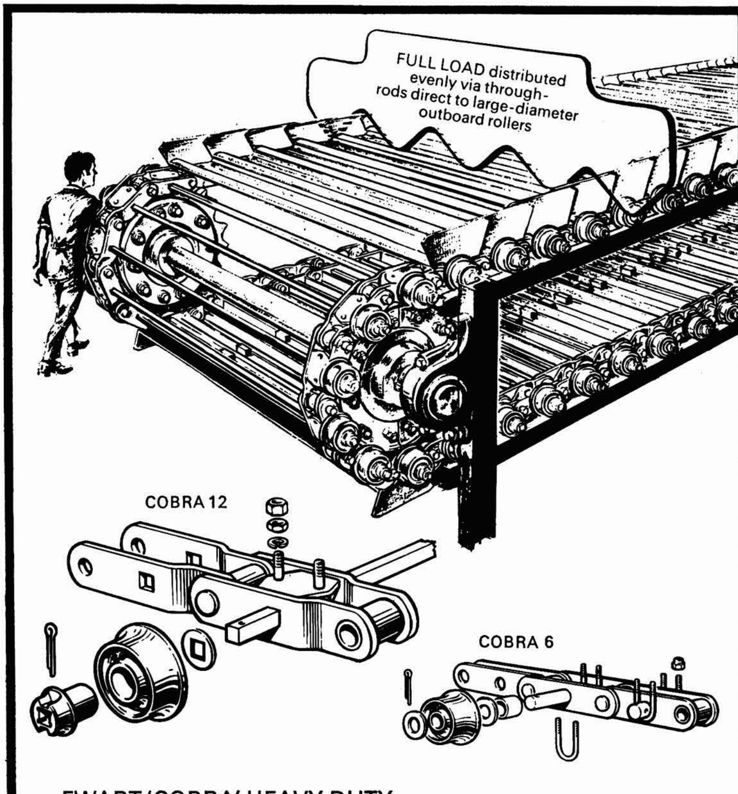

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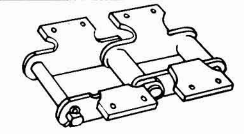

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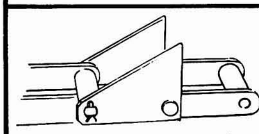
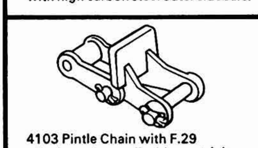


S & M Combination Chain with spur attachment – malleable inner links, with high carbon steel outer sidebars.



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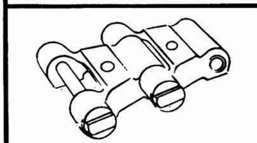

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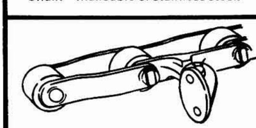

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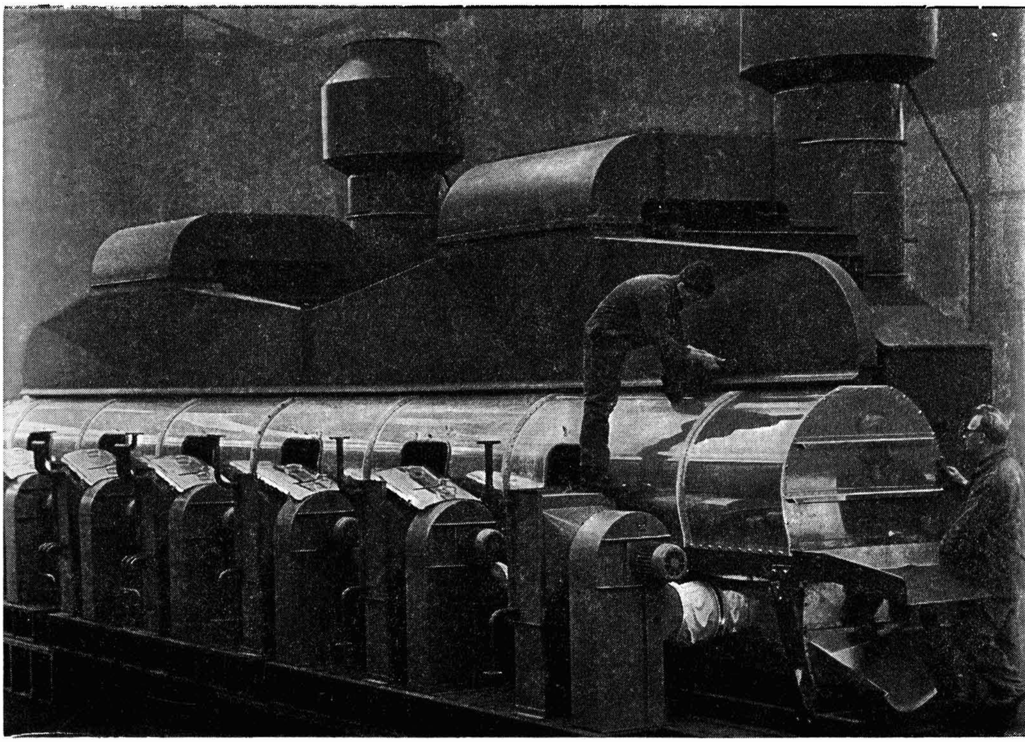

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Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

La composition des polysaccharides indigènes solubles de la canne à sucre. E. J. ROBERTS, M. A. GODSHALL, F. G. CARPENTER et M. A. CLARKE. *p.* 163–165

On donne une description de l'isolation de polysaccharides du type de l'arabinogalactane à partir de la canne. La rotation spécifique trouvée pour les polysaccharides était de —46° (contre des valeurs qui vont de +30° à +160° pour ceux isolés à partir du jus mélangé et de la mélasse); permi les sucres y contenus, le galactose était le plus abondant, suivi par l'arabinose, le mannose, le xylose et le glucose.

* * *

Amélioration du sol et rendement de la canne à sucre au Soudan. H. D. IBRAHIM. *p.* 165–167

On décrit des essais au cours desquels on a déterminé les effets du labour profond et de l'application de gypse, séparément et combinés, sur les propriétés du sol ainsi que sur les rendements en canne et en sucre. Le rendement le plus élevé en canne a été obtenu par le labour profond avec la dose la plus élevée de gypse.

* * *

L'influence du degré de décolletage et autres facteurs culturaux sur le rendement et la qualité de la betterave à sucre. 1ère partie. P. J. LAST, A. P. DRAYCOTT et R. HULL. *p.* 167–170

On donne des détails concernant les essais effectués pour déterminer l'effet de la densité de population et de l'irrigation sur la proportion de betteraves usuellement rebutée, pour quantifier le sucre et les principales impuretés de la fraction rebutée et pour évaluer l'influence de ces impuretés de la fraction rebutée et pour évaluer l'influence de ces impuretés sur la qualité du jus. Les résultats de 1970–71 révèlent que les impuretés dans la betterave augmentent plus vite que le sucre total; si on travaillait le collet et la couronne tout comme la racine, le sucre total par betterave augmenterait de 15%, mais il y aurait augmentation appréciable de la teneur en azote α-aminé, en sucres réducteurs, en sodium et en potassium.

* * *

Comparaison de la diffusion de canne avec des systèmes hybrides moulins/diffusion. J. H. PAYNE. *p.* 170–173

On déduit de l'examen des résultats obtenus en diffusion de canne et par la combinaison moulins et diffusion qu'un moulin en amout d'un diffuseur est superflu et qu'en fait il affecte défavorablement la performance du diffuseur à cause de la structure du lit de fibre qui en résulte; en outre, le procédé combiné ne fournit pas le même taux d'extraction que la diffusion seule.

Zusammensetzung von löslichen, im Zuckerrohr vorkommenden Polysacchariden. E. J. ROBERTS, M. A. GODSHALL, F. G. CARPENTER und M. A. CLARKE. *S.* 163–165

Es wird die Isolierung von Polysacchariden des Arabinogalactan-Typs aus Zuckerrohr beschrieben. Die Autoren stellten fest, dass diese Polysaccharide eine spezifische Drehung von —46° aufweisen. Im Vergleich hierzu lagen die Werte für die aus Betriebsmischsaft und Abläufen isolierten Substanzen zwischen +30 und +160°. Von den in diesen Polysacchariden enthaltenen Zuckern machte Galactose den grössten Anteil aus; dann folgten Arabinose, Mannose, Xylose und Glucose.

* * *

Verbesserung der Bodenbeschaffenheit und des Zuckerrohrertrages im Sudan. H. D. IBRAHIM. *S.* 165–167

Der Verfasser berichtet über Versuche, bei denen der Einfluss einer tiefen Furche und einer Gipsapplikation—einzeln oder in Kombination miteinander—auf die Beschaffenheit des Bodens sowie den Zuckerrohr- und den Zuckerertrag ermittelt wurde. Der höchste Zuckerrohrertrag wurde mit einer tiefen Furche in Verbindung mit der höchsten Gipsgabe erhalten.

* * *

Der Einfluss der Köpfhöhe und anderer pflanzenbaulicher Massnahmen auf Rübenertrag und -qualität. Teil I. P. J. LAST, A. P. DRAYCOTT und R. HULL. *S.* 167–170

Es werden Einzelheiten mitgeteilt über Untersuchungen zur Bestimmung des Einflusses der Bestandesdichte und der Bewässerung auf die normalerweise verlorengehenden Rübenteile, zur mengenmässigen Erfassung des Zuckergehaltes und des Gehaltes an den hauptsächlichen Verunreinigungen in den verlorengehenden Rübenteilen und zur Feststellung des Einflusses dieser Verunreinigungen auf die Saftqualität. Die für 1970/71 erhaltenen Resultate zeigen, dass die Verunreinigungen in der Rübe stärker zunehmen als der Gesamtzucker, so dass die gemeinsame Verarbeitung von Rübenkopf und Wurzelkörper zu einer Steigerung des Gesamtzuckers um 15% a.R., aber auch zu einer beträchtlichen Steigerung von α-Aminostickstoff, Invertzucker, Natrium und Kalium führt.

* * *

Ein Vergleich der Zuckerrohrdiffusion mit kombinierten Mühlen- und Diffusionssystemen. J. H. PAYNE. *S.* 170–173

Auf Grund der Auswertung von Ergebnissen, die mit der Rohrdiffusion und der Kombination Mühle—Diffusion erhalten wurden, wird der Schluss gezogen, dass es nicht erforderlich ist, eine Mühle vor die Diffusionsapparatur zu setzen, sondern dass sie in Wirklichkeit die Leistung dieser Apparatur wegen der Struktur der entstehenden Fiberschicht negativ beeinflusst. Darüber hinaus wird mit dem kombinierten Verfahren nicht die gleiche Extraktionsleistung erzielt wie mit der Diffusion allein.

Composición de polisacaridos solubles indígenas de caña de azúcar. E. J. ROBERTS, M. A. GODSHALL, F. G. CARPENTER y M. A. CLARKE. *Pág.* 163–165

Se describe el aislamiento de polisacaridos del tipo arabino-galactano de caña. Los polisacaridos se encuentran con una rotación específica de —46° (en comparación con valores en la gama +30° a +160° para ellos aislado de jugo mezclado y melaza de la fábrica); de los azucares que contienan, fué galactosa el mayor en cantidad, con, en seguida, arabinosa, manosa, xilosa y glucosa.

* * *

Mejoramiento del suelo y rendimiento de caña de azúcar en el Sudán. H. D. IBRAHIM. *Pág.* 165–167

Se recuerdan ensayos en que se determinaron los efectos de rasgado profundo y del aplicación de yeso, distinto y combinado, sobre propriedades del suelo y sobre rendimientos de caña y de azúcar. El rendimiento de caña más alto se obtuvo con rasgado profundo combinado con el más alto nivel de yeso.

* * *

La influencia del nivel de descoronaje y otros factores culturales sobre rendimiento y calidad de la remolacha. Parte I. P. J. LAST, A. P. DRAYCOTT y R. HULL. *Pág.* 167–170

Se presentan detalles de investigaciones para determinar el efecto de irigación y de la densidad de planteación sobre la proporción de la remolacha usualmente descartado, para cantificar la sacarosa y mayores impurezas en la sección descartado, y para asesar la influencia de estas impurezas sobre calidad de jugo. Resultas para 1970–71 indican que las impurezas en la remolacha crecieron más que la sacarosa total, do modo que tratamiento del raíz entero (con corona) puede aumentar en 15% la sacarosa total por remolacha pero también aumentaría notablemente el N α-amino y azucares invertidos así como sodio y potasio.

* * *

Una comparación de difusión de caña con sistemas híbridas de molienda-difusión. J. H. PAYNE. *Pág.* 170–173

Del evaluación de resultas obtenido en difusion y en molienda-con-difusion de caña el autor concluye que un molino precedente de un difusor no es necesario y en realidad tiene un efecto adverso sobre el cumplimiento del difusor a causa del estructura de la cama de fibra que resulta; además, el proceso combinado no da el mismo nivel de extracción tanto como difusión sola.

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII JUNE 1976 No. 930

Notes & Comments

EEC negotiations on sugar imports

Negotiations between the EEC and ACP countries on a guaranteed minimum price for imported sugar in 1966/67 opened in Brussels on 29th April. The ACP delegation, headed by Mr. SACTAM BOOLELL, Minister of Agriculture for Mauritius, is reported[1] to have indicated that they were looking for a price which was at least 10% higher than the EEC is parpared to offer. During an opening round of negotiations earlier in the month, the EEC's offer of a minimum price equivalent to £171 per metric ton had been rejected as unacceptable, and at that time the ACP representatives were reported[2] to be pressing for at least 30% increase on that price. They maintained that this would merely offset the rise in their production costs since last year, and also wanted the new price for the 1,250,000 tons involved to take effect retroactively from the start of 1976 and not from 1st July when the EEC's sugar crop season opens. The EEC was accused of having little regard for the ACP countries' convenience and little respect for their soverign rights, while also attaching little importance to the talks.

The EEC officials argued that, since nearly all ACP sugar is exported to the UK, their offer of 255 units of account would be worth almost £180 per ton as a result of devaluation of sterling, compared with £140 a year ago. The European Commission pointed out that, because of an expected sugar surplus, beet sugar producers in the EEC were being encouraged to cut back acreage through production taxes and quota reductions. These disincentives would offset the 8% increase to be paid to beet growers and would bring their prices down to approximately the level being offered to the cane sugar exporters.

While accepting that they cannot expect to get the £260 per ton they were receiving until the end of 1975, owing to the special UK supplement which was negotiated during a period of chronic shortage and high world prices, the ACP countries nevertheless feel that the EEC has interpreted the agreement in the most ungenerous way possible. They are also unhappy over the introduction by the EEC of a storage tax for cane sugar, which is levied on beet sugar; their argument is that beet sugar is produced over a relatively short period and has to be stored to ensure orderly distribution throughout the year, whereas cane sugar is produced throughout the year and can be put straight on the market. They feel that, by sharing the tax, they will effectively be subsidizing EEC beet sugar producers. The ACP countries are also angry over the EEC's proposal to raise the profit margins of UK refiners by about 16% and to make allowance for this in its price offer, and are not happy about the plans to abolish the quality premiums for Grade I sugar shipped to the UK.

* * *

US and a new International Sugar Agreement[3]

In an address to the Sugar Club of New York on 25th February, the Deputy Assistant Secretary of State for Economic and Business Affairs stated: "The US has been invited to attend the meetings of both the advisory committee and the ISO council as an active observer. We have accepted these invitations and will also participate in the negotiation. A preliminary council meeting is scheduled for mid-April in London which we will attend. As I indicated earlier, our policy is now undergoing a through review of the goals and options we face. We have not yet decided what our negotiating position for the new International Sugar Agreement should be; however, we would at a minimum, wish the new Agreement to contain: (*a*) assurance of adequate supplies at prices equitable to both producers and consumers of sugar, (*b*) realistic price provisions which will stimulate the investment needed to meet consumption growth without setting prices at artificially high levels, and (*c*) mechanisms which minimize interference with market forces and which are technically sound".

* * *

Cuban sugar production[4]

According to Reuter, Cuban delegates to the fourth meeting of the Group of Latin American and Caribbean Sugar Exporting Countries have been saying that Cuban sugar production last year was 5·7 million metric tons. Sr. RICARDO CARBRISAS, the Cuban Deputy Trade Minister, said that it had proved impossible to maintain production at the level of 8·5 million tons reached in 1970. His Government planned to increase production to the 8–8·7 million tons level by 1980. He added that Cuba had decided to go for the best quality possible rather than produce the quantities of sugar planned earlier. He did not mention reports that adverse rains had affected the 1975/76 crop.

[1] *The Times*, 30th April 1976.
[2] *ibid.*, 9th April 1976.
[3] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (8), 8.
[4] *Public Ledger*, 15th March 1976.

Speaking of changes made in Cuban sugar production, he said that to enable the 1980 target to be reached, there had been improvements in the cane varieties, technical capacity of workers, and mechanization which had enabled the number of cane cutters to be reduced from 360,000 in 1966 to 180,000 last year.

* * *

US sugar imports 1975

Statistics of US sugar imports for last year have been published by C. Czarnikow Ltd.[1] and appear elsewhere in this issue.

The United States is a major sugar producer and consumer and changes in the usual pattern are reflected in the world market. One of the features which had a considerable effect on the world market in 1975 was the fall in imports of sugar into mainland USA and this, in fact, is shown to have amounted to almost exactly two million tons.

The ending of the US Sugar Act brought a change in traditional patterns of imports. On the one hand several countries which, in the past, had done everything in their power to keep up the level of deliveries, found it unnecessary to maintain a keen interest in the US market while, of course, the fall in demand meant that this drop in selling pressure did not create the problems which would have been encountered in earlier years. Meanwhile other countries whose shipments had hitherto been curtailed by their quota limitations now found it possible to expand deliveries.

The most remarkable fall was in arrivals of sugar from the Philippines which, at 413,000 tons, were more than one million tons below the level established in 1974. Imports from Mexico fell by almost 500,000 tons while entries of Brazilian sugar dropped by almost 600,000 tons. Peruvian shipments were some 250,000 tons lower.

Increases were, of course, on a smaller scale but it is noteworthy that imports from Australia expanded by more than 200,000 tons and from India and Thailand by about 100,000 tons each. Meanwhile imports of sugar from South Africa, El Salvador and Colombia also expanded by noteworthy tonnages.

Consumption in the United States fell sharply in 1975 though not by the full extent of the two million tons by which imports dropped. Distribution statistics indicate that there was a substantial fall in stocks of imported sugar during the year while there was also a marked increase in exports. Nevertheless, the calculated consumption figure according to the USDA was down by 1·5 million tons to less than ten million short tons, raw value.

* * *

Swaziland sugar development[2]

Work was expected to start early this year on a R80-million scheme to establish a third sugar growing area in Swaziland, including a new factory which will have an ultimate production of 110,000 tons of sugar annually. The project is being sponsored by the Swaziland Government and the Tibyo Taka Ngwane Fund, a Swaziland Government development fund, who will take up jointly R15·5 million of the R30 million equity to ensure that the project will be controlled from the outset by the Swazi nation. Tate & Lyle Ltd. have agreed to subscribe R3·2 million and have offered to help raise the balance of the capital required.

The new scheme will increase output of sugar from the present 220,000 tons a year to 330,000 tons, most of which will be exported. The project has been thoroughly researched and in 1974 Tate & Lyle Technical Services were commissioned to prepare a final planning and development programme which was completed in June 1975.

In all, 8000 hectares of irrigated land will be put under cane. The Tibo Taka Ngwane Fund has been acquiring suitable plots of land in the Umbuluzi River basin; water for irrigation will be supplied from the Umbuluzi River and a storage dam costing about R3 million will be built on the Black Umbuluzi River at Fairview.

The factory will employ about 3500 workers who will be housed in a modern village. It is planned to make the village a growth point which will eventually accommodate 30,000 people. All financial estimates in connexion with the project have been based on a London Daily Price of £160; on this basis it is estimated that the project will yield a discount cash return of 13·9%.

The two sugar estates at present in production in Swaziland are Swaziland Sugar Milling Co. Ltd. at Ubombo, which is owned by Lonrho Ltd., and Mhulme (Swaziland) Sugar Co. Ltd. which is owned by the Commonwealth Development Corporation. Each factory produces about 110,000 tons of sugar a year.

* * *

Australian sugar production, 1975/76[3]

The 1975/76 Australian sugar season ended with the cessation of crushing at Condong Mill, in New South Wales, on the 13th January. Notwithstanding the highest tons cane per ton sugar ratio since 1964—7·66—a number of records were established. Cane crushed in Queensland amounted to 21,068,974 metric tons, passing the 1974 record of 19,421,069 tons by more than 1·6 million tons. Sugar production in Queensland and Australia as a whole, at 2,752,043 and 2,856,097 tons, 94 N.T., exceeded the 1974 records (2,727,533 and 2,848,542 tons, respectively) by some 24,500 and 7500 tons.

Based on a harvested area of 245,776 hectares (a record), the Queensland industry yielded a record 85·72 tons of cane per hectare, and 11·20 tons of 94 N.T. sugar per hectare.

New South Wales suffered a very difficult and wet season; production of cane was 889,677 tons, compared with 996,654 tons in 1974 and the average c.c.s. content was lower at 11·67 against 12·00. Consequently sugar output fell from 121,009 tons 94 N.T. in 1974 to 104,054 tons in 1975/76, or only 67% of the State's peak equivalent. The tons cane per ton sugar ratio was 8·55.

The good results in Queensland were in spite of interruptions through wet weather, particularly in the closing stages of the season, and some 800,000 tons of cane was left over; it is hoped that this will mostly be fit to harvest in the next season.

[1] *Sugar Review*, 1976, (1275), 43–45.
[2] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 10.
[3] *Australian Sugar J.*, 1976, **67**, 467–471.

Composition of soluble indigenous polysaccharides from sugar cane

By E. J. ROBERTS, M. A. GODSHALL, F. G. CARPENTER and M. A. CLARKE

(Cane Sugar Refining Research Project, Inc., Southern Regional Research Center*, New Orleans, Louisiana, USA)

INTRODUCTION

THE soluble polysaccharides of sugar cane account for a greater proportion of the organic non-sugars than any other group of compounds other than organic and amino-acids[1]. Early workers were aware of the presence of some of the polysaccharides in sugar cane products but were briefly concerned with determining the total quantity of these substances as a group[2,3,4].

In 1958, NICHOLSON & LILIENTHAL[5] isolated, by alcohol precipitation from spoiled cane, a polysaccharide fraction that was similar to dextran in physical and chemical properties. They concluded that the polysaccharide was produced by the action of micro-organisms on sucrose in the cane stalk during the interval between cutting and milling.

In 1960, SUTHERLAND[6] isolated two polysaccharides from cane syrups. The polysaccharides were separated by fractional precipitation with alcohol. One of the polysaccharides found in all samples examined was referred to by SUTHERLAND as a hemicellulose type; the other, a polyglucose of the dextran type, was associated with large increases in viscosity of the syrups. Upon hydrolysis, each fraction yielded glucose, galactose, arabinose, xylose, and rhamnose, indicating incomplete separation of the two polysaccharides; specific rotations of the fractions ranged from +57° to +198°.

ROBERTS, JACKSON & VANCE[7] studied the polysaccharides of sugar cane and concluded that all sugar cane products contain three types of polysaccharides: starch and an arabinogalactan, both metabolic products of the sugar cane plant, plus a dextran type produced by micro-organisms during the delay between cutting and milling of the cane or at some other stage in processing of the juice (as suggested by NICHOLSON & LILIENTHAL[5]).

This paper describes the isolation and composition of the arabinogalactan (indigenous polysaccharide) isolated from sugar cane. We now believe that this polysaccharide plays an important role in acid beverage floc formation[8].

EXPERIMENTAL

Isolation of the sugar cane polysaccharides

Isolation of the sugar cane polysaccharides was previously described[7] by ROBERTS, JACKSON & VANCE. Essentially, it was done under conditions which prevented formation of dextran and inclusion of starch. It was accomplished by cutting cane, quickly grinding it, and immediately precipitating the polysaccharides with alcohol.

Hydrolysis of the polysaccharides

The polysaccharide sample (0·2005 g) was boiled under reflux in 75 cm^3 of 2N sulphuric acid for 4 hours. After the solution had cooled to room temperature, a slight excess of solid barium hydroxide was added to the stirred solution. The excess barium ions were precipitated by bubbling carbon dioxide through the solution until it was neutral. The barium salts were removed by filtration on a mat of filter aid. The filtrate was concentrated in a rotary evaporator below 60°C to about 15 cm^3. The small amount of barium salts which separated during concentration was removed by filtration through a fritted glass funnel, and the filtrate was freeze-dried. The dry hydrolysate weighed 0·1465 g. The low yield of hydrolysate may result from the formation of an insoluble barium salt by an organic acid.

Gas-liquid chromatography of sugars from hydrolysed polysaccharides

The gas-liquid chromatograph was a Hewlett-Packard model 5750† equipped with a flame ionization detector; the column was ⅛-in o.d. stainless steel tube, 6 ft long, packed with 10% OV-1 on "Chromosorb HP", 80–100 mesh. The column was operated isothermally at 180°C with a carrier gas flow rate of 18 cm^3.min^{-1}. Prior to gas chromatography, the sugars were equilibrated overnight in pyridine and silylated with trimethylchlorosilane and hexamethyldisilazane, according to the procedure of SWEELEY *et al.*[9]

Identification and estimation of sugars in hydrolysed polysaccharides

The equilibrated and silylated sugars resulting from hydrolysis of the polysaccharides were identified by comparison of retention times and by peak enhancement with known sugars. Quantitative estimates of each sugar present were made by comparing peak areas, using sorbitol as an internal standard.

RESULTS AND DISCUSSION

Polysaccharides % purity

The carbohydrate content of each sample was determined by the phenol-sulphuric acid method and calculated as anhydro-glucose units (starch), which give an indication of the purity of each polysaccharide sample. The results are shown in Table I.

Specific rotation

The specific rotations of the polysaccharide samples from fresh crusher cane juice are compared in Table I with those isolated from commercial mixed juice and final molasses. Each sample of polysaccharide (samples 1 and 2 isolated from different preparations

* One of the facilities of the Southern Region, Agricultural Research Service, US Department of Agriculture.

1 ROBERTS & MARTIN: *Proc. 6th Tech. Sess. Bone Char Res. Proj.*, 1961, 67–88.

2 FARNELL: *I.S.J.*, 1924, **26**, 480–486.

3 FORT & MCKAIG: *U.S. Dept. Agric. Tech. Bull.*, 1939, (688), 68 pp.

4 RUFF & WITHROW: *J. Ind. Eng. Chem.*, 1922, **14**, 1131–1133.

5 *Aust. J. Biol. Sci.*, 1959, **12**, 192–203.

6 *ibid.*, 1960, **13**, 300–306.

7 *Proc. 1st Tech. Sess. Cane Sugar Refin. Res.*, 1964, 76–84.

8 ROBERTS & CARPENTER: *Proc. 6th Tech. Sess. Cane Sugar Refin. Res.*, 1974, 39—50.

† Use of a company or product name by the Department does not imply approval or recommendation of the product to the exclusion of others which may also be suitable.

9 *J. Amer. Chem. Soc.*, 1963, **85**, 2497–2507.

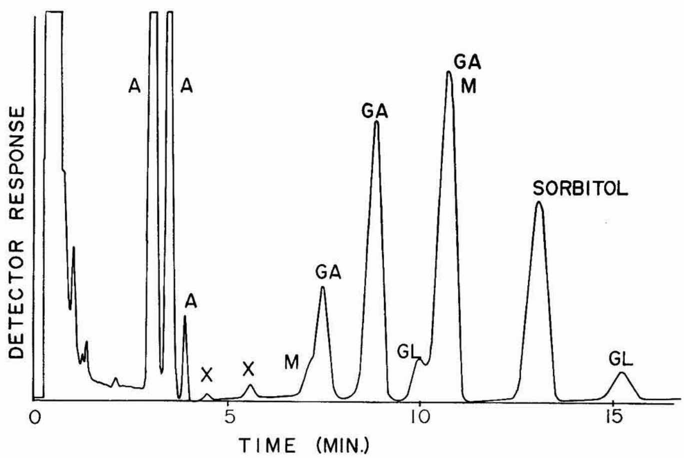

Fig. 1

A = Arabinose
X = Xylose
M = Mannose
GA = Galactose
GL = Glucose
Sorbitol = Internal Standard

Table I. Purity and specific rotation of polysaccharides isolated from sugar cane products

Sample No.	*Source*	*Purity %*	$[\alpha]^{20°}_{5461A}$
1	Fresh crusher juice	86	—46°
2	Fresh crusher juice	86	—46°
3	Fresh maceration juice	88	—45°
4	Commercial mixed juice	—	+30°
5	Commercial mixed juice	—	+150°
	Final molasses	90	+90°
	Final molasses	86	+160°

Note: Purity is calculated as anhydro-glucose (starch) by the method of Dubois *et al.*[10] and $[\alpha]^{20°}_{5461A}$ by the method of Roberts, Jackson & Vance[7].

of fresh crusher cane juice) showed a constant rotation of about —46°, which was in good agreement with the specific rotation $[\alpha]^{20°}_{D}$ = —43·5 of an arabinogalactan isolated from wheat flour by Neukom & Markwalder[11]. Samples 4 and 5, however, from different commercial mixed juices did not show constant rotation; nor did the two samples from cane molasses.

Specific rotation of the polysaccharides from mixed juice varied from +90° to +161°. Since dextran shows a very high dextro-rotation, it is obvious that the polysaccharides isolated from the commercial mixed juice and final molasses must contain considerable quantities of dextran along with the indigenous sugar cane polysaccharides.

Polysaccharide components

The sugars resulting from the hydrolysis of the polysaccharides (Sample 1, Table I) were identified by GLC as galactose, arabinose, glucose, mannose, and xylose. A chromatogram of the hydrolysis products is shown in Fig. 1. The hydrolysate of polysaccharide from commercial mixed juice (Sample 4, Table I) contained a small amount of rhamnose and a predominance of glucose. The quantity of each sugar present was estimated, and the results are given in Table II. Galactose is the predominant sugar component in the polysaccharide (Sample 1) with arabinose second. Xylose, mannose, and glucose are present in trace quantities.

Since arabinose and galactose are always associated with pectin, it has often been assumed that pectin was the source of these sugars. The fact that the polysaccharides could be hydrolysed by pectinase reinforced the possibility that pectin was included in the mixture. However, no galacturonic acid, which is always a major component of pectin, was found in either the acid hydrolysate or in the enzymatic hydrolysate, where it would certainly be evident if the mixture had contained pectin. Thus it appears that the galactose and arabinose are not from pectin, but rather that the indigenous polysaccharides isolated from fresh cane juice are principally composed of an arabinogalactan, mixed with a mannan and a xylan. Attempts to separate this mixture were not successful.

Table II. Estimation of sugars in hydrolysed sugar cane polysaccharides

Sugar	*% Hydrolysate* Sample No. 1* Fresh crusher juice	Sample No. 4† Commercial mixed juice
Galactose	38·8	3·2
Arabinose	28·8	5·6
Glucose	3·7	60·9
Mannose	0·8	13·9
Xylose	0·7	0·8
Rhamnose	0	<0·1

Notes: Sample numbers refer to sample numbers in Table I.
* Moisture content 11·6%; ash 1·5%.
† Moisture content 0·8%; ash 0·8%.

Mannan occurs in the cell walls of most plants; this is probably the source of the mannose in the hydrolysed polysaccharides. Hemicellulose consists chiefly of xylan and accounts for a considerable portion of sugar cane bagasse. Low molecular weight (water-soluble) xylan, which was extracted from the sugar cane along with the sucrose, may be the source of the xylose found in the hydrolysate. The arabinogalactan, mannan and xylan could have become associated by hydrogen bonding during the isolation and drying steps, so that separation might not be effected by the usual methods. The small amount of rhamnose (Sample 4) may be derived from the rhamnoside, quercitrin, which is a known constituent of sugar cane[12], or it may be produced by micro-organisms along with dextran.

This group of indigenous sugar cane polysaccharides is not completely removed during processing of the sugar and can be found in all sugar cane products, including the most highly refined sugar. Several refined cane sugars that cause serious beverage floc formation were analysed for these polysaccharides and other components. Arabinogalactan was found

[10] *Anal. Chem.*, 1956, **28**, 350–356.
[11] *Carbohyd. Res.*, 1975, **39**, 387–389.
[12] Farber & Carpenter: *Proc. 5th Tech. Sess. Cane Sugar Refin. Res.*, 1972, 23–31.

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in all samples of floc-forming cane sugars tested. We believe, therefore, that arabinogalactan is implicated in acid beverage floc formation. Additional evidence will be presented in a forthcoming paper.

Summary

Sugar cane polysaccharides from freshly cut cane have been isolated and analysed. These polysaccharides have a specific rotation of —46°, compared with +30° to +160° for those isolated from commercial sugar cane products. Quantitative estimation of the component sugars resulting from hydrolysis of the cane polysaccharides indicated that galactose predominated, with arabinose, mannose, xylose, and glucose in decreasing quantities. Polysaccharides of the arabinogalactan type may be implicated in floc formation.

Soil improvement and yield of sugar cane in the Sudan

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Introduction

STUDIES carried out in South Africa showed that deep ploughing, compared with conventional tillage, gave an increase in cane yield of about 15% on deep structureless sandy soil, but no increase was observed on the other types of heavy soils studied[1]. It was also found that the application of sulphur and gypsum increased the yield and both treatments had beneficial effects[2]. The permeability of soil in the Sudan Gezira has been improved by gypsum application[3]. Laboratory studies showed that the hydraulic conductivity of the Gezira soil was mainly due to the high clay content (52–65%), high exchangeable sodium percentage (ESP) and low soluble salts. It was suggested[4] that deep ploughing may improve the soil by breaking up the layers of low hydraulic conductivity and mixing them with gypsum from the deep layers.

The purpose of this work was to investigate the effects of deep ripping and gypsum, when applied separately or together, on soil properties and yields of both cane and sugar.

Materials and Methods

Soils

The soils of the Guneid Sugar Cane Research Substation, where this work was carried out, are dark brown heavy, alkaline clays with very low hydraulic conductivity and relatively high ESP at a depth of 20–80 cm. These are vertisols with the dominant clay mineral being montmorillonite and are similar to those of the Gezira on the western side of the the Blue Nile[3,5,6,7].

Initial soil samples were taken with augers in steps of 20 cm down to 120 cm. These samples, after air-drying and passing through a 2 mm sieve, were sub-

[1] Moberly: *S. African Sugar J.*, 1972, **56**, 415–423.
[2] van der Menden: *Proc. 43rd Ann. Congr. S. African Sugar Tech. Assoc.*, 1969, 55–59.
[3] Greene: *J. Agric. Sci.*, 1928, **3**, 531–543.
[4] Zein Elabedine & Strmecki: *Sudan Agric. J.*, 1970, **5**, (1), 16–29.
[5] Ali: "Soil Survey of Guneid Sugarcane Research Station" 1968.
[6] Ibrahim: *Ann. Rpt. Guneid Research Substation*, 1970–71.
[7] Fadl: *J. Soil Sci.*, 1971, **22**, 129–135.

Table I. Properties of the initial soil samples

Depth, cm	*pH* 1:5	*EC* *mmho.cm*$^{-1}$ *at 25°C*	*CEC* *me/100g*	*ESP*	*CaCO*$_3$ %	*Clay* 0·002 *mm* %	*Total* *N* *ppm*	*Organic* *C* %
First experiment								
0–20	9·0	1·24	49	11·2	4·2	55	462	0·344
20–40	9·3	1·03	45	17·3	5·1	55	375	0·298
40–60	9·5	2·35	47	20·4	5·4	55	368	0·294
60–80	9·0	4·60	47	24·3	3·0	56	347	0·344
Second experiment								
0–20	8·5	1·20	57	14·0	4·3	54	644	0·344
20–40	8·6	2·35	58	17·1	4·8	55	588	0·330
40–60	8·7	2·71	59	23·4	4·3	56	599	0·319
60–80	8·5	3·06	61	27·3	5·4	57	644	0·329

Table II

Effect of deep ripping and gypsum application on yields of sugar cane and of sugar (tons per acre) and sucrose recovery (%)

	Dr$_1$			*Dr*$_2$			*LSD*	
	G$_0$	*G*$_1$	*G*$_2$	*G*$_0$	*G*$_1$	*G*$_2$	0·05	0·01
First experiment								
Yield of sugar cane (S.E.±5·13)	62·6	55·3	66·0	73·7	67·7	79·2	18·7	29·3
Yield of sugar (S.E.±0·64)	7·66	7·45	8·96	9·73	9·44	12·02	2·34	3·67
Sucrose recovery (S.E.±0·29)	12·19	13·46	13·60	13·21	13·95	15·19	1·04	1·63
Second experiment								
Yield of sugar cane (S.E.±2·16)	41·9	50·6	57·5	57·7	55·3	65·8	6·8	9·7
Yield of sugar (S.E.±0·65)	4·92	5·75	6·59	6·66	6·45	7·99	2·05	2·92
Sucrose recovery (S.E.±0·37)	11·73	11·36	11·45	11·57	11·66	12·77		

jected to various chemical and physical analyses: pH was determined by a glass electrode (soil:water ratio 1:5), electrical conductivity was determined on the saturation extract by a conductivity measuring bridge, CEC by the sodium acetate method[8], exchangeable Na in 1N ammonium acetate leachate photometrically and $CaCO_3$ was determined using Collin's "Calcimeter". Clay content, total N and organic carbon were determined by the pipette, Kjeldahl and the Walkly-Black methods, respectively. Results of the analyses for the depth 0–80 cm are reported in Table I.

Treatments

Two factorial experiments in which deep ripping and gypsum were involved were set up.

Two types of ploughing were carried out, namely: (*i*) *Standard ploughing:* This type of ploughing, denoted by Dr_1, represents the practice which is normally carried out at the Guneid Sugar Cane Scheme. The soil was disc-ploughed (15–20 cm deep), levelled and eventually ridged at 120 cm row-spacing. (*ii*) *Deep ripping:* This type of ploughing, denoted by Dr_2, was achieved by four ripping shanks (40 cm apart), mounted on a D8 tractor. After ripping (35–40 cm deep), the soil was levelled and ridged at 120 cm row-spacing.

Finely ground gypsum was used at the following levels: G_0 = 0 tons; G_1 = 3 tons; and G_2 = 6 tons gypsum per acre.

After the application of gypsum, the experimental plots were cultivated according to their respective treatments and large amounts of water were given to allow the gypsum to penetrate deeper into the soil.

The number of treatments involved in each experiment was six and these treatments were replicated twice and three times in the first and second experiments, respectively. The following letters were adopted to denote the different treatment combinations:— 1—Dr_1G_0, 2—Dr_1G_1, 3—Dr_1G_2, 4—Dr_2G_0, 5—Dr_2G_1, 6—Dr_2G_2.

The experimental plots were planted with sugar cane of variety N:Co 310. Each plot received nitrogen in the form of urea at the rate of 160 lb N per acre, split at two and four months. At fourteen months old, sugar cane stalks were taken at random for juice analyses. Thereafter the plots were harvested, leaving out the guard rows. Results are reported in Table II. Two weeks after harvesting, soil samples were taken, treated and subjected to the different analyses in a similar way as the initial soil samples. Results of the soil analyses (0–80 cm depth) are reported in Tables III and IV.

Table III. Effect of deep ripping and gypsum application on soil properties (first experiment)

Treatment	*Depth, cm*	*pH 1:5*	*EC mmho.cm^{-1} at 25°C*	*ESP*	*Total N ppm*	*Organic C %*
Dr_1G_0	0–20	8·9	0·76	6·7	468	0·366
	20–40	9·4	0·90	18·2	412	0·330
	40–60	9·6	0·85	28·9	400	0·293
	60–80	9·5	1·75	26·6	373	0·298
Dr_1G_1	0–20	8·9	0·75	5·7	500	0·338
	20–40	9·2	1·13	10·7	373	0·298
	40–60	9·2	2·17	13·4	424	0·291
	60–80	9·1	3·96	16·4	421	0·327
Dr_1G_2	0–20	8·3	1·75	4·1	464	0·339
	20–40	8·9	1·96	5·6	377	0·296
	40–60	9·3	2·27	14·0	377	0·272
	60–80	9·4	2·73	23·4	384	0·314
Dr_2G_0	0–20	9·0	0·92	4·9	473	0·339
	20–40	9·0	1·27	13·6	426	0·257
	40–60	9·3	0·97	15·5	405	0·266
	60–80	9·1	3·00	22·3	400	0·309
Dr_2G_1	0–20	9·0	1·27	8·6	435	0·333
	20–40	9·3	1·93	14·2	450	0·264
	40–60	9·4	3·70	25·1	379	0·304
	60–80	8·6	4·32	25·1	428	0·327
Dr_2G_2	0–20	8·4	2·88	4·3	454	0·343
	20–40	8·8	2·29	7·1	396	0·300
	40–60	9·2	2·55	18·1	396	0·268
	60–80	8·8	5·09	20·0	398	0·289

Table IV. Effect of deep ripping and gypsum application on soil properties (second experiment)

Treatment	*Depth, cm*	*pH 1:5*	*EC mmho.cm^{-1} at 25°C*	*ESP*	*Total N ppm*	*Organic C %*
Dr_1G_0	0–20	8·5	0·73	8·8	556	0·435
	20–40	8·7	1·1	11·2	476	0·386
	40–60	9·0	1·2	23·1	432	0·355
	60–80	9·0	1·6	24·4	425	0·356
Dr_1G_1	0–20	8·0	1·5	6·8	558	0·456
	20–40	8·5	0·9	13·4	479	0·412
	40–60	8·9	1·4	21·9	410	0·326
	60–80	8·8	3·1	24·9	387	0·368
Dr_1G_2	0–20	7·9	1·6	7·2	480	0·415
	20–40	8·2	1·6	9·0	471	0·377
	40–60	8·7	1·9	24·9	425	0·331
	60–80	3·7	3·7	22·5	404	0·359
Dr_2G_0	0–20	8·5	1·5	7·7	518	0·455
	20–40	8·9	1·1	13·6	496	0·462
	40–60	9·0	1·3	22·9	373	0·492
	60–80	9·1	2·1	20·8	366	0·356
Dr_2G_1	0–20	8·0	1·5	7·5	532	0·442
	20–40	8·3	1·3	10·7	461	0·391
	40–60	8·9	1·6	20·8	407	0·336
	60–80	9·0	1·9	23·9	386	0·338
Dr_2G_2	0–20	7·8	2·7	7·0	524	0·482
	20–40	8·2	1·8	7·9	468	0·420
	40–60	8·7	2·3	16·6	443	0·374
	60–80	9·1	2·2	22·8	415	0·336

Results and Discussion

Results in Tables III and IV show that the application of gypsum generally caused reduction in soil pH of the top 40 cm. This reduction was considerable in the case of plots receiving the highest dose of gypsum. On the other hand, the electrical conductivity of the top 40 cm of the plots which were only ploughed seemed to be less than that of the initial soil samples. The electrical conductivity of the gypsum-treated plots, particularly those with the 6 tons/acre of gypsum, increased considerably.

The ESP of the top 20 cm of all the treatments was less than that of the initial soil samples. Gypsum application caused reduction in the ESP of even the 40–60 cm depth in most of the gypsum-treated plots in both experiments. Greater reduction in ESP accompanied the higher application of gypsum.

In the first experiment, ploughing alone or in combination with gypsum caused increase in both the total N and organic carbon in relation to the initial soil samples. But in the second experiment, the amount of total N in the initial soil samples was higher than that of all treatments; whereas the organic carbon of all the treatments was higher than that of the initial soil samples.

Table II shows that the yields of cane of all the treatments (with the exception of treatment Dr_1G_1 in the first experiment) were higher than that of treatment Dr_1G_0 in both experiments. Treatment Dr_2G_2

[8] Richards (Ed.): "Diagnosis and Improvement of Saline and Alkali Soils" (Agriculture Handbook No. 60, U.S.D.A.) 1954.

attained the highest yield of sugar cane in the first and second experiments. Results of the statistical analysis for the first experiment showed that the main effect of deep ripping was to cause a significant increase in yield of cane (5% level). In the second experiment deep ripping and gypsum gave significant increase in yield of cane at 1% and 5% levels. Deep ripping and gypsum increased sucrose recovery significantly at 1% and 5% levels in the first experiment, but in the second experiment there was no significant difference. There was a significant increase (1% level) in yield of cane due to deep ripping in the first experiment.

It was found that deep ripping enhanced the germination of sugar cane tremendously in the first experiment. High germination was also observed in treatment Dr_2G_2. Moreover, deep cultivation was found to cause reduction in the density of the first foot[9]. Conversely, gypsum, both alone and in combination with deep cultivation, increased water penetration from 80 to about 120 cm and also somewhat increased water storage. Deep cultivation alone or combined with gypsum increased the rooting depth of sugar cane.

The results of these two experiments suggest that deep ripping alone or in combination with 6 tons of gypsum per acre might have value for improving these heavy soils and thereby afford considerable increase in sugar cane yield.

Summary

Two factorial experiments, in which gypsum and deep ripping were included, were carried out in two consecutive seasons at the Guneid Research Substation, Sudan. Results showed that gypsum at the highest level caused considerable reduction in both soil pH and ESP and increase in EC of the top 40 cm. Total N and organic carbon were not affected consistently by the treatments. Cane yields were generally increased significantly by deep ripping in both experiments. In the second experiment gypsum also increased cane yield significantly. There was a significant increase in sucrose recovery and sugar yield on treatment with gypsum and deep ripping in the first experiment. The treatment which included deep ripping and the highest level of gypsum gave the highest yield of sugar cane in both experiments.

Acknowledgment

Grateful acknowledgment is made to the Director of the Agricultural Research Corporation, Wad Medani, Sudan, for his permission to publish this paper.

[9] IBRAHIM: *Ann. Rpt. Guneid Research Substation*, 1971–72.

The influence of level of topping and other cultural factors on sugar beet yield and quality.

By P. J. LAST, A. P. DRAYCOTT and R. HULL

(Broom's Barn Experimental Station, Higham, Bury St. Edmunds, Suffolk)

PART I

Introduction

THE British Sugar Corporation stipulates in its contract with growers that all roots shall be topped squarely immediately below where the lowest leaves on the crown have grown. When beet are topped above this demarcation line, the vascular tissue gives an irregular pattern on the surface, but below it the vascular tissues become well defined in concentric rings. The factories insist on beet so topped because the crown tissue contains impurities which are not removed easily when the beet are processed and eventually cause increased production of molasses with commensurate loss of white sugar.

The most troublesome constituents in beet are (*i*) the highly-melassigenic potassium and sodium salts little of which is removed in the purification process, and (*ii*) the soluble organic substances such as the amino-acids, glutamine and nitrogenous bases like betaine. These latter remain in the juices, either unchanged or degraded by liming and gassing into pyrrolidone carboxylic acid and, to a smaller extent, glutamic acid which change the buffering capacity of the extracted juices and again ultimately increase molasses.

Fresh topped beet usually contain about 0·2–0·4 g of invert sugars for every 100 g of sugar present but the sections normally discarded contain much higher concentrations of invert sugars, whose acidic degradation products also lead to further white sugar loss by inversion. Invert sugars are concentrated in the petioles and, although partially removed during fluming (trash removal and washing), cause difficulty in processing if the petiole bases remain attached to the beet.

This investigation was undertaken to determine the effect of plant density and irrigation on the proportion of beet normally discarded, to quantify the sugar and major impurities present in the discarded tissue, and to assess their influence on juice quality. Similar studies have been made by ZIELKE[1] and WINNER & FEYERABEND[2].

EXPERIMENTAL

Beet were harvested from field experiments in 1970–71 at Broom's Barn Experimental Station, Suffolk, which tested the effects of plant density and irrigation; Table I summarizes the yields but full particulars of the experiments have been described by DRAYCOTT & DURRANT[3].

The experiments also tested sodium, potassium and phosphorus fertilizer on some plots, but only small

[1] *J. Amer. Soc. Sugar Beet Tech.*, 1973, **17**, 332–344.
[2] *Zucker*, 1971, **24**, 35–43.
[3] *J. Agric. Sci.*, 1974, **82**, 251–259.

Table I. Plant densities and yields on the main plots from which roots were sampled in 1970-71

	S_1	S_2	S_3	S_4	S_{4x}	S.E.D. (*horizontal*)
Plant densities ('000.ha^{-1})						
Theoretical	19·3	38·8	77·6	103·3	154·9	±1·27
Actual	19·0	38·8	74·6	98·3	147·3	
S.E.D. (vertical)			±0·89			
Root yield (tons.ha^{-1})						
I_o	37·6	48·2	49·3	47·8		
I_w	43·5	53·1	54·2	54·3		±1·93
S.E.D. (vertical)			±1·37			
Sugar (%)						
I_o	16·7	17·8	18·1	18·2		
I_w	16·5	17·2	17·4	17·8		±0·146
S.E.D. (vertical)			±0·099			
Sugar yield (tons.ha^{-1})						
I_o	6·24	8·55	8·90	8·68		±0·334
I_w	7·14	9·14	9·44	9·69		
S.E.D. (vertical)			±0·237			

I_o = not irrigated
I_w = irrigated
S.E.D. = Standard error of differences pooled over the two years.

sodium and potassium by flame photometry, α-amino-nitrogen by the method of MOORE & STEIN[5], and for the concentration of invert sugars colorimetrically using tetraphenyl tetrazolium chloride[6]. The dry matter percentage in the three sections was determined by drying at 80°C. The sugar concentrations and impurities of the whole and scalped roots were then calculated.

The juice purity, defined as the ratio of sugar to total solids in clarified juice, was calculated from the equation:

$$\% \text{ juice purity} = 97{\cdot}0 - 0{\cdot}0008 [2{\cdot}5\,K + 3{\cdot}5\,Na + 10\,\alpha\text{-amino-N}]$$

effects on yield were recorded and the treatments were confounded with the two main treatments—density and irrigation. Similar weights of beet were harvested from each plot (20–25 kg). The roots were lightly trimmed with a knife to remove the leaf stalks and the outer and upper portions of the crown, but the core of the scalp was left intact, as recommended by JORRITSMA & OLDFIELD[4]. The roots were washed and counted, then brei made by holding them vertically on a horizontal reciprocating rasp ("Surform" blades) to give samples of the scalp, crown and normally-topped beet. The weights of the three sections were determined; the sub-division of the roots and their notation, as shown in Fig. 1, was as follows:

1. The scalp D_1
2. The crown D_2
3. The normally-topped beet D_3
4. Scalped beet B_2
5. Whole beet B_1

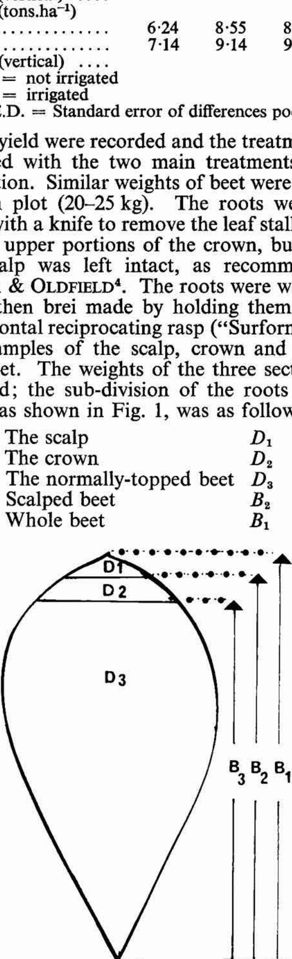


Fig. 1. Diagram of the parts of the root
D_1 Site of bases of living petioles—the scalp; D_2 Leaf scars and lateral buds—the crown; D_3 Normally-topped beet; B_2 Scalped beet; B_1 Whole beet.

Typical whole, scalped and topped roots are illustrated in Fig. 2.

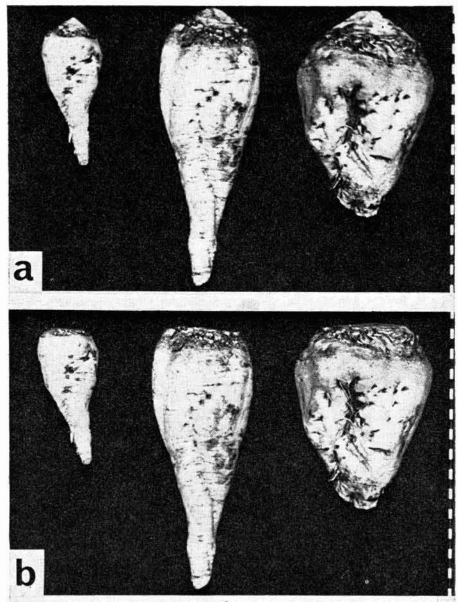
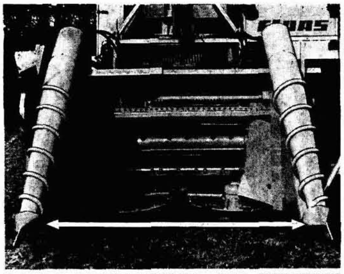
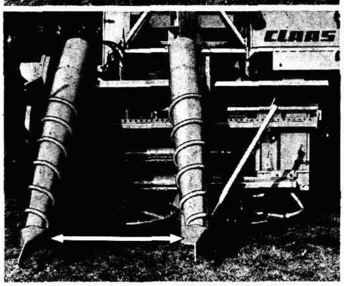


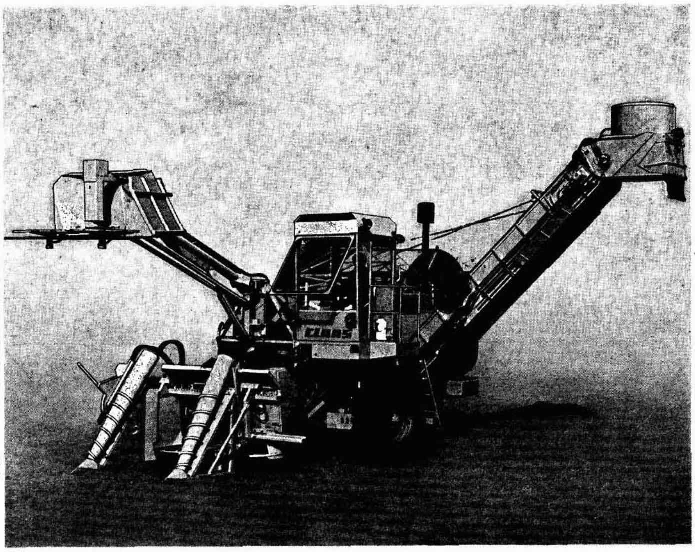
Fig. 2. Sugar beet from three plant densities (147,000, 75,000 and 19,000. ha^{-1}, respectively, from left to right) showing the level of topping (*a*) for whole, (*b*) scalped and (*c*) normally-topped roots.

For each plant section the sugar concentration was determined in duplicate in a neutral lead acetate extract. This extract was also used for the analysis of

[4] *I.I.R.B.*, 1969, **3**, (4), 226–238.
[5] *J. Biol. Chem.*, 1954, **211**, 907.
[6] HARRIS: *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 593–604.







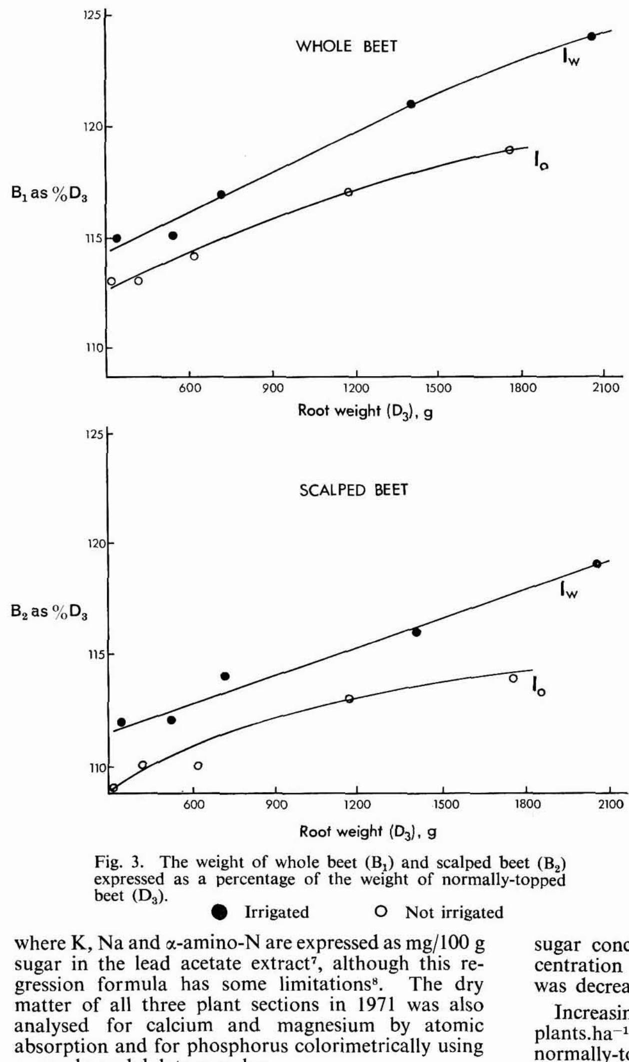


Fig. 3. The weight of whole beet (B_1) and scalped beet (B_2) expressed as a percentage of the weight of normally-topped beet (D_3).

● Irrigated O Not irrigated

where K, Na and α-amino-N are expressed as mg/100 g sugar in the lead acetate extract[7], although this regression formula has some limitations[8]. The dry matter of all three plant sections in 1971 was also analysed for calcium and magnesium by atomic absorption and for phosphorus colorimetrically using a vanado-molybdate complex.

The work was expanded in 1972/73 and the effect of time of harvest and storage on the three root sections was investigated. Beet were harvested at monthly intervals during October-November-December, and were stored outdoors with the scalp intact under straw cover from early November until mid-January. The stored sample and the fresh monthly sample were harvested, processed and analysed as described previously.

RESULTS

1970–71: Plant density and irrigation greatly influenced root weight in 1970–71 and the root weight of whole beet ranged from 2506 g on irrigated plots with 19,000 plants.ha^{-1} to only 362 g on unirrigated plots with 147,000 plants.ha^{-1}. To obtain comparative results for differing-sized roots, weights of whole and scalped roots have also been expressed as a percentage of the corresponding weights of roots topped normally. Fig. 3 shows the relative weights of whole and scalped beet averaged over both years. With 19,000 plants per ha, the large whole beet were 122% of the weight of scalped beet, but the smallest whole beet at a plant density of 147,000 plants.ha^{-1} were only 14% heavier than the normally-topped beet. When averaged over all spacings, untopped and scalped beet were respectively 119% and 115% of the weight of normally-topped beet. The proportion of tissue removed by topping and scalping was greatest on the large beet and the weight of the normally-topped beet increased proportionately from only 82% of the total at 19,000 plants.ha^{-1} to more than 87% when grown at 147,000 plants.ha^{-1} With all plant densities, the weight of tissue removed by topping was greater for irrigated than unirrigated beet, ranging from 5% more at 19,000 plants.ha^{-1} to only 2% more in the dense crop.

Table II gives the weights, sugar percentages, yields and the impurity concentrations in each root section and also the calculated concentrations in the whole and scalped beet, averaged over plant density and irrigation treatments, whilst Appendix Table IX shows the more detailed analysis.

The sugar concentration in the normally-topped beet, 18·98%, was more than 3% greater than in the crown tissue, which in turn contained about $2\frac{3}{4}$% higher sugar concentration than in the scalp. Irrigation usually decreases sugar concentration in beet and all three sections confirmed this. The greatest decrease was in the scalp section where irrigation decreased the sugar concentration by 0·90%, whereas sugar concentration in the crown and normally-topped beet was decreased by 0·66% and 0·38%, respectively.

Increasing the plant density from 19,000 to 147,000 plants.ha^{-1} increased the sugar concentration of the normally-topped beet by 1·48%, but no consistent effect on sugar concentration attributable to plant population was recorded in either crown or scalp. The effect of density on sugar concentration for whole and scalped beet was similar to the results obtained for the normally-topped beet, and for whole beet the concentration was increased by 1·41% when plants at extreme densities were compared.

The sugar concentration was 18·98% in the normally-topped beet, 18·64% in the scalped beet and 18·46% in the whole beet. The same pattern and magnitude of decrease was found in all plant densities and with both irrigation treatments. The concentrations of all major impurities in the beet sections are shown in Table II; all increased greatly in the crown and scalp, compared with the amounts present in the

[7] CARRUTHERS *et al.*: *Paper presented to the 15th Tech. Conf., British Sugar Corp.*, 1962.

[8] KEARNEY: *J. Sci. Food, Agric.* 1971, **22**, 342–348.

normally-topped beet, particularly α-amino-nitrogen, which increased from 192 mg/100 g sugar in normally-topped beet to 919 mg/100 g sugar in the scalp. The potassium and sodium concentrations in the scalp, related to 100 g sugar, were respectively about twice and three times the concentration in the normally-topped beet, whilst the invert sugars increased from only 0·4 g/100 g sugar in the normally-topped beet to 1·5 g/100 g sugar in the scalp. The greater concentration of impurities in the upper sections results in a lowering of the juice purity, the ratio of sugar to total solids in the clarified juice, inasmuch as the juice purity of the whole root was 92·63%, compared with 92·89% for the scalped beet, which in turn was 0·48% less than for the normally-topped beet.

Table II. Analyses, weights and sugar yields of the scalp, crown and normally-topped beet and of scalped and whole root. Average of years 1970-71, plant density and irrigation

	Scalp	*Crown*	*Normally-topped beet*	*Scalped root*	*Whole root*
Sugar %	13·07	15·88	18·98	18·64	18·46
α-amino-N (mg/100 g sugar)	919	584	192	231	246
Potassium ,,	1854	1257	882	917	936
Sodium ,,	398	219	120	130	136
Invert sugars (g/100 g sugar)	1·498	0·716	0·402	0·433	0·458
Juice purity (%)	84·83	89·20	93·37	92·89	92·63
Root weight (g/root)	40	137	939	1076	1116
Total sugar (g/root)	5·2	21·6	174·7	196·0	201·8

Table III

(*i*) The percentage increase in each major impurity when related to 100 g sugar in whole and scalped beet, compared with the amounts present in normally-topped beet, 1970–71

	α-amino-N	*Invert sugars*	*Potassium*	*Sodium*
Whole beet	28	14	6	13
Scalped beet	20	8	4	8
Normally-topped beet	100	100	100	100

(*ii*) The percentage contribution of each section of root to the whole

	α-amino-N	*Invert sugars*	*Potassium*	*Sodium*	*Weight*	*Total sugar*
Scalp	9·3	8·3	5·0	6·9	3·6	2·6
Crown	24·7	16·5	14·0	15·9	12·2	10·7
Normally-topped beet	65·9	75·0	81·0	77·1	84·2	86·7
Whole beet	100	100	100	100	100	100

(*iii*) The increases per root in weight, impurity and sugar yield from crown and scalp, expressed as a percentage of the amounts present in the normally-topped beet.

	α-amino-N	*Invert sugars*	*Potassium*	*Sodium*	*Weight*	*Total sugar*
Whole beet	51·6	33·0	23·5	29·6	19	15
Scalped beet	37·5	21·9	17·3	20·6	15	12
Normally-topped beet	100	100	100	100	100	100

The juice purities of the scalp and crown were respectively 84·83% and 89·20%, considerably lower than the normally-topped beet juice purity of 93·37%. The juice purity of the normally-topped beet increased with plant density (Appendix Table IX), but the results were less consistent for the crown and scalp.

On average, irrigation increased juice purity by 0·70% in the normally-topped beet and at each plant density, but results from scalp and crown were more variable; overall, irrigation decreased the juice purity in both. In general, however, irrigation increased juice purity of the whole root by 0·46% and in the scalped root by 0·50% compared with unirrigated beet. With only one exception, irrigation increased the purity of whole and scalped beet at all densities, although the greatest effects were in the larger beet.

The contribution of each plant section to the whole, in terms of root and sugar yields and impurities, is shown in Table III as is the percentage increase in each factor if either the scalp and/or crown were included. Generally, the impurities increased more than the total sugar. Thus, including the crown and scalp for processing would increase the total sugar per root by 15%, but the α-amino-N and invert sugars showed corresponding total increases of 52% and 33%, respectively. Related to 100 g sucrose, however, the increases were reduced to 28% and 14%. Comparing the two main inorganic cation constituents of impurity showed that the amount of sodium increased by 30% and potassium by 24% in whole beet.

(*to be continued*)

A comparison of cane diffusion with hybrid milling-diffusion systems

By JOHN H. PAYNE

THE development of continuous cane diffusion in Hawaii in the decade 1950–60 was based upon the concept that juice might be more efficiently separated from fibre in sugar cane by subtler means than the application of force in massive milling tandems. The success of pilot exploratory installations in the fifties was followed by equally successful commercial installations in varied parts of the world beginning in the sixties.

Innovations of this kind always find the going hard. In this case, mill manufacturers understandingly sought to protect their business from a new type of competition. Manufacturers of continuous beet diffusers saw an opportunity to sell equipment in a vast new field. Mill owners and operators sought to take advantage of the improved recovery demonstrated by diffusion but without the expense of replacing a good tandem.

The combined effect of these forces was the introduction of hybrid systems using combined milling and diffusion. The field was fertile. Despite the attractiveness of diffusion, the scrapping of a good mill train could in no way be economically justified. An average probable increase in extraction of 5% would require a 20-year pay off. No one was interested in such a low return. Obviously the only possibilities justifying going to the new diffusion would be in replacing a worn-out mill tandem, expanding production capacity, or starting a new sugar project.

Manufacturers of beet diffusers, with no experience in the area of cane preparation and dewatering, offered to provide a "little diffuser" that could just be added to the mill train to give the advantages of diffusion without the cost of new preparatory equipment and without any unacceptable "scrapping." There followed arrangements with mill manufacturers to provide whole new units of combined mills and diffusers.

Such was the origin of milling-diffusion. Often today, however, differentiation from diffusion has been lost. For this reason it is the purpose of this paper to make an orderly comparison of the two.

Diffusion

The thought behind diffusion was to prepare the cane in such a manner that most of the juice could be separated from the fibre by a simple process of displacement with water. The chief governing factors in diffusion were, therefore: (1) cell rupture, and (2) prepared cane permeability.

Since these are determined primarily by the cane preparation, all other conditions in the diffusion system are secondary. Cell rupture of close to 94% is necessary in order to approach an extraction of 98%. But, unless the quality of cane preparation is such that water can flow with a minimum of impedance through a bed of fibre, juice from the opened cells cannot be displaced with dispatch.

The performance of any kind of diffuser is determined by these factors. In practice, it is possible to compensate partially for inadequate cell rupture by use of more water, and for poor permeability by longer residence time, but both mean less efficient use of equipment.

Ideal preparation, therefore, is that which brings about cell rupture at the 94% level, leaving the fibre in a condition that will form a uniform, permeable bed with a minimum of channels. Up to the present time, the best method for achieving this quality of preparation is by means of two-stage shredding in machines depending upon impact-shattering for most of their action. Cutting, grinding, or compressing actions are less effective.

Having satisfactory preparation, the next step is diffusion. Here, equipment is necessary (the diffuser) which will provide a bed of optimum dimensions, through which a counter-current flow of juice to fibre can be maintained until the desired juice displacement is obtained. The diffuser should be clean in design, simple in operation, reliable in performance, and with built-in flexibility sufficient to handle routine variables such as cane quality, trash content, and production rates. The closest approach to the ideal in this case is the undisturbed bed type in which the fibre is moved from intake to discharge point as a continuous mat, while juice, resulting from water addition at the discharge end, is pumped forward in successive stages. The ring-type diffuser best accomplishes this because the bed is not disturbed. In conveyor-type machines the bed is subjected to continuous shaking, giving compaction which lowers permeability. Also, at the sides, where the bed is moving with respect to the container walls, channelling occurs and ineffective juice flows to the bottom. Liquid flow, therefore, becomes more difficult to control. For efficient performance, the diffuser must be filled with juice to the bed level at all times. If the level drops, air spaces develop and juice flow is air-blocked. If the juice level is much above the bed, flooding occurs, and lateral and longitudinal flow negates the counter-current operation.

The final step is dewatering. Since this is common to milling, diffusion, and milling-diffusion, it will not be discussed at this time.

With the quality of preparation described and the diffuser operation indicated, extraction at the 98% level, with the bagasse pol below 1%, has been achieved routinely over the past ten years in commercial operations. These results were obtained at dilutions considered normal for milling—the 25% range.

As in milling, most of the juice is removed at the beginning of processing. This is shown in a typical diffuser operational curve given in Fig. 1 from Pioneer Mill Company, Hawaii, where the first installed Silver ring diffuser is operating. In this curve is shown the pol and refractometer solids of the juice at the successive pump units in the counter-current flow system. It will be noted that the pol drops rapidly at the beginning then slows, the curve becoming relatively flat after the middle of the diffuser. Pumps 18 and RJ (return juice) are recycle systems so that pump 17 handles first-pass juice. By two stages from this, at pump 15, more than 50% of the juice has been removed. The number of stages following after this depends upon what extraction is desired. As is shown by the flatness of the curve at the end, the point of diminishing returns is close. If the last two stages were eliminated, extraction would drop only slightly.

Milling-Diffusion

The milling-diffusion approach has been chiefly to consider diffusion as simply an adjunct to milling.

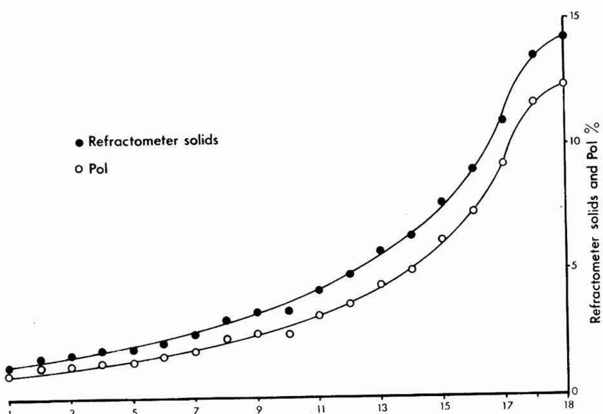


Fig. 1. Diffusion gradients (extraction 97·9%, dilution % absolute juice 23·2)

The quality of preparation that has been provided in milling is accepted, and emphasis is placed on the importance of the initial expulsion of more than 50% of the juice.

Several authors have discussed this point. CRAWFORD[1] has presented it in simple terms as follows:

> If the required overall extraction (mill and diffuser) is 97·5% and E = % pol extracted in the first mill, then the pol extraction, e, necessary in the diffuser based on the pol of bagasse from the mill is given by the formula:
>
> $$e = 100 \frac{(97{\cdot}5 - E)}{(100 - E)}$$
>
> The relationship between E and e for three values of E is:
>
> | | | % | |
> |---|---|---|---|
> | Pol extraction, first mill, E | 65·0 | 70·0 | 75·0 |
> | Pol extraction, diffuser, e | 92·5 | 91·7 | 90·0 |
>
> It is seen that as mill extraction increases, the required diffuser extraction decreases.

CRAWFORD goes on to say:

> "... that the higher the pol in the feed the higher will be the percentage of extraction. The same may be true of diffusion."

and quotes from FOSTER & HILL[2] who reported simulated bed extractions of only 82·8 and 89·9% after mill expulsion of 65% of the pol. CRAWFORD comments that it

> "... may be difficult to obtain the higher overall extractions often quoted for bed diffusers wtih moderate No. 1 extractions."

An examination of the data of FOSTER & HILL provides an important clue. In addition to the tests on simulated diffusion of first mill bagasse which gave the low extractions recorded, the investigators also reported on eight tests in which the first mill bagasse was shredded before the simulated diffusion. In these tests the extraction averaged 91·7%. Two factors could account for this. The first is better preparation, that is, more cell rupture. The second is better bed permeability and bed structure by fluffing up and making a more homogenous mat. These two factors are basic in the preparation needed for diffusion and speak against the milling-diffusion compromise.

Furthermore, basic principles should not be permitted to lapse. As CRAWFORD mentioned, the higher the pol in feed the higher will be the extraction, be it diffusion or milling. This means that the percent extraction from cane is always going to be higher than that from first mill bagasse. An example will illustrate this:

Assume that 100 tons of cane, of 13·0% pol and 13·0% fibre, yields 26 tons of final bagasse of 1·5% pol, 50·0% fibre, 48·5% moisture. The loss will be 0·39 tons pol and extraction

$$\frac{13{\cdot}0 - 0{\cdot}39}{13{\cdot}0} \times 100 = 97{\cdot}0\%.$$

If 65% of the pol is expelled in the first mill, there will be 13·0 × 0·35 = 4·55 tons pol remaining in the first mill bagasse. With a final bagasse as above, the extraction from the first mill bagasse will be

$$\frac{4{\cdot}55 - 0{\cdot}39}{4{\cdot}55} \times 100 = 91{\cdot}4\%.$$

The decrease will obviously continue as juice removal continues. As the pol in bagasse becomes lower, the percentage extraction must likewise be lower, provided the pol in bagasse remains the same. In reality, the pol in bagasse may decrease also. This will be true if the basic principles of diffusion are followed. If the cells are ruptured and the extracting water can get to the juice, then bagasse pol will drop. If, on the other hand, little attention is given to cane preparation and water is added to coarse compressed bagasse from a first mill, the subsequent extraction will be low, both by definition and in practice.

These observations explain why most of the milling-diffusion installations have not reached the level of extraction obtained in diffusion and why many remain in the range of conventional milling. (This is illustrated in Table I.)

Table I. Comparison of diffusion at Pioneer with milling-diffusion in South Africa

Probably the best operations in milling-diffusion are those of South Africa. The following table shows the results obtained in the past five seasons with the four milling-diffusion installations, compared with Pioneer. It should be remembered that the cane in South Africa is hand-harvested whereas at Pioneer it is mechanically harvested by push-rake.

	Extraction				
	Diffusion	*Milling-Diffusion*			
	Pioneer	*Entumeni*	*Empangeni*	*Union Coop.*	*Malelane*
1973	97·69	97·02	96·24	96·92	94·57
1972	97·62	97·56	95·71	97·81	95·60
1971	97·86	97·04	95·23	97·57	95·67
1970	98·11	96·04	94·28	97·91	94·86
1969	97·61	95·59	94·53	97·08	93·60
Ave.	97·78	96·65	95·20	97·46	94·86
		Average 96·04			

Since the percentage extraction of juice by milling-diffusion drops so markedly following first mill expelling and such does not occur in diffusion for reasons of better bed characteristics, then the offering of milling-diffusion appears meagre. A common-sense approach also presents a conundrum. If one mill is more effective in extracting juice than a diffuser, would not two be still better? At what point does one stop? Carried to its logical conclusion, this argument would return us to a conventional milling tandem and milling-diffusion would disappear!

It was shown in the discussion under diffusion that some 50% of the juice is removed in the first two extraction stages of a Silver ring diffuser. This means that these two stages approach the equivalent extraction of a first mill. The mill, therefore, takes the place of two or at most three stages in the diffuser. As pointed out, it does this at the expense of some diffuser performance. But even if this were not so, it means that the diffuser needs only limited additional stages to bring the bagasse to the pol level equivalent to first mill bagasse. In the case of the ring diffuser, there are 17 effective stages so that the increase is from 12 to 18%. However, for equivalent effectiveness, even this increase in stages is not necessary and can be overcome by the more efficient extraction offered by the properly prepared bed.

1 *I.S.J.*, 1968, **70**, 195–199.
2 *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 111–119.

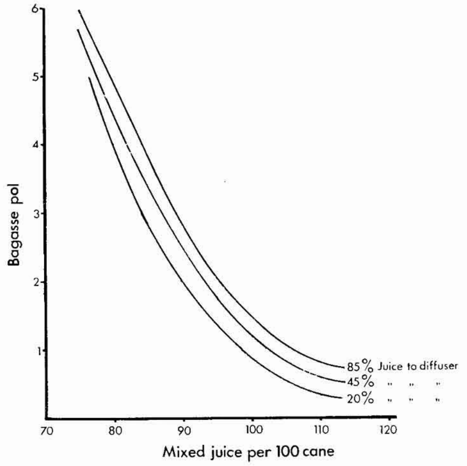


Fig. 2. Effect of draft on bagasse pol (from BRÜNICHE-OLSEN)

Better preparation and the use of more water could also provide the same results even with poor preparation, as pointed out by BRÜNICHE-OLSEN[3] in a theoretical discussion based upon experience with milling-diffusion installations featuring a minimum of cane preparation. In Fig. 2, he has plotted the calculated pol in bagasse at three levels of prepressing, against the draft, which is juice per hundred cane, an increase of which means addition of more water to the cane. He states:

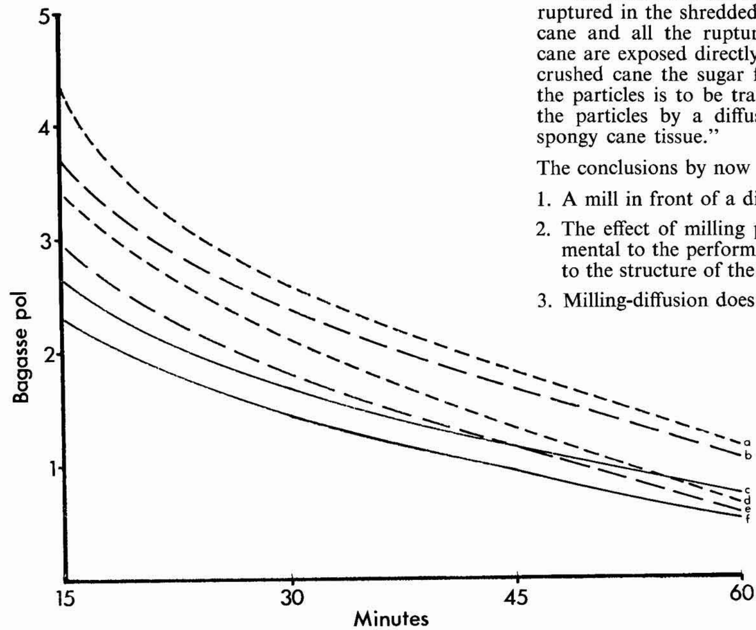


Fig. 3. Effect of retention time on bagasse pol (from BRÜNICHE-OLSEN)

KEY: a — 85% juice to diffuser, $E = 5{\cdot}5$
b — 45% ,, ,, ,, $E = 5{\cdot}5$
c — 20% ,, ,, ,, $E = 5{\cdot}5$
a — 85% ,, ,, ,, $E = 7{\cdot}2$
b — 45% ,, ,, ,, $E = 7{\cdot}2$
c — 20% ,, ,, ,, $E = 7{\cdot}2$

"As can be seen from the figures, an omission of the prepressing can be compensated for by 10–15% increase in the amount of juice produced."

In Fig. 3, BRÜNICHE-OLSEN has also plotted calculation of pol in bagasse against retention time in the diffuser at three levels of prepressing and with two diffusers, E7·2 and E5·5 (the E5·5 being a smaller unit). He comments on these curves as follows:

". . . an inefficient prepressing or no prepressing at all can be compensated for by an at most 60% increase in retention time for the cane in the diffuser . . . No doubt a relation exists between the value of *E* (diffuser size) and the preparation and character of the cane in the same way as the dimensions of the beet cossette and the character of the beet tissue is decisive for the extraction of sugar from beets by diffusion . . it is unfortunately impossible to refer the above calculations to any specific well-defined preparation of the cane but the results are to be regarded as indicative only regarding the influence of the important number of other parameters of the milling diffusion of cane."

Thus BRÜNICHE-OLSEN is confirming that, even with poor preparation, prepressing, i.e. milling first, is not necessary, and addition of more water and/or use of a longer retention time will compensate for it.

More recently, the same investigator[4] has reported that, in laboratory tests at 75°C, the extraction of shredded cane was six to seven times as high as for cane crushed to simulate the action of a mill*. He states:

"The reason for this is partly that more cells are ruptured in the shredded cane than in the crushed cane and all the ruptured cells of the shredded cane are exposed directly to the juice, while in the crushed cane the sugar from the interior parts of the particles is to be transferred to the surface of the particles by a diffusion process through the spongy cane tissue."

The conclusions by now are unavoidable:

1. A mill in front of a diffuser is unnecessary.
2. The effect of milling prior to diffusion is detrimental to the performance of the diffuser owing to the structure of the resulting fibre bed.
3. Milling-diffusion does not give the extraction in practice that diffusion does.

What then is the place of milling-diffusion? It is an adjunct to milling, definitely not a replacement for diffusion. Whether it is more desirable than milling is a subject for another appraisal.

[3] *I.S.J.*, 1967, **69**, 99–101, 131–134.
[4] BRÜNICHE-OLSEN: *Proc. 14th Congr. ISSCT*, 1971, 1229–1236.
* This work was done primarily to determine the effect of repeated compressions on the extraction in which he found that the rate of extraction is increased several times by repeated squeezing.

Sugar cane agriculture

Behaviour of the Gurdaspur borer *Bissetia steniella* Hmpsn. (Lepidoptera: Pyralidae) in Rajasthan. S. KUMAR. *Indian Sugar*, 1975, **25**, 99–108.—Detailed investigations of the habits of this borer, which occurs widely in Indian cane areas, are reported. Attacks by *B. steniella* are associated with attacks by the top borer, *Scirpophaga nivella.*

* * *

The effects of different levels of exchangeable sodium on soil hydraulic conductivity. M. A. JOHNSTON. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 142–147.—Permeability studies on samples of five South African soil series having a wide range of physical properties are reported in which their sensitivity to salt was determined. From critical levels of sodium adsorption obtained from the test data it was found possible to assess the degree of "sodicity" of soil from problem areas. The relationship between exchangeable sodium percentage and sodium adsorption ratio of the soil solution was determined for each sample.

* * *

Implementation of field layout for mechanization and surface water control. O. P. LANDREY, J. P. FOURIE and N. A. JOHNSTON. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 148–153.—In view of the need for greater mechanization of field operations in South Africa, revision of the methods of laying out cane fields has become necessary, since machines cannot easily cope with irregular terrain, varying row widths and the presence of short lines. The principles involved, the requisite design criteria and the techniques for their implementation are described with the aid of photographs and diagrams.

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An evaluation of various types of cultivators for weed control in sugar cane. E. MEYER and A. G. DE BEER. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 154–156.—Details are given of the performances of 13 cultivators tested on various types of soil under wet and dry conditions against grasses, water grasses and broad-leaved weeds at three stages of growth. Distinct differences were found between the performances, with some implements giving consistently good results when used properly. Time of use was the most important single factor governing successful weed control and it became progressively more important the lighter was the cultivator. Coiled-tine and spring-tine cultivators gave excellent results and are recommended for a wide range of conditions; rolling cultivators are also suitable provided the fields are reasonably level and land preparation is such that high speeds are possible.

Comparison of two methods of drying-off sugar cane. J. E. LONSDALE. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 157–159.—Two trials are reported in which gradual drying-off based on Class A pan evaporation was compared with a process in which irrigation was stopped at a pre-determined time before harvest. For July and September harvests there were no differences between the two methods, and gradual drying-off at 0·5 pan evaporation for 4 months is recommended. With the other method, a total of about 230 mm should be allowed to evaporate from a Class A pan between the last irrigation and harvest. It was found that drying-off does not overcome the adverse effects which late top-dressings of N have on yield and quality of N:Co 376 cane.

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An assessment of chemical ripening of sugar cane in South Africa and Swaziland. H. ROSTRON. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 160–163. A review is presented of experimental work conducted in South Africa and Swaziland since 1968 on chemical ripeners. Both "Ethrel" and "Polaris" have consistently improved cane quality and sugar yield, particularly with young, active cane under irrigation. At the same rate of application "Ethrel" proved more effective than "Polaris". Varietal differences in response to the ripeners have been established.

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Studies of nematode populations in sugar cane soil profiles. R. H. G. HARRIS. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 164–170.—The vertical distribution of populations of different nematode genera and species in soil profiles treated with ethylene dibromide as nematicide and untreated was investigated in plant and 1st ratoon crops. It was found that nematodes, which proved to be associated with root damage, were not restricted to any particular level down to 2 m. Possible seasonal fluctuation in numbers was indicated. Nematicide treatment to a depth of 23 cm affected nematodes down to 2 m and gave dramatic increases in cane growth compared with lack of treatment. The methods used for nematode sampling and extraction are described.

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Nematicide application to ratoon crops of sugar cane grown on some sandy soils of the Natal sugar belt. S. RAU and P. K. MOBERLY. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 171–173.—The effects of "Temik" application to 1st ratoon cane which had already been treated with the nematicide at planting were determined at a number of locations. Results indicated an increase in yield which varied widely with location and soil type but averaged 71% over the untreated cane yields. However, response to treatment was not as high in the ratoon crop as in the plant cane, and ratoon crop yields frequently fell short of the climatic potential. Suitable application rates and time of application are discussed. It is recommended to burn cane and apply "Temik" to the ratoons rather than risk a severe nematode outbreak where there is a trash blanket (which makes application of nematicide difficult). "Vydate" applied to ratoon cane was considered to have no effect, any apparent success it did achieve being attributed to the residual effect of "Temik" applied at planting.

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The use of crop data from comparable farm groups as an extension aid. A. B. TUCKER. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 174–176.—The importance of keeping and evaluating farm records for use in determining the suitability of cane varieties and optimum harvest time on similar farms in a given area is discussed.

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Effects of age and harvest season on the yield and quality of sugar cane. J. E. LONSDALE and J. M. GOSNELL. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 177–181.—Time of harvest was found to have a considerable effect on cane yield and quality in tests in Rhodesia involving two varieties harvested as 1st, 2nd and 3rd ratoon crops at 4 different times and 5 different ages in the range 10–18 months. The influence of age was governed by variety and harvest time, but results indicated that it is not advisable to stand cane over in the Rhodesian Lowveld.

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Further studies on the use of a polyethylene mulch in the growing of sugar cane. S. RAU and E. W. MILLARD. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 182–186.—Trials with polyethylene film applied to plant and ratoon cane showed that in some cases yield was increased by the treatment and that substantial improvements in germination and increases in stalk populations and elongation rates also resulted in five out of the six plant crops and one out of the three ratoon crops involved. The effects declined with age, however. The greatest (90 cm) of four widths of film tested was marginally superior. Soil types and season affected the responses, and the use of plastic film is considered justifiable only for autumn planting.

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Seedling selection and resistance to smut disease in sugar cane. K. J. NUSS. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 187–188.—The resistance of parent clones and their progeny in single lines to smut was determined at Pongola field station and the results tabulated. While several clones gave a high percentage of resistant offspring, it was concluded that progeny of smut-resistant parents still need to be screened, since even resistant clones may give susceptible offspring.

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The search for alternative varieties to N:Co 376 in Rhodesia. G. L. JAMES. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 189–195.—A review is presented of 22 trials conducted over 10 years on 100 early-, mid- and late-season varieties to find alternatives to N:Co 376, the major variety grown in Rhodesia but which is highly susceptible to smut. Tabulated data show that very few of the varieties consistently gave greater yields than N:Co 376.

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A comparison of sucrose patterns, yields and third leaf N % dry matter of sugar cane varieties grown in the Pongola area. D. B. HELLMANN. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 196–201.—Estimated recoverable sugar % cane was determined in random samples of cane stalks taken before harvest and its pattern with crop age and time of year established for a number of varieties. The trials covered both spring- and autumn-harvested cane and were intended to establish the suitability of varieties for the Pongola area of South Africa. Results, given in tabular and graph form, showed that N:Co 310 did not give higher sugar yields than did N:Co 376 and N:Co 334; because of this and its high susceptibility to smut it is not recommended for the area and endangers the other two varieties named of which N:Co 376 is the one particularly recommended. N 52/219 also performed relatively well, and should be recommended for the northern areas of Natal.

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Time and intensity of flowering as influenced by certain temperature and photoperiod treatments. P. G. C. BRETT, R. HARDING and J. G. PAXTON. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 202–205. Flowering induction in a heated photoperiod house with initial daylengths of 12 hours 45 minutes or 12 hours 53 minutes combined with glasshouse treatment using constant artificial dawns and heating is reported. The shorter initial daylength gave best results; the longer daylength delayed flowering and also appeared to have an adverse effect on initiation. Temperature in the glasshouse treatment played an important role in tassel production.

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Some observations on the sugar cane selection programme in South Africa. R. S. BOND. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 206–208. Evidence from cane selection studies is considered in relation to the possibility of evaluation selection performance of different parental combinations by means of a cross assessment trial. The evaluation is based on an estimate of the mean estimated recoverable sugar content of the cross obtained from plots planted with original seedlings in a replicated layout. Crosses with an unsatisfactory assessment may be culled before entering the selection programme at the original seedling stage. The possible effect of adding a cross assessment stage to a selection programme is discussed in general terms.

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Investigations on sugar cane growth in relation to the climatic conditions of Uttar Pradesh. U. S. SINGH. *Sugar News* (India), 1975, **7**, (1), 43–48, 16.—A study of the effect of climatic conditions in UP on cane growth is reported, from which it is concluded that sudden drops in temperature, R.H. and rainfall are responsible for a relatively short growing period, which in turn inhibits stem elongation and thus gives poor potential cane yield.

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Planting operations. L. L. LAUDEN. *Sugar Bull.*, 1975, **53**, (21), 5.—General advice is given on land preparation and seed cane planting.

The effects of antibiotics and other antimicrobial agents on the ripening of sugar cane. L. G. NICKELL and D. T. TAKAHASHI. *Hawaiian Planters' Record*, 1975, **59**, 15–20.—Tabulated data from cane ripening tests involving more than 10 commercial Hawaiian varieties demonstrate the performances of a number of antibiotics, sulpha drugs and other antimicrobial agents. Those having high ripening activity compared with untreated controls were naramycin A, cycloserine, magnamycin, nystatin, streptomycin sulphate, rifamycin, novobiocin and neomycin sulphate.

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Sugar cane variety recommendations for Louisiana for 1975. ANON. *Sugar Bull.*, 1975, **53**, (22), 24–25. Recommendations given are based primarily on results of outfield tests. The characteristics of the varieties are briefly described and planting recommendations given for the different cane areas of Louisiana. It is stressed that all the varieties mentioned are susceptible to ratoon stunting disease and setts should therefore be heat-treated.

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Some varietal characteristics of the more important commercial varieties (in Louisiana). ANON. *Sugar Bull.*, 1975, **53**, (22), 26–27.—The advantages and disadvantages are given for CP 48-103, CP 52-68, CP 53-357, CP 61-37, L 60-25, L 62-96, L 65-69 and N:Co 310. A variety census is given for the major cane areas of Louisiana, showing the percentage distribution of each variety in 1975 as well as changes occurring between 1974 and 1975.

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Review of work conducted with sugar cane ripeners. R. JULIEN. *Rev. Agric. Sucr. Maurice*, 1975, **54**, 34–40. While "Ethrel" and "Racuza" have had no significant effect on cane sugar content or growth in three years of trials in Mauritius, "Polaris" has been found to increase sugar content and to inhibit growth, the response depending on variety, time of application, dosage rate and interval between application and harvest. While the tests have been conducted in April, July and September, it is pointed out that during November and December, cane in Mauritius (where the harvest extends from July to December) undergoes a drop in sugar content and it would be interesting to establish whether "Polaris" would maintain the sugar content at its optimum level at the end of the harvest period. For application, a helicopter would be suitable under Mauritian conditions, but the costs need to be assessed; as an alternative, a high-ride tractor could be used under certain circumstances. A bibliography of 41 articles on cane ripeners is appended.

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Sugar cane cultural practices and harvesting methods in Mexico. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 25–27.—Cane agricultural practices and machinery used in Mexico are briefly described.

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Importance of chemical weed control in Mexico's sugar cane crop. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 36–38.—Pre- and post-emergence herbicides and application methods which could be of value to Mexican cane growers are described and the situation in Mexico mentioned.

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Scope of intercropping in sugar cane in north India. R. S. KANWAR. *Sugar News* (India), 1975, **7**, (2), 5–8. Trials in 1972–73 and 1973–74 are reported in which sugar beet, wheat, potato and onion, raya (*Brassica juncea*) and toria (*B. compestria*) were grown as intercrops with autumn-planted cane. The maximum net income per unit area was provided by potato followed by onion (two intercrops); raya is suitable since it protects the young cane plants from frost and matures in March, when conditions favour a resumption of cane growth. Wheat, however, adversely affects cane. Briefer mention is made of research on intercropping with spring-planted cane.

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Sugar cane seed material. M. LAKSHMIKANTHAM. *Sugar News* (India), 1975, **7**, (2), 9–12.—A brief account is given of the nature and types of cane seed material, viz. top setts from mature cane, cuttings from immature cane, and sprouted setts (rayungans). Factors influencing germination are discussed and rapid multiplication of seed material by raising of short-period crops, e.g. extending from February to August, is described. Seed rates are given for various parts of India.

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"Polaris". L. L. LAUDEN. *Sugar Bull.*, 1975, **53**, (23), 4.—A warning is given that the financial rewards from the use of "Polaris" cane ripener may not come up to expectation; since considerable variation can occur in estimates of cane yields per acre and of cane sugar contents even where two cuts are made side by side in the same cane for sampling purposes, the grower could draw erroneous conclusions, and the author suggests awaiting the recommendations of the US Dept. of Agriculture and Louisiana State University.

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Sugar cane variety outfield experiments in Louisiana during 1974. C. A. RICHARD and M. J. GIAMALVA. *Sugar Bull.*, 1975, **53**, (23), 10–15.—Results of cane varietal trials on light and heavy soils are reported. For plant and ratoon crops on both types of soil, the outstanding commercial variety was CP 65-357, followed by CP 61-37 and CP 67-412.

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Nature of the ratoon stunting disease agent. A. G. GILLASPIE, R. E. DAVIS and J. F. WORLEY. *Sugar J.*, 1975, **38**, (4), 7–10.—See *I.S.J.*, 1974, **76**, 369.

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Sugar cane smut in Guyana. G. ARCENEAUX. *Sugar J.*, 1975, **38**, (4), 15.—Mention is made of the outbreak of smut in Guyana[1] which is regarded by the author as posing a serious threat to the Western Hemisphere, since the disease spores are wind-borne and a high proportion of cane grown is highly susceptible to the disease.

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Northern cane fields need major drainage schemes. R. H. BELCHER. *Producers' Rev.*, 1975, **65**, (8), 3–4. The pressing need for improved drainage on cane farms in the north of Queensland is discussed. Not only does efficient drainage increase cane yields, but it would enable an additional minimum of 5000 ha to be assigned to cane in the area in question. At a price of $A200 per metric ton of 94 n.t. sugar, it is calculated that $A16,000,000 is being lost annually on existing cane land through poor drainage, while a further $A11,000,000 is being lost in the form of non-utilization of potential cane land. Good drainage

[1] *I.S.J.*, 1975, **77**, 191.

also contributes to more consistent crops in wet and dry years and helps the farmer avoid delays in mechanical harvesting caused by wet weather.

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This plant cane harvester saves time, money. ANON. *Producers' Rev.*, 1975, **65,** (8), 17–18.—A modified 4-wheeled Crichton harvester used to cut plant cane on two Queensland farms and maintain supplies to the planters is described and illustrated. It is calculated that the machine will enable three men to plant unstripped cane on 6 acres per day.

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Easy pumping of "aqua" ammonia. ANON. *Producers' Rev.*, 1975, **65,** (8), 19.—A brief description is given of a pump for rapid transfer of aqueous ammonia fertilizer from farm storage tanks.

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Irrigation gives him higher yields. ANON. *Producers' Rev.*, 1975, **65,** (8), 35–36.—Details are given of the furrow irrigation system used by Mr. J. T. ELLIOTT on 51 ha of his farm in the Pleystowe region of Queensland which has enabled him to produce 10 tons more ratoon cane per acre than on non-irrigated farms in the area. The scheme permits 5 acres to be irrigated every 24 hours.

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Inhibition of sugar cane yields by high water table during the dormant season. C. E. CARTER and J. M. FLOYD. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 14–18.—Experiments are reported in which the water table was maintained at three different heights (12, 30 and 48 inches below the soil surface) during the growing season in plant and 1st ratoon crops and during both growing and dormant periods in 2nd and 3rd ratoon crops. Cane yields for the plant and for the 1st ratoon crops were similar, irrespective of water table level, the 12-inch level giving a slightly higher yield. On the other hand, where water was applied during both growing and dormant seasons, there were marked differences between yields, the lowest occurring with the 12-inch table and the greatest being with the 48-inch table. The same pattern applied to sugar yield, plant population and stalk weight. It is calculated that sub-surface drainage to reduce the water table level to below 30 inches would pay for itself in two years on the basis of the increased cane and sugar yield this would permit.

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Field valuation of sub-surface drainage for sugar cane in Louisiana. C. R. CAMP and C. E. CARTER. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 19–24. Preliminary analysis is made of tests on water table control with sub-surface plastic drainage tubing placed at various depths and varying distances apart in a silty clay loam. Results indicated that all depth × spacing combinations were satisfactory. A drain line covered with a spun nylon envelope to prevent clogging by sediment performed well, but further study and evaluation are needed. In all cases, the time between precipitation and accelerated flow from the drains was very short.

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Spring planting of sugar cane in Louisiana. H. P. FANGUY and G. T. A. BENDA. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 25.—Although cane is normally planted in Louisiana in the period August-December, planting may be inhibited by prolonged rain or early frosts. Experiments were therefore conducted on spring (March–April) planting of transplants (which needed considerable labour as well as greenhouse facilities and irrigation) and seed cane, both types of material giving good stands. However, even the highest yield obtained was well below yields obtained from autumn-planted cane; moreover, the practicality of spring planting is governed by availability and quality of seed cane, land preparation, weed control, weather conditions and the need for irrigation.

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Sugar losses from field mud. B. L. LEGENDRE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 26–29. Comparisons were made between milling extraction and sugar yield for cane accompanied by 0, 10, 20 and 30% mud by weight of cane. Results indicated that for each 10% increase in the mud content there was a 0·5% increase in cane fibre measurement, a 9·1% fall in juice extraction, a 0·7% decrease in juice sucrose content, a 0·5% decrease in juice purity and a 13·8 kg fall in 96 pol sugar per gross ton of cane (10·7 kg decrease per net ton).

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Maturity studies of sugar cane varieties in Florida. E. R. RICE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 33–35.—A two-year study of maturation patterns of six varieties showed important varietal differences in the estimated 96 pol sugar yields on the five sampling dates (the 1st of each month from November to March inclusive). All varieties averaged more sugar on all sampling dates in the 1st ratoon crop than in the plant cane crop.

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Evaluation of the effect of "Glyphosine" on sugar cane maturity. J. J. CHEN and J. C. P. CHEN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 42–49.—Trials with "Glyphosine" ("Polaris") are reported in which the ripener was applied to plant cane of L 60-25 and L 62-96 varieties at 2·5 and 3·5 lb per acre on 18th September and 3rd October. Sampling of the cane and juice analysis were carried out each week after application. The sugar content of both varieties reached a maximum 41 days after the earlier treatment, whereas no significant peak was observed with the later application. L 62-96 appeared to respond to treatment better than the other variety. At 3·5 lb per acre, "Polaris" caused maximum increase in cane sugar content and in sugar yield from 2·749 to 2·983 tons per acre. Desiccation of the cane leaves, inhibition of terminal growth and development of side shoots were observed, these characteristics being more usual in the early-treated rather than the late-treated cane. Ratoon growth in areas of poor drainage was delayed by the treatment.

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Loss of sugar by leaves of sugar cane and related grasses. J. E. IRVINE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 50.—Guttation water exuded from leaves of "Rio" sorghum was dried and the residue analysed by gas-liquid chromatography to reveal the presence of dextrose, levulose and sucrose. Dew collected from cane varieties also contained the three sugars. The quantities were greater in varieties with horizontal rather than vertical leaves, and horizontal leaves contained more dew. The leaf sheath margin on *Pennisetum* hybrids also yielded the same three sugars.

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Containerized cane handling. J. GIARDINA. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 51–53. Details are given of a cane transport system involving use of 10-ton containers, which are hauled, one at a time, on a trailer chassis to a transload station located within ½–1 mile of the fields. At these stations the containers are transferred by a fork-lift unit to a flat-bed trailer (able to carry two containers) for transportation to the factory, where they are emptied directly onto the feeder table or stored (by means of a fork-lift truck) for night crushing of the cane.

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The molasses-producing ions in Florida sugar cane juices. R. P. DESTEFANO. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 55–60.—The potassium, calcium and chloride contents in juice from a number of varieties grown in Florida were determined and found to differ widely between the varieties. Growth factors, e.g. fertilization, weather and soil type, were also found to affect the levels.

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Controlled photoperiodism in basic sugar cane breeding. P. H. DUNCKELMAN and M. A. BLANCHARD. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 80–85. The application of photoperiod control to induce simultaneous flowering of breeding stocks at Houma, Louisiana, is reported. From the successes obtained in these first trials, it is thought that the basic breeding programme will be expanded to provide basic germplasm for improvement of commercial cane varieties in the US.

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The genetic behaviour of resistance to lodging in sugar cane: methods of classification of clonal plots. H. P. VIATOR and M. T. HENDERSON. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 86–90.—Classification of cane varieties for their lodging characteristics based on five visual categories did not adequately differentiate between certain varieties according to their known habits, did not closely relate the erectness classes to the degree of harvestability of the plots, and did not permit recognition of differences between clonal plots in the percentages of stalks that were severely lodged. A new method of classification was therefore devised and tested; in this system, a visual estimate was made of the percentage of stalks lodged in each plot (lodging being defined as a slope from the vertical of at least 45°). The new system proved to be as rapid and simple as the earlier one while eliminating the snags mentioned above. It was observed that the lodging of virtually all severely-lodged stalks was due to failure of the root system to provide adequate support or to root lodging, rather than to bending of the stalks.

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Comparison of 2-stage selection schemes in sugar cane. N. I. JAMES and J. D. MILLER. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 91–96.—A six-year study to determine the efficiency of four possible two-stage selection schemes in a population of 376 cane clones is reported. The cane was grown as plant and ratoon crops of seedlings and in clonal plots measuring 1·2 m; all four combinations were tested for stalk number, stalk diameter and Brix. Selection for these three factors was found to be more efficient in the plant crop of seedlings than in the ratoon crop, while it was about the same for the two clonal plots. The average performance of plant and 1st ratoon crops in plots of two 4·6-m rows was also determined for each factor to show the gain from selection for each population with year-to-year variation eliminated. While stalk number repeatability was low, stalk diameter repeatability was higher; Brix repeatability was not as high as that of stalk diameter, and the gain from selection for this factor was relatively low, being about half that for stalk diameter and number.

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Radio-sensitivity and selection for mosaic-resistant variants in sugar cane. R. D. BREAUX. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 97–100. The radio-sensitivity of ungerminated buds of nine mosaic-susceptible cane varieties to gamma irradiation from ^{60}Co was measured. Normal plants predominated in all varieties in a greenhouse test after 2·5 and 5·0 Kr irradiation, and in two varieties after treatment with a dosage of 7·5 Kr, whereas survival as normal plants was below 10% in most of the varieties after a dosage of 10·0 Kr. More than 500 sub-clones of variety CP 65-357 (susceptible to strain H of mosaic) from irradiated single-eye cuttings were planted in alternate plots with N:Co 310 which was heavily infected with mosaic. Of the sub-clones, 56 were found to be free from the disease in the autumn; however, by the following spring, all were infected, indicating that most had been escapes. One sub-clone was found to be more mosaic-resistant than CP 65-357, but preliminary analyses indicated that its juice quality may be inferior.

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Bacterium associated with ratoon stunting disease. A. G. GILLASPIE and J. F. WORLEY. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 101.—See *I.S.J.*, 1974, **76**, 369.

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Field planting of sugar cane hot water-treated for sugar cane mosaic and ratoon stunting disease control. G. T. A. BENDA. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 102.—The tolerance to heat required for mosaic and RSD control can be increased by exposing cuttings or whole cane stalks to a series of hot water treatments at daily intervals, most infected buds being cured by 20 minutes' treatment at 52° (pre-treatment), 57·3° and 57·3°C, respectively, during a 3-day period. Longer treatments are required for certain combinations of mosaic virus strains and cane varieties. The survival of buds on heat-treated stalks which are 6–9 months old is favoured by allowing the live sheaths to cover the buds, harvesting the stalks 1–5 days before treatment, avoiding temperature and humidity extremes before and between treatments, promptly planting the treated material, and adjusting the pre-treatment period for heat-sensitive varieties. Stubble cane seemed to survive treatment better than did plant cane, although shoots from cured buds can become re-infected by mosaic. If a diseased shoot from an uncured bud is on the same seed cane piece, the virus may spread through the cane after planting. To reduce the chances of re-infection, immature nodes (which generally survive treatment uncured) should be discarded, and shorter rather than longer cuttings should be planted.

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Greenhouse control of three sugar cane seed piece pathogens with thiophanate methyl. S. M. YANG and F. SEABERG. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 103–107.—While only 10% of single-node seed pieces germinated when potted in soils infected with red rot (*Colletotrichum falcatum*), black rot (*Ceratocystis adiposa*) and pineapple disease (*C. paradoxa*), more than 80% of similar seed pieces germinated after immersion in 0·7% a.i. thiophanate methyl (TPM) suspension for 10 minutes and planting in infected soil. More than 75% of such seed pieces, treated with TPM and immersed in spore suspensions of the three pathogens together or alone, germinated after planting in steamed soil, compared with less than 40% untreated seed pieces. Whole stalks were harvested from plants growing in pots drenched once with 0·28% a.i. TPM 2, 4 and 6 weeks before harvest. These were inoculated separately with the three pathogens. While these did not spread from the inoculation sites, they did spread in untreated stalks. More than 90% of the seed pieces obtained from plants in drenched pots germinated, whereas less than 20% of those from untreated pots germinated in potted soils infected with the three pathogens together.

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Mass screening of sugar cane selections for eye spot resistance. J. L. DEAN and J. D. MILLER. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 108.—Outbreaks of eye spot in variety CP 57-603 have emphasized the need for eye spot resistance in commercial varieties in southern Florida. To obtain the desired agronomic characteristics, breeders must use susceptible parents and discard susceptible progeny. In order to increase the efficiency of a breeding programme, the screening of the progeny must be carried out in early selection stages when the populations are high, thus necessitating use of mass screening methods. One such method at Canal Point involved dispersal of inoculum over field cane from a tractor-mounted power sprayer in two successive winters. While conditions were highly favourable in the first but not the second winter, disease development and classification of clones for eye spot resistance were adequate in both years. Inoculation was done at night in order to take advantage of dews and higher relative humidity which promote infection. Blackstrap molasses (5% by volume) added to the inoculum substantially increased infection.

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The effect of number of cultivations on sugar cane production in Louisiana. R. J. MATHERNE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 109–112. Six trials are reported which were carried out over nine years to determine the effect of number of post-planting cultivations on cane yields. It was found that yields were good, regardless of the number of cultivations, where the fields were in good condition and not heavily infested with Johnson grass; but where infestation was heavy, frequent cultivation increased yield. In all fields, weed infestation gradually increased with less than three cultivations; lodging was generally greater and harvesting more difficult with only one or two cultivations. The optimum appeared to be three or four cultivations.

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A review of sugar cane borer control in Louisiana. S. J. VIATOR. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 113–114.—The borer *Diatraea saccharalis* is the most destructive cane pest in Louisiana. Information is given on the chemical control system used as well as details of the borer's seasonal history and morphology. The number of insecticide applications has been reduced, and averaged 1½ in 1973. Weekly field surveys are now recommended and only cane having at least 5% infestation (considered the economic injury threshold) is treated; this allows varietal resistance, climatic conditions and predators to play their part.

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Sand land sugar cane. G. DODGEN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 115.—Mention is made of the results of a trial crop of cane on sandy land in Florida; yield was 46·6 tons per acre, and sugar content averaged 14·5%. Ratooning appeared to be satisfactory with all varieties.

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Evaluation of sugar cane harvester components by use of high-speed photography. J. E. CLAYTON. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 116–119. See *I.S.J.*, 1975, **77**, 145, 209.

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Mechanical harvesting at the Glades County Sugar Growers Cooperative Association. G. THOMAS. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 120–122. Results of mechanical harvesting, first used in 1972–73, are reported and future plans discussed. It is concluded that the Massey-Ferguson 102 will harvest cane satisfactorily under most of the field conditions encountered.

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Green and burned sugar cane: a harvest comparison. J. R. ORSENIGO. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 123.—Comparison between the effects of harvesting burnt and green cane showed that green cane harvesting caused appreciable increases in man-hours and trash received at the factory, and considerably reduced the capacities of the continuous loaders, infield transport and factory transport. There was no significant difference in juice quality between burnt and green cane.

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Aerial application results of "Paraquat" to hand- and machine-cut sugar cane harvested by United States Sugar Corporation. J. W. BEARDSLEY. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 124.—Mention is made of aerial application of "Paraquat" dichloride as a foliar desiccant to cane. A number of factors have been evaluated as a guide to the effectiveness of the treatment.

* * *

A short-billet, continuous-feed sugar cane planter. W. S. BOOTS. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 152–153.—Details are given of a cane planter which plants two rows of short-billet cane simultaneously; a number of them have been used, and preliminary conclusions drawn on their performance. Problems yet to be overcome are mentioned.

* * *

Double-drill planting of sugar cane in Louisiana. S. RODRIGUE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 181.—The experience gained in mechanical harvesting of cane planted in two drills 30 inches apart on 7½-ft rows is briefly described. While yield was increased by 14% over that obtained by single drilling on 6-ft rows, there are a number of problems to be overcome, and these are listed.

Sugar beet agriculture

Topping—why? ANON. *Die Zuckerrübe*, 1975, **24**, (5), 14.—The adverse effect of beet crowns on factory processing makes it necessary to top beet correctly. Since it has been found that crowns contain 6·2–7·8% sugar while the complete beet contains 15–18%, poor topping will reduce the delivered beet sugar content to an excessive degree; on the other hand, crowns contain a much greater proportion of K and Na (which are highly melassigenic), noxious N and invert sugar, so that their removal is warranted. Mechanical sources of certain specified disorders in topping are briefly examined.

* * *

Effect of pile covering on weight and sugar shrink in pile rims. W. R. AKESON, E. L. STOUT and S. D. FOX. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 108–115. It has been found that beets deteriorate as a result of dehydration and alternate freezing and thawing in the outer 2–3 ft of storage piles in the western USA. Studies conducted during two years in Colorado during which beets were stored for 26, 49 and 71 days showed that covering the piles with woven polypropylene or straw reduced weight and sugar losses which otherwise were considerable around the rim on all sides of the pile, e.g. more than 40% of the total sugar loss in unprotected piles occurred in the outer 2 ft. Lowest losses occurred when 6-inch layers of straw covered the sides and a 2-inch layer covered the top (a greater thickness than this on the top was found to raise the temperature in the pile and thus increase losses).

* * *

Reduction of sugar loss in sugar beet piles with straw and plastic covering. W. R. AKESON and S. D. FOX. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 116–124. Beet storage tests at a number of locations during 1969–73 are reported. Tabulated results show that protection with 6-inch layers of straw on the side and 1–2 inches of straw on the top of the piles gave the most satisfactory results in terms of weight and sugar loss reduction (approximately 20% for both factors) compared with unprotected piles. The straw also reduced the fall in purity and invert sugar formation. Woven polypropylene covering reduced losses under some conditions, but caused freezing and thawing in the interior of the pile.

* * *

Effect of topping procedure on beet quality and storage losses. W. R. AKESON, S. D. FOX and E. L. STOUT. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 125–135. In 3-year investigations to determine the effect of topping on beet storage and processing properties, beets which had their leaves removed by flailing but remained untopped lost 12% less sugar during storage than did topped beets, while beets with half the crown removed lost as much as or more than the normally topped beets. While sugar yields per acre would be increased by harvesting without topping, sugar factory performance would suffer, and further studies are considered necessary in order to determine whether the increased factory costs would be offset by the additional income resulting from reduced storage losses.

* * *

From research results to field performance—why the gap? B. B. FISCHER, L. M. BURTCH and R. D. KUKAS. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 136–141. The authors complain that, despite successes in experiments with herbicides used for control of various weeds, many beet fields are so infested with weeds that the beet plants cannot be seen. Why growers should be reluctant to apply results of research work in normal field operations is discussed, and ways in which the authors consider the gap can be closed are examined.

* * *

Search for causative agents of the sugar beet yellow wilt in Chile. C. URBINA-VIDAL and H. HIRUMI. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 142–162. Electron microscopic studies of beet yellow wilt revealed mycoplasma-like organisms (MLO) as well as elongated virus-like particles associated with characteristic inclusions—all of which were absent in healthy plants. It was considered highly probable that the MLO were largely responsible for the disease, while the presence of the virus-like particles suggested a complex disease etiology. Long filamentous particles, morphologically resembling the beet yellows virus, were found in both yellow wilt-infected and apparently healthy beets. It is therefore concluded that the yellow wilt-infected plants may also have been infected with a type of beet virus yellows.

* * *

The effect of ammonic-N or nitrate-N dominated fertilizer programmes on the nitrogen and sucrose content of sugar beet tissues and yields of sugar beets. W. A. DICKINSON. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 163–181.—The effects of ammonia-N fertilizers were compared with those of nitrate-N fertilizers as regards beet sugar content, brei nitrate-N content, the average N content of petioles and roots, and beet yields. Results tended to show no significant differences as a result of the fertilizer differences. The possibility that erroneous conclusions have been drawn concerning the significance of petiole and brei nitrate-N in relation to sugar content is examined, and it is suggested that the problem arises from the ease with which nitrate-N can be determined while yet representing only a portion of the total N content, and it may be N constituents other than nitrate which are responsible for the drop in sucrose. Analysis for "other-N" in roots is considered to give a more accurate picture of the sucrose-nitrogen relationship, although such analysis is more laborious, time-consuming and costly.

Predicting sugar beet storage losses using regression analysis. M. G. Barnes, W. R. Akeson and N. Pence. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 182–185.—Multiple linear regression analysis was used to establish independent variables which have greatest effect on beet storage losses. Equations were then derived by using each variable with as many as possible of the other variables in all combinations which did not include inter-correlated variables in the same equation. The equations were then compared and the one with the highest multiple R-square became the "predictor" equation for estimation of beet weight and sugar losses. The method was applied to beets stored in different geographical regions of the USA. Predicted values made at the end of the harvest in 1972 were close to actual losses.

* * *

Infrared aerial photography estimation of yield potential in sugar beets exposed to blackroot disease. C. L. Schneider and G. R. Safir. *Plant Disease Reporter*, 1975, **59**, 627–631.—Infrared aerial photographs of a field belonging to the Michigan Agricultural Experiment Station (USA) were intended to correlate photographic estimates of relative foliage density with ground-based estimates and with yield determinations for a number of beet varieties exposed to blackroot but differing in resistance to the disease. The techniques used are described and results obtained are reported. The photographic estimates of foliage quantity correlated highly with pre-harvest visual estimates of foliage vigour and quantity and with root yield measurements.

* * *

Effect of different dates of sowing and harvesting on the yield and quality of different varieties of sugar beet. S. Singh, L. K. Bishnoi, S. S. Narwal and C. N. Babu. *Indian Sugar*, 1975, **25**, 125–127.—Trials in Haryana showed that beet seed sowing in the 1st to 3rd weeks of October was optimum in terms of yield, while the sucrose content was not noticeably affected by differences in sowing date between 20th September and 20th November. Varietal differences were considerable as regards yield but not sucrose content.

* * *

The adverse effect of excessive doses of nutrients on sugar beet emergence, population and processing quality and on soil structure. I. Gutmański. *Gaz. Cukr.*, 1975, **83**, 208–213.—Tests conducted during 1969–73 are reported in which N, P and K as well as specific micronutrients (particularly Mg) were applied at normal rates and at rates well in excess of requirements as determined by soil analyses. From the results it was generally concluded that excessive fertilization adversely affects both soil properties and beet processing quality, and that these effects tend to outweigh any advantage of higher plant population, should this occur.

* * *

Nitrogen fertilization of sugar beet according to location and fertilizer requirement prediction. C. Winner. *Zucker*, 1975, **28**, 563–572.—A survey is presented of the various methods available for evaluating soil nitrogen which may be available to the plant as a basis for determining nutrient requirements. The effects of soil type and weather conditions on N behaviour in the soil are examined and the nitrogen cycle is explained. Comparison between (i) N application in the spring, and (ii) one-third ploughed-in during the preceding autumn and the rest applied before sowing in the spring has shown differing results in terms of beet yield, the trials covering the period 1968–69, 1971–72 and 1974.

* * *

Advice on harvesting and frost precautions. A. Vigoureux. *Le Betteravier*, 1975, **9**, (91), 6–7.—Advice is given on topping and on recovery of the tops, which should not be allowed to remain too long in the field before ensilage, since this reduces their fodder quality. The leaves should be piled as quickly as possible and covered with plastic sheeting. For adequate frost protection of beet clamps it is recommended to make the clamps low and wide, and cover them with 0·1-mm plastic sheeting as soon as frost is imminent. Frozen beet should not be re-covered, but the clamps should be uncovered as soon as a thaw occurs. The clamp should be sited so that one end faces the direction from which the coldest winds blow, thus leaving the major side surfaces less exposed.

* * *

Genetics and modern methods of sugar beet selection. J. Christmann. *Ind. Alim. Agric.*, 1975, **92**, 721–728. The production of polyploid monogerm beet seed and the advantages this has brought in beet breeding are explained. It is pointed out that in 1975 more than half of the beet grown in France consisted of monogerm varieties, most of which were offspring of commercial triploid seed obtained from male-sterile monogerm diploids pollinated by a fertile multigerm tetraploid line.

* * *

Effect of plant population on beet yield and processing quality. L. Schmidt, R. Železný and R. Bureš. *Listy Cukr.*, 1975, **91**, 169–174.—Investigations during 1971–74 showed that, of a beet plant population in the range from $<$50,000 to $>$85,000, that above 85,000 gave the highest beet yield and white sugar recovery, while 80,000–85,000 was optimum for sugar yield. While high inverse correlation was found between plant population and α-amino-N, correlation between population and ash content was poor. High correlation was also established between population and sugar content.

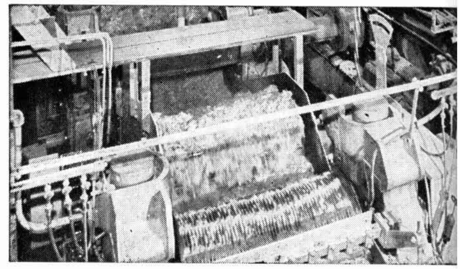
* * *

Investigations on a population of ***Cercospora beticola*** **Sacc. tolerant to "Benomyl".** V. d'Ambra, S. Mutto and G. Caruba. *Ind. Sacc. Ital.*, 1975, **68**, 91–93. Laboratory investigations of a population of *C. beticola* not controlled by "Benomyl" sprays showed that the tolerance was real and that there was a statisally different behaviour of monoconidial isolates of the fungus. All the isolates were also tolerant to thiophanate methyl to a degree higher than to "Benomyl", but were sensitive to both "Maneb" and triphenyl tin acetate.

* * *

Sugar beet fertilization. Anon. *Le Betteravier Franç.*, 1975, **45**, (283), 15–18.—Advice is given on establishment of a fertilizer programme for beet. Optimum quantities of N, P and K are discussed, and views of various authors quoted. Selection of N-P-K formula and method of application are also discussed. The article covers farmyard and green manure, dry and liquid fertilizers.

Cane sugar manufacture



Sucrose loss in diffusion with reference to thermophilic bacteria and lactic acid. L. McMastey and A. B. Ravnö. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 49–52.—Investigations of sucrose degradation by hyperthermophilic bacteria in cane diffusion showed that lactic acid was the major organic acid formed and that, as in beet diffusion, the ratio of sucrose destroyed to lactic acid produced was 2:1. Lactic acid contents and bacterial counts were generally higher when the diffusion temperature did not exceed 75°C. Formalin was found to be an effective method for controlling bacterial activity.

* * *

Some aspects of flocculant use in clarification and filtration. J. P. Murray and G. S. Shephard. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 53–58. Studies on the effect of flocculants on juice clarification and filtration showed that optimum choice of flocculant can be established by relating the correlation between zeta-potential and pH of the juice system to the degree of hydrolysis of a given flocculant. The performances of "Talosep A3", "Talosep A5", "Superfloc A110", "Superfloc A130" and "Superfloc A150" (all partially hydrolysed polyacrylamides) were determined in batch tests and found to vary widely according to the juice, although all improved clarification compared with the absence of flocculant. The flocculants also improved mud filtrability; it was found that those which have a degree of hydrolysis which is greater than that required for optimum settling may give better juice clarity and superior mud filtration. The less negative the juice zeta-potential the better was mud filtrability and the lower was the degree of hydrolysis required for optimum filtrability. However, results also showed that the zeta-potential may change markedly, necessitating a reassessment of flocculant required for optimum clarification.

* * *

The effect of low juice purities at Darnall on boiling house capacity. R. D. Archibald and I. A. Smith. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 63–73.—Cane processing at Darnall in 1974/75, when drought caused the non-pol content to rise at times to almost 1½ times average values, is reported. Despite the inferior cane quality, the factory maintained high throughputs. The performance of the boiling house is discussed, and details are given of various measures adopted which permitted maintenance of high loads. While high flexibility of the pan station made a good contribution, the continuous *C*-centrifugals were of particular value. Estimates of maximum pan station capacity agreed closely with actual results.

* * *

Friction loss and heat transfer coefficient in finned tube heat exchangers for reheating massecuites. E. E. A. Rouillard. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 74–79.—Equations developed for prediction of the friction loss in packed columns are applied to calculation of friction loss and heat transfer in finned-tube massecuite reheaters and calculated results compared with actual values obtained in reheaters at different South African factories. From the studies it is concluded that heat transfer rates in exchangers with the tubes staggered are higher than those with the tubes in line, while friction loss was the same in both types.

* * *

Increased capacity of continuous centrifugals on low-grade massecuite. M. A. J. McEvoy and R. D. Archibald. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 80–85.—Details are given of modifications to continuous BMA K850 low-grade centrifugals. Test results showed that the modified machine handled approximately twice the quantity of massecuite of the normal machine with a molasses Brix 2–3° lower than from the standard centrifugal; however, molasses average purity was 0·1 units higher with the modified machine. At a throughput of 4 tons of massecuite per hour (compared with about 1 $ton.hr^{-1}$ for the standard K850 and 2½ $tons.hr^{-1}$ for the modified K850), a prototype BMA K1100 machine gave about the same molasses purity as the standard K850, while Brix averaged 4·7° lower.

* * *

Some aspects of bulk storage of VHP sugar in Durban. Z. J. Kimmerling. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 103–106.—Investigations of the effects of stored very high pol (VHP) sugar on silo temperature and relative humidity at Durban terminal are reported. A difference between the outside R.H. (80%) and that inside the silo (60%) was considered possibly a result of sugar dehydration in the absence of ventilation; the R.H. curves for the outside and interior of the silo had similar profiles. The stored sugar formed a superficial crust within 5–10 days; this appeared to protect the pile from further humidification and deterioration. The moisture content of the crust was of the order of 0·20% (occasionally rising to above 0·50%) compared with 0·10% in the sugar. Occasional condensation in the silo, which lasted for 12–18 hours and was followed by rapid drying, was attributed to abnormal weather conditions and sharp fluctuations in the R.H. outside and inside the silo. Problems created by excessive dust content in sugar delivered to the terminal are discussed, and measures described which resulted in delivery of "dust-free" sugar.

* * *

Engineering steel chains for conveying and power transmission. C. G. Wildsmith. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 107–110.—Various aspects of conveying chains are discussed by a representative of Ewart Chainbelt Co. Ltd., including the main types of cast malleable and steel conveying chains available, conveyor chain selection, chain life, factors of importance to the factory engineer (chordal action, catenary effect and shock loading), types of wear, materials used in sprocket manufacture and latest developments, particularly the "Cobra" (carrier outboard roller assembly) conveyor manufactured by Ewart. How to minimize problems associated with conveying is explained, and brief mention is made of conveyor chain standardization and slat clearances. The four main types of chains available for power transmission are listed and briefly discussed.

* * *

Pulverized coal firing of small boiler plant. A. G. HURTER. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 111–114.—Advantages of pulverized coal firing coupled with pneumatic firing of bagasse are discussed. Properties of pulverized coal, its storage and conveyance are described and a flow diagram is given of a typical scheme for pulverizing the raw coal and feeding it to the boiler. It is stressed that the success of such a system is largely determined by the feeder, and a system is described which delivers the coal-air mixture at a steady rate and a pressure above atmospheric. Burner operation is briefly examined, while the question of dust separation is treated in more detail. Tests on clay particles averaging 0·7 μ have indicated that a packed tower system could remove 99% of the dust produced in pulverized coal firing. The major argument against the introduction of pneumatic firing of bagasse has been the high moisture content, but it is considered that use of preheated air as the conveying/primary air could reduce the moisture content by about 2% per 60°C of air preheat lost in the drying zone. A two-stage air preheating scheme could be applied.

* * *

Some effects of cane trash on milling quality of sugar cane. B. L. LEGENDRE and J. E. IRVINE. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 167–173. The effects of trash on a number of factors were investigated. Results showed that bagasse and fibre % cane increased significantly with the trash content while normal juice extraction, sucrose content and purity fell. Sugar yield per ton of cane also fell with increase in trash content. Green tops caused a reduction in the dextrose:levulose ratio, while dry trash had little effect, although the ratio fell further with overall increase in trash. Differences were found between green tops, dry trash, a mixture of these, and wet trash as regards their effects on the above factors; wet trash had the most serious effect on sugar yield per ton of cane, dry trash had the smallest effect, while green tops on their own or mixed with dry trash had roughly the same effect. Maceration water led to a recovery of sugar that would have been lost in cane trash and greatly increased normal juice extraction from samples, whether trash was present or not; sucrose in normal juice was unaffected by increased levels of maceration water, whereas purity fell significantly with increase in the water.

* * *

An improved system of heating massecuites and like viscous substances. J. P. MUKHERJI, A. C. CHATTERJEE, S. S. GANGAVATI, C. S. SUNDER and P. D. KAMBUJ. *Sugar News* (India), 1975, **7**, (1), 23–28.—Trials in which massecuite was reheated with evaporator bleed vapour in a pugmill (provided with a rotary helical element) feeding a battery of continuous centrifugals showed that the heating was uniform along the trough; an increase of 8–10°C in the massecuite temperature was rapidly obtained (from an initial 40–44°C) and heat transfer was greater than in conventional reheating with water.

* * *

Cooling and reheating of *C*-massecuite for better exhaustibility of final molasses both in continuous and batch-type crystallizers at Bhogawati. V. R. R. BHONSALE. *Sugar News* (India), 1975, **7**, (1), 29–34.—The boiling and cooling of *C*-massecuite at this Indian factory, which has both batch and continuous crystallizers, are discussed in relation to centrifugal performance and final molasses exhaustion. Tabulated data for 1973–74 show that molasses purities from the batch crystallizers were somewhat higher and the glucose:ash ratios lower than from the continuous system.

* * *

Review of performance of sugar factories in 1974. J. T. D'ESPAIGNET. *Rev. Agric. Sucr. Maurice*, 1975, **54**, 62–69.—The performances of the 21 Mauritius sugar factories in 1974 are reviewed. Among the items mentioned, cane preparation is shown to compare unfavourably with results obtained in South Africa. A 743 m^2 heating surface semi-Kestner evaporator used as 1st effect in a quadruple-effect evaporator (with two identical vessels in parallel as 2nd effect having the same 418 m^2 of h.s. as the 3rd and 4th effects) has contributed to trouble-free operation with higher rates of evaporation than with the previous arrangement. Difficulties in conditioning 40-mm sugar crystals produced in a Fives-Cail Babcock continuous vacuum pan led to the decision to produce 60-mm crystals which could be easily dried in the centrifugals; batch vacuum pans were used to build up magma crystals to about 0·35 mm, after which final crystallization took place in the continuous pan. By using low-pressure steam for 30 seconds in the centrifugals, it was possible to produce raw sugar averaging 0·45–0·50 mm to meet export standards, and it is thought possible to abolish the use of the batch pans and operate the continuous pan at a higher massecuite level to increase retention time and produce the desired 0·50-mm crystals. Two-massecuite boiling has been and is being adopted at most of the factories although, at one, the 2-massecuite scheme was replaced with a 3-massecuite system when boiling of low-purity 1st massecuites led to considerable increase in boiling house losses.

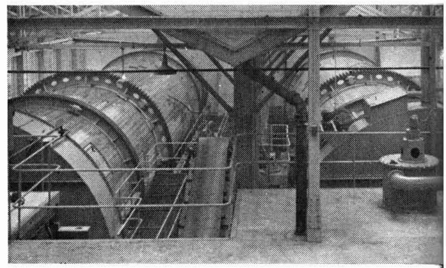
* * *

The expanding Mexican sugar industry. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 21–23.—A brief survey is given of the Mexican sugar industry, with mention of new factories, particularly Ingenio Benito Juárez (of which some illustrations are presented) and Alvaro Obregón, which is the pilot project for four other factories to be built in the south of the country.

* * *

Study on cane sugar extraction. M. BEAUVISAGE. *Ind. Alim. Agric.*, 1975, **92**, 761–764.—Four methods of extracting sugar from cane are described and their advantages and disadvantages examined. They are: conventional milling, diffusion, alternate bagasse pressing and imbibition, and a proposed method involving a conventional mill followed by two stages each of lixiviation and milling with recycling of juice and imbibition with water at the last mill.

Beet sugar manufacture



The hydrodynamics of sugar solutions crystallized in a fluidized bed. E. E. SHUMSKAYA and V. D. POPOV. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 29.—From tests on fluidized bed crystallization, an equation has been derived for calculation of crystallization rate in terms of crystal size, kinematic viscosity and density of solid and liquid phase.

* * *

A study of the durability of sugar factory equipment components toughened by plastic deformation of the surface layer. B. M. ZINKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 30–31.—Strain hardening as a means of increasing component wear resistance, particularly in the case of moving parts, is discussed and reference made to tests in which the two methods considered the simplest and most effective (rolling and jet blasting) were investigated. Results showed that both methods increased wear resistance by 15–20%.

* * *

Friction losses in air-massecuite streams. YU. G. ARTYUKHOV and V. T. GARYAZHA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 31–32.—Friction losses in the ascending branch of a steel tube circuit were determined in tests in which massecuite Brix, crystal content and flow rate were varied as well as air flow, operating temperature and circulation conditions (natural or forced). Results showed that pressure loss due to friction of an air-massecuite mixture is given by $\frac{\Delta P_0}{(1 - \varphi)^2}$ where ΔP_0 is pressure loss due to friction when there is no air flow and φ is the true air content.

* * *

Phase rates of air-massecuite streams. YU. G. ARTYUKHOV and V. T. GARYAZHA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 32.—A mathematical relationship has been derived for calculation of the true air flow rate in vertical massecuite streams.

* * *

Boiler and feed water treatment for sugar factories. G. POHLE. *Zucker*, 1975, **28**, 482–491.—After a brief look at boiler pressure ranges and fuels, the author discusses the purity requirements of feed water for boilers of up to 64 bar pressure and for boilers of greater pressures than 64 bar. The use of condensate as make-up water is examined, with particular mention being made of the organic components in it and the effects they can have in a sugar factory. Factors governing the choice of raw water treatment are: water composition, boiler type and pressure, and treatment costs. After summarizing the various processes applicable to surface and to underground water, the author deals in greater detail with multi-stage complete desalinization processes and gives some information on resin regeneration costs as well as quantities and composition of waste water from both co- and counter-current processes. The article concludes with descriptions of feed water deaeration processes (both thermal and chemical) and with a warning on the need for boiler protection after the end of the campaign.

* * *

Gas and dust emissions from sugar factories—technical possibilities of reducing emission with reference to local regulations. H. SMIDT. *Zucker*, 1975, **28**, 491–499.—Types of sugar factory emission and means of reducing it are discussed against the background of legal requirements in West Germany. The major source of gaseous emission is the boiler plant, and the author discusses the ranges of levels of sulphur dioxide, nitrogen oxides and hydrogen fluoride found in boiler smoke from a sugar factory slicing 5000 tons of beet a day. Pulp dryer emission contains the same components as boiler flue gas plus others, such as organic compounds, which are odoriferous. The nature of dust emission from boilers will depend on whether they are fired with solid fuel or with oil. Typical fly-ash particle sizes originating from solid fuel are indicated as well as flue gas dust contents. Flue gas from oil-fired boilers contains three types of solids: fly-ash from incombustible components, soot formed by hydrocarbon separation during gas phase combustion, and coke from cracking processes taking place during evaporation and combustion of the oil droplets. The major part of the fly-ash is formed by vanadium, while other heavy metals, alkali and alkaline earth metals are responsible for a minor proportion. Complete elimination of gaseous emission is impossible at the present level of technology, and the only means of reducing the level is to build suitably high stacks. The SO_2 level can be reduced by burning solid fuel or oil of low sulphur content. Multi-cyclones are of value in reducing the dust emission from pulp dryers. Soot blow-off creates problems with boiler emission control, but with normal boiler operation compliance with the law is not difficult. Mention is made of smell reduction by dilution with air (using a sufficiently high stack) and of detecting any such reduction (by organoleptic tests undertaken by a panel of 10 people, it is suggested). Quantitative determination of the "odour load" by measurement of the total carbon content in emission is explained in an appended discussion. Also mentioned is the measurement of SO_2 in flue gas and a suitable height of stack for SO_2 dilution.

* * *

The beet flume line. O. BÖHM. *Listy Cukr.*, 1975, **91**, 158–162.—The number of days lost in transfer of beet from the pile to the factory, i.e. the difference between normal working and reduced working of equipment as a result of excessive quantities of

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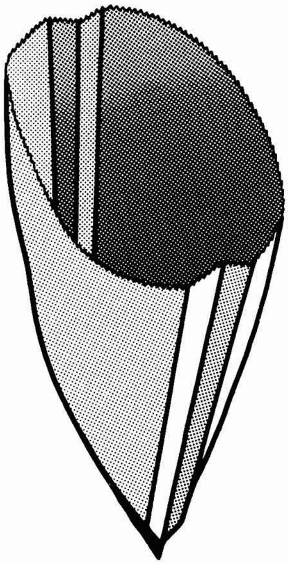

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extraneous matter, has been calculated for the Czechoslovakian sugar industry. By far the greatest loss is experienced with the beet elevator; this is double the loss for the next piece of equipment, viz. the beet pump. The author describes equipment which he considers most suitable for handling beet and gives advice on selection. Brief mention is also made of modern beet washers, including the RT reciprocating bed-type[1].

* * *

New spray for beet discharge from vehicles. S. DUŠEK. *Listy Cukr.*, 1975, **91**, 162–166.—Details are given of a new Czechoslovakian beet discharger which comprises a central control tower provided with a water nozzle on each side, so that high-pressure water can be directed down onto the beet in rail trucks or road vehicles so as to unload them.

* * *

Production of lime and CO_2 in the sugar industry. I. SUÉ. *Sucr. Belge*, 1975, **94**, 345–352.—See *I.S.J.*, 1976, **78**, 55.

* * *

Experience in operation of Alma-Ata sugar factory. T. YA. SHALIMOVA, R. YA. GERASIMOVA and S. P. MARTIROSOVA. *Sakhar. Prom.*, 1975, (8), 8–9.—The introduction of a horizontal pre-liming tank and adoption of simultaneous liming and carbonatation at Alma-Ata has helped improve juice purification efficiency and white sugar quality, even when substandard beets are processed. The juice purification process used is outlined and some performance figures given for 1973/74 and 1974/75.

* * *

Change in nitrogenous substances and pectins during juice purification. K. P. ZAKHAROV, R. G. ZHIZHINA and V. Z. SEMENENKO. *Sakhar. Prom.*, 1975, (8), 10–14.—Tests have shown that juice purification with removal of pre-carbonatation mud reduces the total N content in raw juice to a greater extent than conventional juice purification processes and leads to higher 1st carbonatation juice settling rates. Determination of juice pectin content and of pectin molecular weight again showed that the process with pre-carbonatation mud removal was more efficient. Under highly alkaline conditions in main liming, pectin molecules are broken down, so that a smaller amount of pectin is removed by settling; this is confirmed by the discrepancies between actual pectin content in intermediate products from 2nd carbonatation to molasses and the mean molecular weight.

* * *

Tests on a vacuum pan with hydrodynamic intensification of circulation. V. T. GARYAZHA *et al. Sakhar. Prom.*, 1975, (8), 15–20.—Trials are reported in which air or steam injected into the tubes of a pan calandria at a pre-determined rate inhibited the backflow of the vapour-massecuite mixture and instead imparted an extra force, thus increasing circulation while not creating any hydraulic resistances in the massecuite circuit. For smooth distribution of the injected air or steam, the pressure in the distribution chamber was maintained much higher than in the tubes. Results indicated that the system reduced colour formation, increased the crystallization rate and lowered the crystal size distribution while giving larger average crystal sizes by comparison with conventional boiling without injection.

Intensification of crystallization by artificially-induced temperature fluctuation. V. O. SHTANGEEV, V. YA. BORISENKO, I. S. GULYI and I. G. BAZHAL. *Sakhar. Prom.*, 1975, (8), 20–23.—Based on the re-crystallization theory, whereby crystal growth takes place under the effect of periodic changes in massecuite temperature resulting from unevenness in the temperature field, tests were conducted on boiling of *A*- and *B*-massecuite (in a 2-massecuite system) in which the reheat steam pressure (and, hence, temperature) was subjected to periodic changes. Results, given in graph form, showed that the induced pressure differences led to an increase in crystal size and reduction in crystal size distribution compared with conventional boiling, while other parameters were unaffected.

* * *

The mechanical composition of impurities in sugar factory flume-wash water. A. P. PARKHOMETS, YU. V. RASKIN, G. P. DORICHENKO and N. A. ZAN'KO. *Sakhar. Prom.*, 1975, (8), 29–31.—The amount and nature of impurities found in sediment from flume and wash water at 23 Soviet sugar factories is examined, and the range of particle sizes discussed. The effect of treatment in settling ponds on particle size distribution is also indicated.

* * *

Introduction of gravity-discharge sugar carriers. N. M. KICHIGIN, I. I. NOVOGURSKII, V. A. PROSTIBOZHENKO and S. F. TIMOSHENKO. *Sakhar. Prom.*, 1975, (8), 37–39.—Information is given on a Soviet mass-produced 13-ton bulk sugar road vehicle with double inverted conical tank and two bottom discharge ports. Sugar feed and discharge operations are briefly explained.

* * *

A continuous sand trap. M. I. YANITSKII. *Sakhar. Prom.*, 1975, (8), 39.—A simple but effective sand trap described comprises a 2 m long screen profiled to the shape of the flume bottom beneath which is a steeply sloping bunker ending in a pipe through which the sand is discharged into the wash water drain.

* * *

The vacuum filter unit at Gindeshty sugar factory. P. S. MAKSIMUK, P. S. VAKULKO and M. T. MAYANSKII. *Sakhar. Prom.*, 1975, (8), 40–42.—Modifications to the vacuum filters at this Soviet factory included replacement of the open juice tank after the filtrate receivers with a larger sealed tank which is under greater vacuum than the receivers, thus facilitating filtrate withdrawal as well as gas and air separation from the juice. Other changes mentioned are applicable to the factory in question but would not necessarily apply elsewhere.

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The BMA-Zsigmond-Gryllus process—a new process for thin juice deliming. I. Fundamentals of thin juice deliming. E. GRYLLUS and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1975, **100**, 493–501.—While existing ion exchange methods of thin juice deliming reduce the Ca^{++} ion content to an adequate extent, problems arise through regeneration of the resin with NaCl. Laboratory tests were conducted on regeneration of resin with sugar factory intermediate products. Results showed that molasses was not suitable since

[1] *I.S.J.*, 1974, **76**, 268–269; 1975, **77**, 269–271.

it introduced more alkali ions into the treated juice and thus led to additional molasses formation; dilution of the molasses to avoid this would entail increased evaporation. Middle-product raw run-off and thick juice were found to be suitable as regenerants, both permitting a deliming efficiency greater than 90%. However, use of run-off has a number of disadvantages, including: creation of cation imbalance in sugar house products; the need for dilution, heating and filtration; and composition, purity and colour content which are widely different from those of the thin juice, such that even dilution will not bring the colour level down sufficiently. On the other hand, thick juice has the same composition as thin juice and no dilution is necessary. The deliming process uses a highly acidic, macroporous cation exchange resin, and tests showed a 93% reduction in hardness (from 54·6° to 3·7°) (the mean of 9 cycles) when 61°Bx thick juice was used for regeneration. Comparative tests were also conducted on 8 resins, and results are tabulated.

* * *

Thick juice tank of 100,000 m³ capacity with floating roof at the Plattling factory of Südzucker. ANON. *Zeitsch. Zuckerind.*, 1975, **100**, 509–510.—Illustrated information is given on a 81-m diameter thick juice storage tank designed to store juice of 67°Bx precooled to 18°C. The 350-ton roof of the tank is a special sealing system taking the form of a membrane roof with a thin annular pontoon and 96 evenly distributed "buoys"; in operation, it is loaded with a 200-mm layer of water so as to permit it to lie on the surface of the juice and all air to be evacuated. The system contributes to complete sealing of the tank. The roof is raised (for tank cleaning purposes) by means of 10 blowers. The juice is fed and withdrawn through a suction pipe.

* * *

The effect of a magma boiling scheme on massecuite quantity and sugar quality. K. HANGYÁL. *Cukoripar*, 1975, **28**, 97–98, 129–134.—Results obtained over three campaigns at five Hungarian sugar factories using a normal 3-massecuite or 4-massecuite system (the latter including a refined sugar strike) are compared with those obtained at the other six where magma boiling is used. White sugar yield and purity, massecuite quantity and 2nd and 3rd remelt liquor colour are tabulated for each factory. Balances are calculated for all schemes, including four variants of 4-product boiling which differ according to the footing used for the refined sugar strike: 2nd plus 3rd sugar (little used in Hungary), 2nd sugar plus 15% 1st sugar, and two systems using 2nd sugar. Comparison is made of the massecuite quantities and sugar yields as well as qualitative factors. It is shown that magma boiling provides better quality sugar than do conventional boiling schemes, although the quantity of middle-product massecuite is 40% greater in magma schemes. However, maintenance of the middle-product purity at 87 (through adjustment of 3rd sugar quality and quantity) contributes to stabilization of the entire boiling scheme.

* * *

Improved means of separating impurities from beet in beet washers. A. M. ELAGIN and B. I. LIKHACHEV. *Sakhar. Prom.*, 1975, (8), 52–56.—Various devices tested at different Soviet factories for removal of impurities from beet during treatment in Dobrovol'skii washers are described and results achieved with them are indicated.

* * *

Automation of manufacturing processes in large sugar factories. C. SOBIESZAK. *Gaz. Cukr.*, 1975, **83**, 185–188.—The Chemadex central recording and data processing system (CRPD) is intended for factories slicing 6000 tons of beet a day and can handle 143 parameters, of which 104 are adjusted automatically while the remainder are manually regulated. Operation of the system is outlined and details are given of the control parameters for each process from beet storage to waste water treatment control.

* * *

Practical measurements of heat transfer coefficients in a trough-type diffuser. A. SOKOLOWSKI and A. LAMPRECHT. *Gaz. Cukr.*, 1975, **83**, 188–190.—Details are given of the measuring technique used to determine the coefficient of heat transfer from the steam jackets to the cossettes in a DDS-type diffuser. The temperatures of the cossettes, fresh and press water and juice were measured in the four diffuser sections, and an average coefficient of 400 kcal.m^{-2}.hr^{-1} per °C of 2nd effect vapour established.

* * *

Data processing in a sugar factory by means of a minicomputer system. A. KUBASIEWICZ and W. LEKAWSKI. *Gaz. Cukr.*, 1975, **83**, 191–193.—The use of a "Compucorp 425G" minicomputer to process sugar factory data is demonstrated by details of programmes (written in algebraic language) devised for Lublin factory; these include calculation of a sugar and molasses balance, evaluation of boiling house and evaporator performance, and calculation of factory heat and mass flow.

* * *

Secondary results from stabilization of limed flume water. K. SKALSKI. *Gaz. Cukr.*, 1975, **83**, 196–199. While the amount of mud settling out of flume water after 90 days was unaffected by liming of the water, the treatment did cause marked acceleration in the rate at which water separated from the mud. Graphed and tabulated results apply to the three major soil types found in Polish beet fields: podsol, podsol-brown earth and loess. The effect was greatest with the last of these.

* * *

Grid-type water separator for sugar beet. Z. BURCZYŃSKI and R. WIŚNIOWSKI. *Gaz. Cukr.*, 1975, **83**, 200. A description and diagram are given of a patented beet water separator, the grid of which is continuously raised and lowered (between an angle of 18° when stationary and the horizontal) by an electric drive connected to one end, while the other end pivots about a point just to the side of the beet flume.

* * *

Sugar beet storage in the Soviet Union. M. BRANDT and J. MALEC. *Gaz. Cukr.*, 1975, **83**, 205–207.—Beet storage practices in the USSR are described.

* * *

Level of waste water technology in the sugar industry and waste water legislation. H. P. HOFFMANN-WALBECK and A. PELLEGRINI. *Zucker*, 1975, **28**, 527–534. After a brief discussion of the waste water legislation which is due to come into force in West Germany on 1st January 1977, the authors survey the situation in West German sugar factories and calculate the "units of pollution" and the costs of treatment per 1000 tons of beet processed. The possibility of reducing effluent quantity and load is discussed, particularly in the light of other national and EEC legislation which is forecast, and the problem of muddy flume water treatment examined. The system used at Tirlemont is described[1], and problems of operating small activated sludge units discussed.

* * *

Protracted and low-load biological processes. K. METZ. *Zucker*, 1975, **28**, 534–537.—The oxidation pond process introduced at Offenau sugar factory is described in which large 7·5 m long rotors operated by 30 kW motors reduce the BOD_5 of waste water to 25 $mg.litre^{-1}$ or below from an initial load of up to 500 $mg.litre^{-1}$ in the period of one day without any problems with mud or odour. The rotors can be used to treat effluent having a load of below 300 $mg.litre^{-1}$ in oxidation ditches and thus replace the protracted oxidation pond process which lasts 100 days. The possibility of combining the accelerated and the extended process is discussed.

* * *

Experiences with small biological treatment plants at Hannoversche Zucker AG, Rethen and Weetzen. E. GREULICH. *Zucker*, 1975, **28**, 537–545.—Details are given of the waste water treatment plants at Weetzen and Rethen factories; at the former, an "Aquapura" system is used in which the soil from the beets is settled with carbonatation mud in parallel mud ponds; flume water flows thence to a buffer tank with regeneration effluent and wash water. The waste water then passes to an anaerobic tank for 16 days' retention; treatment involves the use of ferrous sulphate as coagulant, although this has not always been necessary at higher temperatures. Tabulated results indicate a final load which is as low as 7 $mg.litre^{-1}$ (compared with an initial 1420 $mg.litre^{-1}$) at a throughput of 432 m^3 per day. At Rethen, a similar plant (but without after-treatment as used at Weetzen) has failed to achieve the same successes as at the other factory, and ferrous sulphate is always needed in order to obtain activated sludge. At both factories, degradation is considerably reduced when the water temperature is below 8°C.

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Analysis of rheological measuring systems for control of sucrose crystallization. D. SCHLIEPHAKE and K. AUSTMEYER. *Zucker*, 1975, **28**, 546–554.—See *I.S.J.*, 1976, **78**, 55.

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Reflections on (juice) purification from results of tests conducted in a pilot plant during the 1973-74 and 1974-75 campaigns. P. HENNETON. *Ind. Alim. Agric.*, 1975, **92**, 767–786.—The method described earlier[2] was tested on a laboratory scale during the 1974/75 campaign at Lillers sugar factory. After liming, the juice was subjected to 1st and 2nd carbonatation and its properties then compared with those of juice obtained by conventional purification. Results indicated that, although the new process yielded a 1st carbonatation juice of high filtrability and settling rate, 2nd carbonatation juice colour was higher, reducing sugars were insufficiently degraded (2% decomposition compared with 90% in the conventional process) and amide saponification was incomplete, while the lime salts content was lower than in conventional 2nd carbonatation juice. However, it is thought that such a juice would be highly unstable in evaporation. The effect of reducing sugars on juice purity, the part played by liming, and the influence of 2nd carbonatation end-point on the lime salts content have been studied. Addition of NaOH to 2nd carbonatation juice to displace Ca^{++} ions has been tested but regarded as unsuitable, chiefly because of the quantity needed.

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Development of juice purification in French sugar factories. T. CALDEMAISOUS. *Ind. Alim. Agric.*, 1975, **92**, 791–798.—A survey is presented of juice purification practices used in French sugar factories, covering liming, 1st carbonatation, 1st carbonatation mud separation, mud and filter cake sweetening-off, 2nd carbonatation, 2nd carbonatation juice filtration, thin juice deliming and demineralization by ion exchange and raw juice ion exchange treatment (conducted only on a semi-pilot plant scale in 1970 at the author's factory but not yet practised commercially). Juice alkalinity at each purification stage is tabulated for 1953–73 together with 2nd carbonatation juice pH and lime salts and mud sugar; raw and thin juice analyses are also given for the same period, and the question discussed as to whether sufficient progress has been made in juice purification since, despite a number of benefits obtained, the percentage of impurities removed remains unaltered.

* * *

Effect of beet properties on slicing. K. VUKOV. *Zeitsch. Zuckerind.*, 1975, **100**, 549–552.—The four mechanical properties of sugar beet which govern slicer efficiency are discussed in turn, viz. resistance to cutting, modulus of elasticity, tensile strength and impact strength. The effect each has on slicing is explained and the technique used to determine the value is described. Beets are classified according to given values and ranges of values, viz. normal, woody (this category also covers the presence of impurities such as large-stalked weeds), brittle and soft beet.

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The BMA-Zsigmond-Gryllus process—a new process for thin juice deliming. II. Semi-industrial and factory tests. E. GRYLLUS and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1975, **100**, 554–561.—Semi-industrial tests, involving the treatment of 70·5 m^3 of thin juice per m^3 of cation exchange resin and regeneration of the resin with 10·9 m^3 of thick juice per m^3, are reported. Results indicated up to 95% deliming even at an initial hardness of 70–80° and a relatively uniform final calcium content despite fluctuations in the initial content. These tests were followed by full-scale tests, in which the deliming and regeneration columns were replaced by special vessels taking the form of a tank within a larger tank. Average results indicated 86% reduction of the initial lime salts content, giving a juice hardness of 4·6° (34·3 mg lime salts per 100°Bx). After resin regeneration with thick juice of about 57°Bx, a precipitate started to form in the thick juice; after standing, it was filtered, whereby its lime salts content was reduced by 15%, i.e. by 24 mg per 100°Bx.

[1] SIMONART *et al.*: *I.S.J.*, 1976, **78**, 56.
[2] GIORGI & GROULT: *ibid.*, 1975, **77**, 23.

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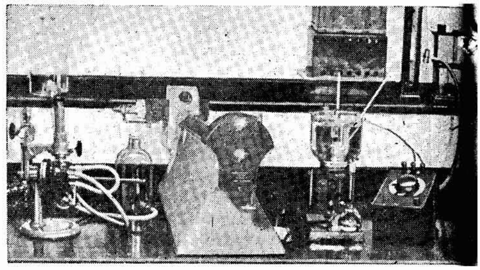

Distribution of the more important components in the sugar beet root. K. Fábián and J. Kollár. *Cukoripar*, 1975, **28**, 134–139.—Beet crowns, collars and roots (from 10 samples) were analysed for sugar, invert sugar, ash, α-amino-N and (K + Na); thin juice from the three sections was also analysed for purity and total anions (meq per 100 g sugar). Results, in the form of block diagrams and tables, show how the sugar content of the crown was considerably lower than that of the root while the values of the other factors investigated were higher; the collar showed the same pattern as the crown, but the differences between the values for the collar and root were very much smaller than between the crown and root. Hence, it is advisable to top beets before processing.

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Formation and composition of beet molasses. XIV. Summary of previous reports and supplementary information. G. Vavrinecz. *Cukoripar*, 1975, **28**, 92–93, 145–148.—See *I.S.J.*, 1975, **77**, 185.

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Chromatography of sugars in a thin layer of silica gel. I. I. Gavrilyuk. *Izv. Akad. Nauk Moldav. SSR, Ser. Biol. Khim. Nauk*, 1971, (4), 32–35; through *S.I.A.*, 1975, **37**, Abs. 75-1265.—Sugars are separated by ascending chromatography on a 0·2 mm layer of silica gel impregnated with sodium monophosphate, using 11:12:6:3 *n*-butanol:acetone:methanol:water as solvent; four solvent passages of 50–60 min (15–16 cm height) are used, each followed by hot air drying for 20 min. The separation temperature is preferably 10–12°C; if it is 20–22°C, the layer requires prior activation for 2 hours at 100°C. R_f values depend on the exact conditions used, but are about 15, 70, 78 and 86% of the solvent travel for raffinose, sucrose, glucose and fructose, respectively. The spots are revealed with diphenylamine: analine:phosphoric acid in acetone; for quantitative determination, each spot is scraped off into 2 cm^3 methanol containing HCl and ascorbic acid; the gel is centrifuged off and the optical density at 642–648 nm is compared with a calibration curve.

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Application of the direct isotope dilution method to determination of the sucrose content in sugar beet digestion fluids. K. Malec, A. Szuchnik, S. Rydel and E. Walerianczyk. *Zeitsch. Zuckerind.*, 1975, **100**, 502–505.—Details are given of the preparation of a ^{14}C-labelled sucrose solution and measurement of its specific radio-activity for use in determining the sucrose content in beet juices. The unknown sucrose is determined as $M_D \left(\frac{I_D - I_t}{I_p - I_t} - 1\right)$ where M_D = amount of labelled sucrose added (g), I_D = counting rate (impulses per min), I_t = background counting rate (impulses per min) and I_p = counting rate of the radio-active sucrose isolated from the mixture after isotope dilution (impulses per min). Since the specific activity is proportional to the counting rate, knowledge of the former parameter is not necessary. Results indicated that most of the sucrose was found by this means in basic lead acetate-clarified solutions of known concentration. Glucose, fructose and raffinose had no significant effect on the results. Good agreement was obtained between values obtained by isotope dilution and by polarimetry. The new method is applicable to beet of varying quality and is recommended as a check method for polarimetric determination.

* * *

Brix of muddy sugar cane juice. W. Stewart. *Sugar J.*, 1975, **38**, (3), 45–46.—Where hydrometer Brix cannot be measured because of excessive mud particles in the juice sample, the addition of 600 ppm polyelectrolyte has been found to cure the problem by flocculating the suspended material. Addition of a few drops of mercuric chloride solution in alcohol to the juice samples prevented decomposition where the juice was taken from old or stale cane.

* * *

Frost *vs.* cane juice acidity—cane supply line inspection. J. C. P. Chen, R. W. Picou and G. T. Blanchard. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 83–84.—Details are given of a routine system for checking cane for deterioration resulting from frost. It is based on determination of juice acidity as an approximate criterion of frost damage.

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Evaluation of post-freeze cane juice quality. J. C. P. Chen and J. J. J. Chen. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 85–91.—See *I.S.J.*, 1976, **78**, 53.

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The apparent purity and the exhaustion of final molasses. A. Acosta. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 104–106.—The Brix, direct pol, apparent purity, Clerget sucrose, reducing sugars, total sugars and total sugars per 100°Bx are tabulated for 16 final molasses samples from the 1972/73 season and are discussed. It is concluded that apparent purity is meaningless for molasses exhaustion evaluation, and that a suitable criterion of exhaustion is the total sugars per 100°Bx; for Florida and Louisiana a value of 55% is suggested as a target.

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Core sampling of Louisiana sugar cane—1972 studies. H. S. Birkett and J. J. Seip. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 195–209.—Because of what are regarded as shortcomings in the cane payment system used in Louisiana, studies have been conducted with the aim of developing a better system. Initial investigations concerned comparison between the conventional sampling system and core sampling,

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which is considered more suitable. Tabulated data are presented and discussed.

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A statistical analysis of the effect of cane quality on extraction performance. P. W. REIN. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 43–48.—Multiple linear regression analysis was applied to daily mill extraction figures obtained from seven sugar factories in order to establish the effect of cane quality (expressed as pol and fibre content) on mill performance. The formulae of DEERR, MITTAL and HUGOT are examined. While these give values which are dependent on cane quality, a new expression is derived for calculation of CRE (corrected reduced extraction) which incorporates a pol correction factor. It is identical to DEERR's expression for calculation of lost absolute juice % fibre on pol (PLAJ) with the correction factor added, and so takes the form: $CRE = \frac{(100 - E)(100 - F_c) P_c^{0 \cdot 6}}{F_c}$, where E = extraction %, F_c = fibre % cane and P_c = pol % cane.

* * *

Evaluation of a new Nutsch bomb design. G. R. E. LIONNET and D. FALCONER. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 86–89.—The design of the Nutsch bomb used to assess the performance of low-grade crystallizers, massecuite reheaters and centrifugals has been found to suffer from a number of defects, the most serious being the excessive time needed to extract sufficient molasses, which could affect the purity determination. Modifications to the design are described and tests on the new bomb reported. Results showed that the extraction time was considerably shorter than in the standard bomb and that molasses viscosity and mother-liquor purity were more important than massecuite temperature in governing the time. One disadvantage of the new design is the comparative difficulty of feeding the massecuite.

* * *

Quantitative determination of sugars in factory products by gas chromatography using open tubular columns. D. NUROK and T. J. REARDON. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 94–98. Quantitative determination of glucose and fructose (using arabinose as internal standard), sucrose (with trehalose as internal standard) and 1-, 6- and neo-kestose (for which melezitose is a suitable internal standard) was carried out by gas-liquid chromatography using open tubular columns. The sugars were determined as trimethylsilyl derivatives.

* * *

Analysis of final molasses for sucrose and pol. M. KORT, M. MATIC, P. MELLET and D. NUROK. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 99–102.—Comparison was made between cane molasses sucrose as determined by the isotope dilution method and gas-liquid chromatography. The former method gave a value averaging 0·5% higher, because of incomplete elimination of oligosaccharides, so that the GLC method is considered more accurate. However, even making allowance for the kestose content still left a difference, possibly a result of the presence of other substances which produce reducing sugars on hydrolysis (as does kestose). On the other hand, while the GLC method is preferable, not all factory laboratories have the means for this, so that the isotope dilution method is recommended for routine purposes, correction being made by a simple subtraction. Pol was found to be unsuitable as a measure of sucrose content because of wide variation in the amount and composition of optically-active impurities and interaction of lead with these. While the quantity of fructose removed during clarification increased with the amount of basic lead subacetate used, glucose remained largely unaffected. An error of between 0·3% and 1·5% can be expected in a factory balance when 10 g of lead acetate is used; this is recommended as a fixed quantity.

* * *

Collaborative study on the determination of trace elements in dried sugar beet pulp and molasses. I. Mercury. P. B. KOSTER, P. RAATS, D. HIBBERT, R. T. PHILLIPSON, H. SCHIWECK and G. STEINLE. *Zucker*, 1975, **28**, 555–562.—See *I.S.J.*, 1975, **77**, 299–305.

* * *

Balance of the metals in five sugar factories during the 1973-74 campaign. Forecasts of purities and yields from beet. P. DEVILLERS, P. GORY and M. LOILIER. *Ind. Alim. Agric.*, 1975, **92**, 733–745.—See *I.S.J.*, 1976, **78**, 60.

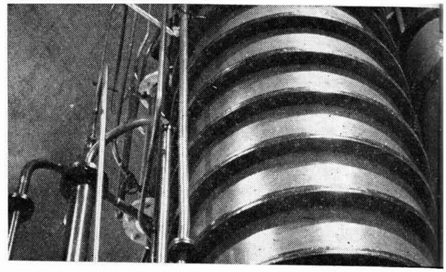
* * *

Some risks of errors in sucrose determination by polarimetry. M. ROCHE. *Ind. Alim. Agric.*, 1975, **92**, 747–751.—Possible errors in polarimetric measurement of sucrose are examined. The first source discussed is the cover glass; while strain resulting from excessive tightness of the glass or under the effect of a knock will impart distortion, this will usually disappear after a short period, but the error can be permanent should the glass be chipped. Although correction is normally applied for temperature of measurement where this differs from 20°C, sugar solution expands with temperature, and the volume of solution caught in the light beam will therefore contain less sucrose and the reading will be reduced. Allowing for expansion and elongation of the tube (which increases the reading), there is still a correction to be made in addition to the normal temperature correction. Further correction is necessitated by the variation of the rotatory power of quartz wedges with temperature. Lead subacetate causes changes in the optical rotation of sugar solution components; this effect is particularly important in the case of amino-acids, since the effect will depend on the individual amino-acid, while further complication arises because of lack of knowledge of the amino-acid content in normal routine analysis. Results of tests are reported which indicate the extent of the possible error resulting from each effect mentioned above.

* * *

Effects of freeze on juice quality of several Louisiana sugar cane varieties. F. A. MARTIN, C. A. RICHARD and M. J. GIAMALVA. *Proc. 1974 Meetings Amer. Soc. Sugar Cane Tech.*, 30–32.—The post-freeze deterioration of six commercial and three experimental cane varieties was determined by evaluating the pre- and post-freeze juice acidity (by titration to pH 8·3 with 0·1N NaOH). Under the cane payment system used in Louisiana, the maximum permissible acidity at which no penalty is exacted is 2·5; a variety was considered frost-tolerant if its acidity did not greatly exceed this value. Of the nine varieties tested, only three proved to be tolerant: N:Co 310, CP 65-357 and CP 68-361.

By-products



Synthetic reaction rate of sucrose stearic acid ester. T. Kojima and S. Nishimoto. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 1–9.—The effect of pressure on the reaction between sucrose and methyl stearate in dimethyl sulphoxide containing potassium carbonate was determined at 13, 30 and 60 torr and 90°C. Under the controlled conditions investigated, it was found that some of the methanol formed was dissolved in the reaction mixture and that the reaction was completed more rapidly at a lower pressure. Attempts to derive a rate equation for both reversible and irreversible reactions from experimental results were unsuccessful. It is therefore concluded that the reaction of methyl stearate with the OH^- radical in the sucrose molecule is not subject to a random distribution law and/or in the first stage of the reaction methyl stearate is not completely dissolved and the reaction takes place in two stages.

* * *

Contribution to the systematic treatment for obtaining sugar and alcohol. H. L. Fernandes. *Brasil Açuc.*, 1975, **86**, 28–56, 152–167.—The text is a Master of Cybernetics dissertation on the consideration of the various stages of processing in the raw sugar factory, in a sugar refinery and in a distillery, as systems for construction of models to be used in establishing computer programmes.

* * *

Activated carbon from bagasse by means of chemical activation. G. Ocampo, N. la Serna, G. Llerena, R. Pombo and J. Lastra. *CubaAzúcar*, 1975, (April/June), 21–26.—An account is given of laboratory and industrial-scale trials in which bagasse was impregnated with 30% phosphoric acid and heated in an oven to produce an activated carbon which was then washed, dried and milled. Yields up to 40% were obtained and the carbon had similar characteristics to those presently used for refining. Aspects of the process to be emphasized in order to ensure economical production are mentioned.

* * *

Effect of the addition of sodium and calcium chlorides on the vapour-liquid equilibrium of the ethyl alcohol-water system at atmospheric pressure. D. Mondeja G. *Centro Rev. Cient. Univ. Central Las Villas*, 1973, **1**, (2), 67–79.—Determination of vapour-liquid equilibrium curves for the ethyl alcohol-water system in the presence of NaCl (soluble only in the water) and $CaCl_2$ (soluble in both components) showed that the former did not change the azeotropic composition while the latter eliminated the azeotrope.

* * *

Renewable fuels: ethanol produced by fermentation. W. E. Trevelyan. *Trop. Sci.*, 1975, **17**, (1), 1–13. The use of alcohol instead of petrol as motor fuel is discussed and its production by fermentation of carbohydrates, including molasses, surveyed. The author examines both technical and economic aspects.

The value of proteinated waters from the saccharate process in cattle feed. L. Gonry. *Sucr. Belge*, 1975, **94**, 239–243.—See *I.S.J.*, 1976, **78**, 126.

* * *

Technology of the rum industry. W. H. Kampen. *Sugar y Azúcar*, 1975, **70**, (8), 36–43.—The processes and materials involved in rum manufacture from cane molasses are described with the aid of diagrams, and brief mention is made of distillery by-products and waste treatment and disposal.

* * *

Marketing sugar by-products for animal feed. J. Freivalds. *Sugar y Azúcar*, 1975, **70**, (9), 23–27. The forms in which beet and cane molasses and beet pulp are available as animal fodder and the marketing of these by-products are discussed. It is stressed that an increasing amount of molasses is being used as liquid feed, in which form it is a means of introducing urea into rations; mention is also made of a dried molasses powder manufactured by a South African company under the name "Kolori 3,000" and of a similar product manufactured in the US. The author also considers molasses transport aspects.

* * *

Question of molasses storage. A. D. Kovalenko. *Ferment. Spirt. Prom.*, 1974, (5), 27–29; through *S.I.A.*, 1975, **37**, Abs. 75-1177.—In September 1972 at Anna alcohol distillery, Voronezh, two large (approx. 2000 tons) tanks of poor-quality beet molasses stored for several weeks were heated for sterilization; one lot remained stable at $\not>$78°C for 12 days; in the other, rapid Maillard reaction on the sixth day caused the temperature to rise to 105°C, producing steam, corrosive gases and total degradation of sugar to charred particles and a resinous mass. It is recommended that molasses temperature during long storage should be $\not>$ 25–30°C; sterilization should last $<$ 2 hours, in small tanks; molasses at $<$ 75°Bx containing $<$ 44% sugar should be kept separate, and processed as soon as possible.

* * *

Possibilities for carrying out thermophilic methane fermentation of slops from Cuban cane molasses and biosynthesis of vitamin B_{12}. I. S. Luchev, R. Yalumov, M. Fidanova and K. Fidanov. *Nauch. Trud. Nauch.-Izsled. Inst. Vinarska Pivovar. Prom.* (Sofia), 1970, **12**, 79–91; through *S.I.A.*, 1975, **37**, Abs. 75-1188. Tabulated compositions of vinasses from cane and beet molasses are compared and results of experiments with a mixed bacterial culture in 200-litre fermenters are presented. After 42 days at 54–56°C, the yield of vitamin B_{12} + analogues was approx. 1·1 mg.litre^{-1}; with inclusion of 0·5% yeast hydrolysate on vinasses, it increased to approx. 1·9 mg.litre^{-1}.

* * *

New process of composting bagasse and filter cake to increase cane production. R. P. Humbert. *Brasil Açuc.*, 1975, **86**, 145–148.—See *I.S.J.*, 1976, **78**, 94.

US sugar imports[1]

	1975	1974
	(*short tons, raw value*)	
Hawaii	954,847	988,833
Puerto Rico	96,093	157,167
Argentina	112,318	109,755
Australia	464,049	241,705
Belize	46,251	62,506
Bolivia	3,750	5,714
Brazil	198,554	783,330
Canada	45,986	1
Colombia	161,613	104,820
Costa Rica	56,240	78,515
Dominican Republic	775,444	817,728
Ecuador	46,967	59,628
Fiji	1	46,083
Guatemala	60,729	95,934
Haiti	11,622	18,807
Honduras	6,264	8,455
India	187,648	84,902
Korea, South	11,388	—
Malagasy Republic	13,022	13,088
Malawi	26,585	10,274
Mauritius	26,741	45,527
Mexico	42,089	538,131
Mozambique	15,090	—
Nicaragua	57,962	53,254
Panama	93,797	65,525
Paraguay	3,328	8,506
Peru	215,052	471,145
Philippines	413,065	1,472,299
Salvador	107,466	65,127
South Africa	134,083	69,410
Surinam	1,279	—
Swaziland	35,833	41,360
Taiwan	139,977	90,059
Thailand	123,818	26,220
West Indies	235,937	282,146
Other Countries	279	22
	4,925,167	6,915,976

New USSR sugar factory[2].—A new sugar factory, the largest in the Ukraine, has been put into operation. It has a capacity of 6000 tons of beet per day, and previously a plant half this size has taken three years to build, but the Teofil'skii plant was only 24 months in construction.

* * *

French beet growers fear greenfly attack[3].—French beet farmers fear that unusually high temperatures recorded in April may result in greater aphid damage to beet in early June. The dry weather has slowed the effect of herbicides, so that in some regions weeds are rampant, and has also resulted in increased bird and parasite damage. Although sowings are very much more advanced than in the same period in 1975, the continuing dry weather is causing particular concern in central and eastern France—the soil structure is very good, but rain is needed to help the young plants grow.

* * *

Sugar machinery company changes hands.—The assets of J & L Engineering Co., manufacturers of cane agricultural equipment and beet and cane factory equipment, have been acquired by Hillman Manufacturing Co., of Pittsburgh, Pa., USA, and the company's name changed to J & L/Honiron Engineering Co. Inc.

* * *

Zaire sugar project[4].—China is to aid Zaire with the construction of a sugar refining and cultivation project at Yawenda, near Yangambi in Haut-Zaire province.

* * *

Louisiana sugar crop, 1975[5].—The 1975 Louisiana sugar cane crop produced 644,000 tons of sugar according to preliminary figures compiled by the American Sugarcane League. This compares with 594,000 tons produced from the 1974 crop. Although Louisiana normally produces about 180 pounds of sugar per ton of cane, the 1975 crop figure rose to 198 pounds, primarily owing to higher juice volume and clean cane. The yield of cane for the 1975 crop was disappointing at 21 net tons of cane per acre as against 21·3 tons per acre in 1974 when the crop was reduced by hurricane damage. No significant change in cane acreage is expected for the 1976 crop.

Brevities

USSR sugar beet production plans[6].—Under the 1976–1980 five-year plan, sugar beet production in the Soviet Union is to be increased to 95–98,000,000 metric tons.

* * *

Hawaii sugar production, 1975[7].—Production of sugar in Hawaii in 1975 amounted to 1,107,199 short tons, raw value, (1,004,229 metric tons). Production was thus 66,457 tons above that of 1974 which reached 1,040,742 short tons.

* * *

Alcohol production from sugar cane in Brazil[8].—The first large plant to produce ethyl alcohol directly from sugar cane was scheduled to go on stream in November 1975 in Brazil. The GIASA distillery is located in the state of Paraiba and is designed to produce 100,000 litres of alcohol per day, 50% from molasses produced by the firm's two sugar factories and 50% from cane juice extracted in a new mill. Three grades will be produced: a hydrated alcohol, anhydrous alcohol for mixing with petrol, and a highly purified grade for use in perfumes, etc. The cost of alcohol production for fuel is less than half that of petrol and there are plans for expansion of the cane area for this purpose.

* * *

Colombia sugar exports 1975[9].—Colombia shipped 197,589 tons of sugar in 1975 compared with 139,995 tons in 1974. According to an announcement of the Colombian Institute for Foreign Trade, the value of the 1975 exports, at $82·4 million, was less than that of 1974 exports ($87·8 million). Exports have been suspended recently, owing to shortages on the domestic market possibly caused by large-scale smuggling across the border with Venezuela. This is seen as a temporary measure, however, and exports are expected to reach the 1976 target of 200,000 metric tons out of a production of a little over one million metric tons, raw value.

* * *

Louisiana sugar factory closure[10].—The Catherine sugar factory at Bayou Goula, in Louisiana, closed after the 1975 crop. It was recently purchased by Southdown Sugars and will be used as part of a consolidation programme with Cedar Grove sugar factory, also purchased by Southdown.

* * *

New Surinam sugar factory[11].—According to press reports, preparations are under way for the construction of a sugar factory, to be erected in the Tibitie district by the Brazilian company Dedini. The factory will have an annual production capacity of 45–50,000 tons of sugar, requiring an area of 6000 hectares to be planted to cane.

* * *

Canada beet sugar crop, 1975[12].—A total of 120,406 long tons of sugar was produced from a beet area of 79,475 acres during the 1975/76 campaign in the three provinces of Alberta, Manitoba and Quebec. In 1974/75 91,550 tons of sugar had been produced from an area of 67,578 acres.

* * *

Cuban cane crop mechanization and irrigation[13].—It is reported that 1325 cane harvesters are currently in operation in Cuba. It is expected that during the 1976 season nearly one-third of the cane fields will be harvested mechanically. About 10% of the cane fields are presently irrigated and this is to be increased to about one-third by 1980.

[1] C. Czarnikow Ltd., *Sugar Review*, 1976, (1275), 45.
[2] *Pravda*, 24th December 1975.
[3] *Public Ledger*, 1st May 1976.
[4] *Moscow Narodny Bank Bulletin*, 21st January 1976.
[5] *Willett & Gray*, 1976, **100**, 75.
[6] *Sakhar. Prom.*, 1976, (3), 2.
[7] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (6), 8.
[8] HUMBERT: *Sugar y Azúcar*, 1976, **71**, (2), 33.
[9] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (6), 8–9.
[10] *Sugar y Azúcar*, 1976, **71**, (2), 11.
[11] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (6), 10.
[12] C. Czarnikow Ltd., *Sugar Review*, 1976, (1274), 41.
[13] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (8), 9.

Brevities

Singapore sugar imports[1].—Imports of sugar by Singapore in 1975 totalled 147,522 metric tons, tel quel, as against 111,963 tons in 1974. Australia supplied the bulk of the imports, at 137,474 tons, whereas in 1974 her supplies had been a much smaller proportion at 63,250 tons, and appreciable supplies had also come from Fiji (36,601 tons) and Thailand (11,380 tons).

* * *

West Indies sugar factory revival plans[2].—The new Government of Antigua which regained power at general elections in February, promised to encourage revival of the sugar industry there in its election manifesto. Antigua formerly produced up to 30,000 tons of sugar a year but a long drought made the industry uneconomical and the one factory on the island was closed after the 1971 crop. The Minister of Agriculture of the Government of St. Vincent recently announced similar plans for revival of the island's sugar industry which was abandoned in 1962 when the one factory closed. In that year 2700 tons were produced and the Minister disclosed that the proposed revival would be mainly to supply local consumption needs of about 1200 tons a year.

* * *

Switzerland sugar imports 1975[3].—Switzerland imported a total of 130,642 metric tons of sugar, tel quel, as against 216,535 tons in 1974. France had provided nearly half the latter—107,314 tons—but in 1975 French supplies were only 32,460 tons, while the UK supplied 67,416 tons in 1975 as against 53,044 tons in 1974. Holland, which provided 15,936 tons in 1974, supplied only 20 tons in 1975.

* * *

Bulgarian sugar expansion plans[4].—The current five-year plan (1976-1980) envisages an increase in sugar beet production to 2·7–2·9 million metric tons per annum as against the average annual beet production of 1·699 million tons during the period 1971–1974.

* * *

Uruguay sugar factory plans[5].—Italian and Spanish finance is to be provided for a beet sugar project in Uruguay which will cost £7,350,000.

* * *

Polish sugar factory for Hungary[6].—According to Polish press reports, Poland is to erect a modern sugar factory in Hungary near Kaba. The factory is to have a beet processing capacity of 300,000 tons per annum.

* * *

Japan sugar imports[7].—Japan's raw sugar imports fell last year to 2,462,506 metric tons from 2,773,289 tons in 1974, according to customs statistics. Suppliers were as follows:

Argentina	10,862	tons
Australia	229,832	,,
Brazil	385,220	,,
Cuba	430,613	,,
Philippines	595,760	,,
South Africa	353,998	,,
Taiwan	107,392	,,
Thailand	308,365	,,
USA	40,464	,,
	2,462,506	,,

* * *

New Indonesian sugar factories[8].—It is reported that a sugar factory is to be built near the town of Kupang on the island of Timor. Another modern sugar factory is also to be built in Takalar, South Sulawesi, with completion in about 2½ years.

* * *

Bagasse paper plans for Pakistan[9].—The Pakistan Industrial Development Corporation is studying the possibility of erecting a paper factory using bagasse as raw material at Jamshoro near Hyderabad. The capacity would be 100 tons per day of printing and writing papers.

* * *

Nicaragua sugar factory loan[10].—It is reported that the Banco Centro-Americano de Integración Económica has approved a loan of US $2·6 million to help finance a sugar mill in the Province of Rivas.

Finland sugar imports and exports[11]

	1975	1974
	— *metric tons, tel quel)* —	
Imports		
Argentina	3,232	
Brazil	12,699	1,8100
Cuba	81,734	79,441
Dominican Republic	36,433	0
Guatemala	0	7,475
Guyana	5,577	8,509
Philippines	30,814	0
El Salvador	0	2,920
South Africa	0	12,801
Sweden	625	1,003
USSR	0	29,891
Other countries	1	2
	171,215	143,852
Exports		
Germany, West	2,381	668
Guinea	0	99
Iceland	866	1,605
Norway	11,515	11,617
Senegal	0	121
Sweden	17,864	2,045
Other countries	721	332
	33,347	16,487

New Zealand beet sugar possibility[12].—The Trade and Industry Minister has announced that the Government of New Zealand is to look again into the possibility of establishing a beet sugar industry.

* * *

Switzerland campaign results, 1975/76[13].—The two Swiss sugar factories sliced a total of 479,559 metric tons of beet in 1975/76 to give 59,437 tons of white sugar. In the previous campaign 518,443 tons were sliced to produce 66,486 tons of white sugar.

* * *

Sri Lanka sugar development plans[14].—The sugar industry is being given priority by the Government in the development programme for 1976, with a production target of 27,000 tons as against only 18,000 tons in 1975. Consumption is such that production of only 18,000 tons entails a need to import 50,000 tons of sugar.

* * *

Italy sugar production, 1975/76[15].—Sugar production in Italy during the 1975/76 campaign was 1,289,410 metric tons, white value, according to the Ministry of Agriculture.

* * *

New sugar factories in the USSR[16].—According to official information, ten new sugar factories were erected in the Soviet Union in the period 1971–1975.

* * *

Finland campaign results, 1975/76[17].—The five beet sugar factories in Finland sliced a total of 640,322 metric tons of beet in 1975/76 as against 629,499 tons in the previous campaign. Sugar production was 60,343 tons of white sugar (64,115 tons in 1974/75) and 21,712 tons of raw sugar (12,489).

* * *

Libya sugar imports, 1975[18].—According to reports from Libya, sugar imports in 1975 were around 120,000 tons.

1 C. Czarnikow Ltd., *Sugar Review*, 1976, (1275), 45.
2 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (9), 7.
3 C. Czarnikow Ltd., *Sugar Review*, 1976, (1276), 49.
4 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (9), 6.
5 *Zeitsch. Zuckerind.*, 1976, **101**, 166.
6 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (9), 6.
7 *Public Ledger*, 7th February 1976.
8 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (7), 9; (9), 10.
9 *Zeitsch. Zuckerind.*, 1976, **101**, 165.
10 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (9), 8.
11 C. Czarnikow Ltd., *Sugar Review*, 1976, (1272), 32.
12 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (9), 12.
13 *Zeitsch. Zuckerind.*, 1976, **101**, 165.
14 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 12.
15 *Zeitsch. Zuckerind.*, 1975, **101**, 165.
16 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 7.
17 *Zeitsch. Zuckerind.*, 1976, **101**, 164.
18 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 7.

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