International Sugar Journal

JULY 1976

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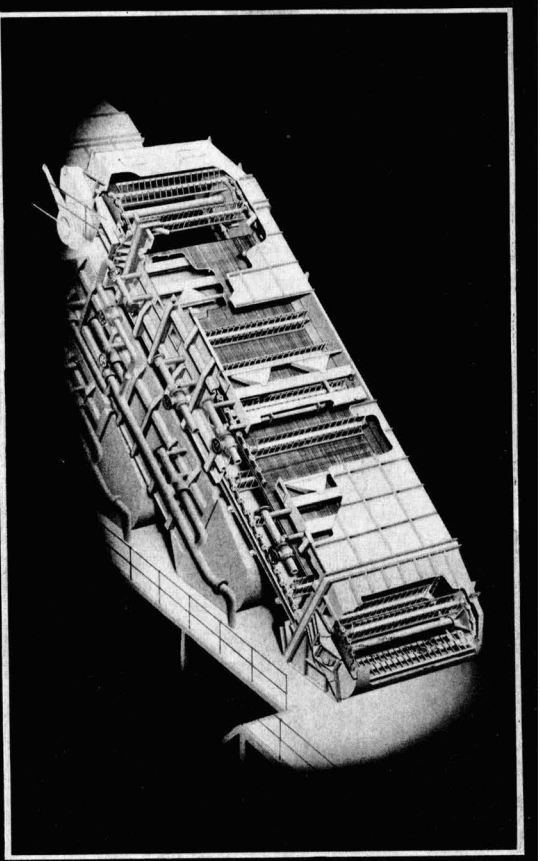

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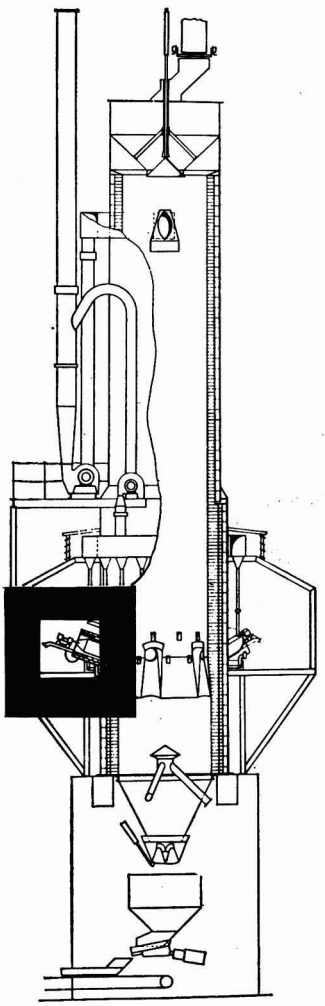

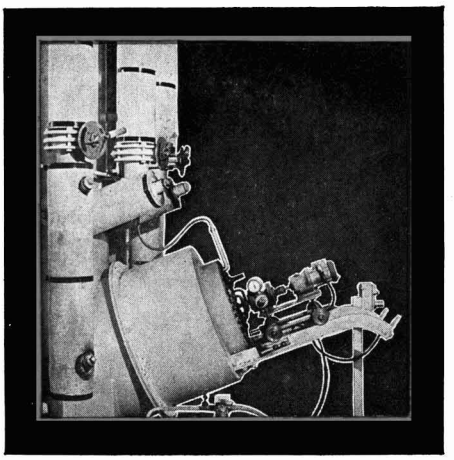

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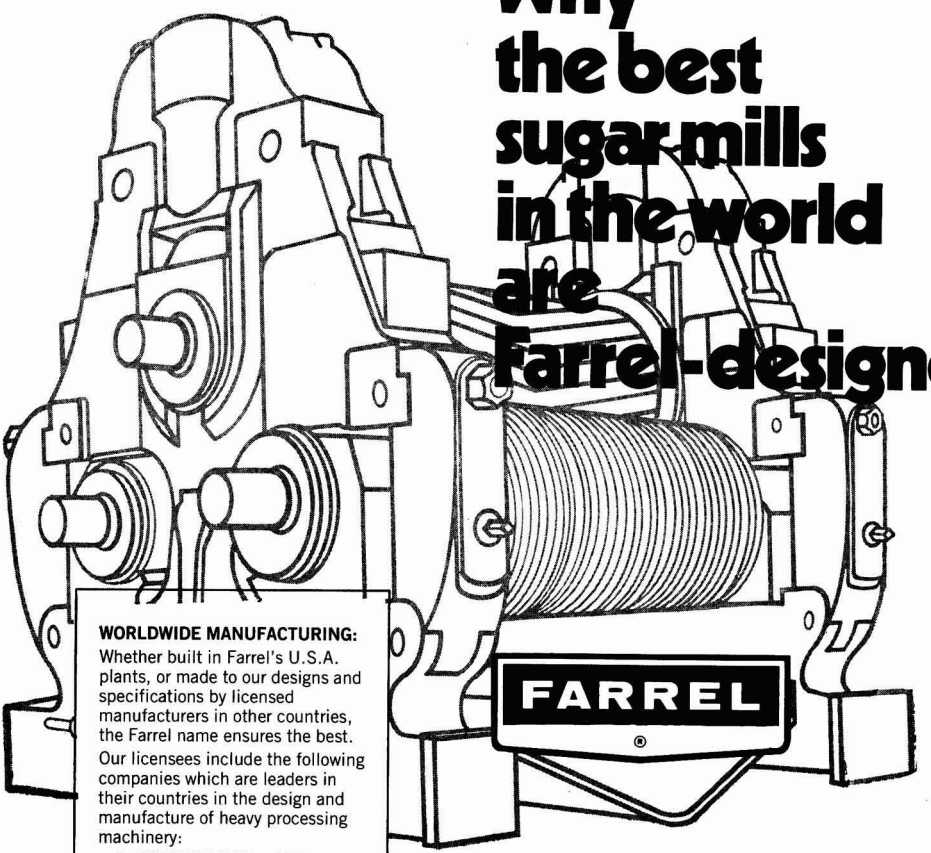

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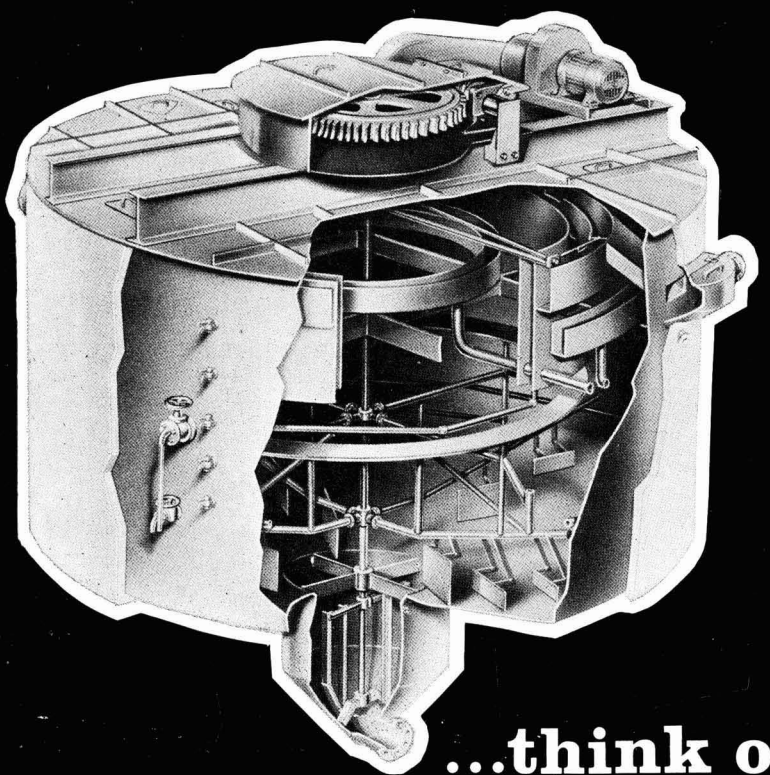

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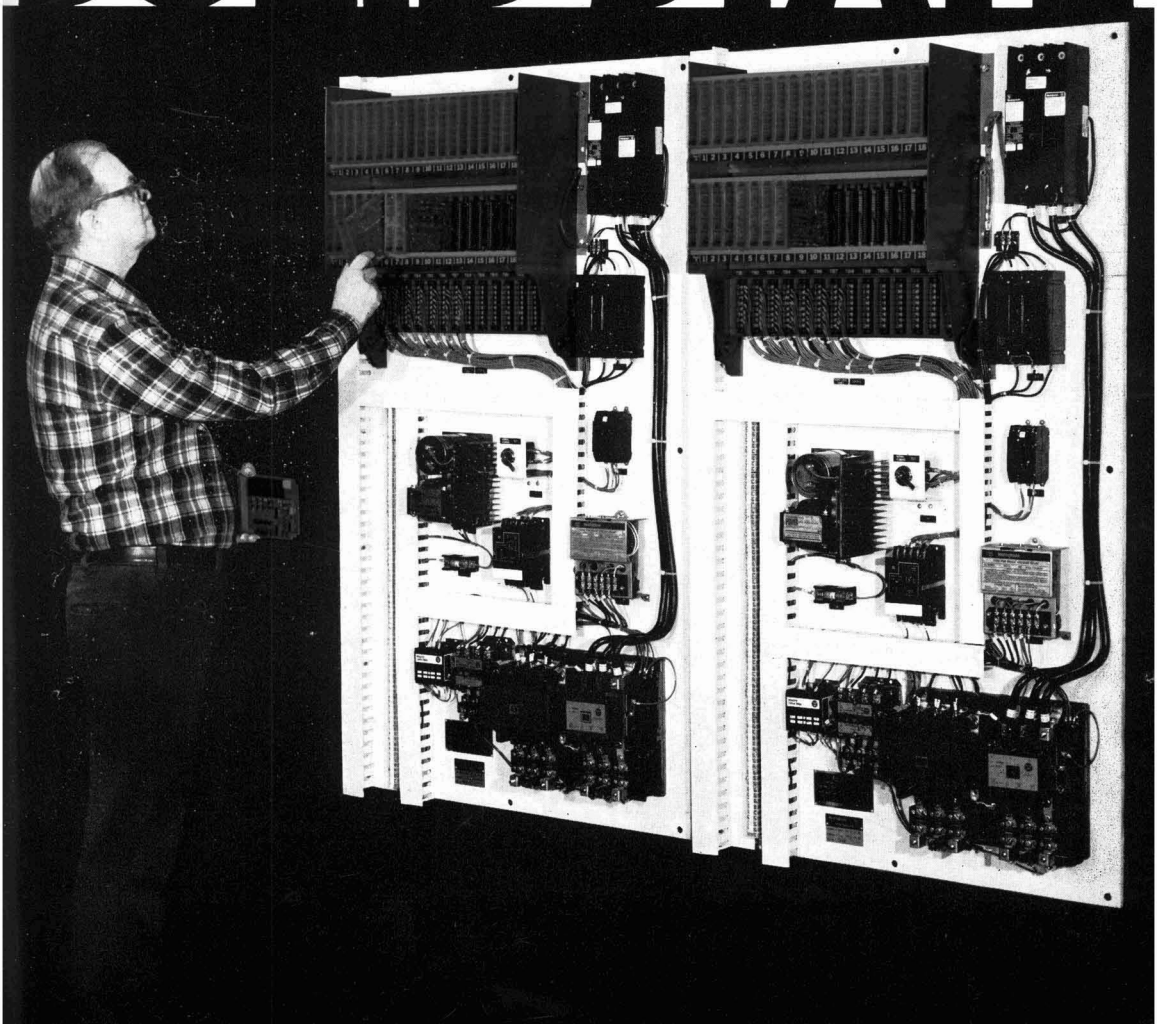

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July 1976

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Influence du degré de décolletage et d'autres facteurs culturaux sur le rendement et la qualité des betteraves. IIème Partie. P. J. LAST, A. P. DRAYCOTT et R. HULL. *p.* 193–197

On donne un compte rendu d'études sur les effets de la date d'arrachage et du stockage sur les sucres totaux et la qualité de la betterave. Les résultats indiquent que des quantités appréciables de sucre sont laissées dans le champs lorsqu'on suit le procédé de décolletage défini dans le contrat entre la British Sugar Corporation et les planteurs, la quantité étant la plus importante dans le cas de grosses betteraves obtenues par irrigation de champs à faible densité de peuplement. Cependant, la récolte des collets augmente les impuretés les plus importantes, en particulier les composés α-amino-N; ces impuretés augmentent de 14% après un stockage de 2 mois tandis que le sucre inverti augmente de 16% par rapport aux quantités présentes en novembre alors que dans les betteraves normalement décolletées, elles n'augmentent que de, respectivement, 12% et 10%. Si on envoyait plus de collet à l'usine, l'absorption de toutes les substances nutritives importantes augmenterait considérablement et it faudrait ajuster les fumures recommandées.

* * *

L'évaluation de la qualité du sucre brut. F. H. C. KELLY. *p.* 197–200

On décrit un système d'évaluation de la qualité du sucre brut à raffiner dans lequel on donne à chacun des douze paramètres une valeur numérique comprise entre 0 et 1 à 0,1 d'intervalle. La valeur de chaque paramètre est alors portée sur un rayon correspondant dans un système polaire, les "mauvaises" qualités étant vers le centre et les "bonnes" qualités à la circonférence formée par les extrémités des 12 rayons. On trace alors un profil en dessinant des lignes droites entre deux points sur des rayons adjacents, la superposition des profils de divers échantillons permettant une comparaison facile.

* * *

Les effets du gel sur la canne à sucre et le comportement, dans l'usine, des cannes touchées par le gel. H. A. NAQVI et S. M. ALAM. *p.* 200–203

Des études dans la sucrerie des auteurs au Pakistan ont montré les effets nocifs du gel (qui se produit tous les 3–4 ans) sur la canne et son traitement subséquent. On donne les résultats de fabrication pour 1966/67–1974/75 et on dit quelques mots sur la résistance au gel de variétés spécifiques. L'irrigation dès que la température descend et que le gel s'annonce a aidé à protéger les cannes.

Der Einfluss der Köpfhöhe und anderer pflanzenbaulicher Massnahmen auf Rübenertrag und -qualität. Teil II. P. J. LAST, A. P. DRAYCOTT und R. HULL. *S.* 193–197

Die Verfasser diskutieren den Einfluss des Erntetermins und der Lagerung auf den Gesamtzuckergehalt der Rübe und die Rübenqualität. Die Ergebnisse lassen erkennen, dass beträchtliche Zuckermengen auf dem Feld blieben wenn das Köpfen nach der im Vertrag zwischen der British Sugar Corporation und den Rübenanbauern festgelegten Methode erfolgte. Diese Zuckermenge war dann am grössten, wenn grosse Wurzeln durch Beregnen von Rübenbeständen zu geringer Bestandesdichte erhalten wurden. Durch Ernten der Köpfe jedoch wurde die Menge an den hauptsächlichsten Verunreinigungen, besonders an α-Aminosäurestickstoff, gesteigert. Diese Verunreinigungen erhöhten sich gegenüber den im November gefundenen Mengen nach zweimonatiger Lagerung um 17%, während der Invertzucker um 16% stieg. Dagegen stiegen die Werte bei normal geköpften Rüben um 12 bzw. 10%. Wenn grössere Köpfe zur Fabrik gelangen, erhöht sich der Entzug aller wichtigeren Nährstoffe wesentlich, und es ist eine Korrektur der empfohlenen Düngerzusammensetzung erforderlich.

* * *

Die Bestimmung der Rohzuckerqualität. F. H. C. KELLY. *S.* 197–200

Es wird ein System zur Bestimmung der Qualität von zur Raffination bestimmtem Rohzucker beschrieben, in welchem jeder der zwölf Parameter einen Zahlenwert im Bereich von 0 bis 1 in Abstanden von 0,1 erhält. Der Wert für jeden Parameter wird dann in einem polaren System entlang des entsprechenden Radius aufgetragen: "mindere" Qualitäten liegen in der Nähe des Mittelpunktes und "gute" Qualitäten an dem durch die Enden der 12 Radien gezogenen Kreis. Durch Verbindungsgeraden zwischen zwei Punkten auf benachbarten Radien werden Profilstücke erhalten. Durch Aufeinanderlegen der Profilstücke für verschiedene Proben ist leicht ein Vergleich möglich.

* * *

Der Einfluss von Frostperioden auf Zuckerrohr und das Verhalten des dem Frost ausgesetzten Rohres in der Fabrik. H. A. NAQVI und S. M. ALAM. *S.* 200–203

Untersuchungen in der Fabrik der Verfasser in Pakistan haben den nachteiligen Einfluss von Frostperioden—wie sie in Abständen von drei bis vier Jahren auftreten—auf Zuckerrohr und die spätere Verarbeitung gezeigt. Es werden Betriebsergebnisse für die Jahre 1966/67 bis 1974/75 mitgeteilt und auf die Frostresistenz spezifischer Sorten Bezug genommen. Eine Bewässerung unmittelbar nach Senkung der Temperatur und nach Erscheinen vom Frost trägt zum Schutz des Zuckerrohres bei.

La influencia del nivel de descoronaje y otros factores culturales sobre rendimiento y calidad de la remolacha. Parte II. P. J. LAST, A. P. DRAYCOTT y R. HULL. *Pág.* 193–197

Se discuten investigaciones de los efectos de la fecha de cosecha y de almacenaje sobre azucares totales y calidad de la remolacha. Resultas indican que cantidades notables de azúcar permanecen en el campo cuando es proseguido el procedimiento de descoronaje especificado en el contrato entre la British Sugar Corporation y los cultivadores, siendo la cantidad la mayor en el caso de raices grandes obtenido por regadío de cosechas de baja densidad de planteación. Sin embargo, cosecha de las coronas aumentó las impurezas mayores, especialmente los compuestos α-aminonitrogenosos; estos compuestos se aumentaron 17% despues de 2 meses de almacenaje, mientras que azucares invertidos se aumentaron 16%, en comparación con las cantidades presente en noviembre; en remolachas descoronado normalmente, los aumentos fueron 12% y 10% respectivamente. Si más de la corona pasan a la fábrica, las cantidades de los mayores nutritivos removido del campo crecerían considerablemente y aplicaciones recomendados de abonos necesitarían ajustarse.

* * *

Evaluación de la calidad de azúcar crudo. F. H. C. KELLY. *Pág.* 197–200

Se describe una sistema para evaluar la calidad de azúcar crudo para refinación en que cada uno de doce parámetros es dado un valor numérico en la gama 0–1 en intervalos de 0·1. El valor de cada parámetro es marcado a lo largo de un radio corespondente en un dibujo polar, siendo "malas" calidades acerca del centro y "buenas" calidades a la circunferencia formado por los términos do los 12 radios. Se produce un perfilo por delineación entre dos puntos en radios adyacentes, y superimposición de perfilos para diferentes muestras permite comparación sencilla.

* * *

Efectos de helada sobre caña de azúcar y el comportamiento en la fábrica de caña afectado por helada. H. A. NAQVI y S. M. ALAM. *Pág.* 200–203

Invenstigaciones en la fábrica de los autores en Pakistan han indicado los efectos adversos sobre caña y su tratamiento subsecuente de helada que ocurren en ciclos de 3–4 años. Resultas de elaboración se presentan para 1966/67–1974/75 y los autores refieren a la resistencia contra helada de variedades específicas. Aplicación de agua de regadío luego que hay una caída de temperatura y hay señales de helada asisten proteger la caña.

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII JULY 1976 No. 931

Notes & Comments

ISJ Panel of Referees

Following his retirement from the service of Générale Sucrière of France, M. GEORGES PIDOUX decided also to retire from our Panel of Referees. We are much obliged to him for his valued help in maintaining the standard of the articles published in our pages.

We are very furtunate in obtaining the agreement of Mr. STEPHEN STACHENKO to take the place of M. PIDOUX on our Panel. Born in France, Mr. STACHENKO graduated from the University of Aix, Marseilles, and obtained his M.Sc. at the Sorbonne in Paris. His career in the sugar industry dates from his work in the late 1940's with Professor DĚDEK after which he carried out research and development work for the Groupement Technique de Sucrerie, becoming Chief Chemist in 1951. In 1954 he joined Canada & Dominion Sugar Co. Ltd., now Redpath Sugars Ltd., as Assistant Chief Chemist, becoming Chief Chemist of the Montreal refinery in 1957. Subsequently he was appointed Company Chief Chemist in 1963, General Manager of Research and Development in 1969 and President in 1975. Mr. STACHENKO will thus bring many years of expertise in beet sugar processing and sugar refining to the assessment of articles submitted for publication and we are sure that our readers will, like us, be grateful to him for doing so.

* * *

European sugar production 1977

F. O. Licht K.G. have recently produced[1] calculations of potential sugar production in Europe from the 1976/77 crop on a basis of their first estimate of beet areas and the highest, average and lowest sugar yields per hectare achieved during the period 1972/73 –1975/76. The corresponding production figures are 16,225,000, 15,365,000 and 14,428,000 metric tons, raw value, for Western Europe and 15,342,000, 13,976,000 and 12,872,000 tons for Eastern Europe, giving totals of 31,567,000, 29,341,000 and 27,300,000 tons.

This last figure represents an increase of 745,000 tons or 2·81% on actual production from the 1975/76 campaign while the average yield calculation represents an increase of 2·8 million tons or 10·47%. On the basis of highest yields during the last four campaigns (which in most cases were exceeded in 1971/72) European production could be 5 million tons or 18·88% more than in 1975/76.

However, experience has shown that there are always adjustments to the first area estimates during the year, because these are usually based on target figures, and it is usual to find a reduction although not a large one. On the other hand, the average yield of sugar per hectare for the past four campaigns includes the very poor results of the past two campaigns and, given normal weather conditions, sugar yields might be higher than the averages on which the intermediate figures were calculated.

Weather during the growing season is, of course, all-important, but it seems reasonable to anticipate a considerably higher sugar production in Europe in 1975/76.

* * *

Dominican Republic sugar policy

It was reported[2] that the Dominican Republic State Sugar Council planned to store the entire current export crop of 1·25 million metric tons of sugar rather than selling at existing prices. The Council's executive director, RAFAEL DAVID RODRIGUEZ, said that some of the sugar is being stored in converted hangars, while the bulk of the remainder is in privately-owned factories where there is still spare capacity. Both the Council, which controls about two-thirds of the country's sugar exports, and private exporters have said they will store the sugar until prices rise. In March, the Council refused bids of up to 15·52 cents per lb on the New York market, and also rejected an unspecified offer from the Venezuelan Government for 100,000 tons.

However, sales to two refiners were announced at the beginning of May totalling 300,000 tons at world prices plus a 40-points premium, which indicates that the policy may have been changed[3].

* * *

Sugar Board payments

The 1975 Report and Accounts of the UK Sugar Board indicates exchequer payments to Tate & Lyle Ltd. and Manbré & Garton Ltd. of £93,800,000 last year to balance the sugar equalization scheme introduced in 1974 to even-out the difference between prices of beet and cane sugar. Although the programme was intended to be self-balancing, the price guaranteed for raw sugar imported in 1975 from ACP countries pushed equalized prices up, so that the scheme could no longer be kept in balance, and payments started from early June. Their level rose as successive reductions in equalized prices were agreed by the Ministry of Agriculture, Fisheries & Food in order to meet competition from sugar produced elsewhere in the EEC. As stated earlier[4], the Board is to be abolished this year.

[1] *International Sugar Rpt.*, 1976, **108**, (7), 1–4.
[2] *The Times*, 15th April 1976.
[3] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (13), 7; (14), 9.
[4] *I.S.J.*, 1976, **78**, 32.

Beet sugar *vs.* cane sugar

Against the background of the talks between the ACP countries and the EEC over the price to be paid for imported cane sugar, a battle is taking place in the UK between advocates of beet sugar who want to enlarge its share of the market and the sugar refiners who see their future somewhat threatened now that the UK is a member of the EEC which is within sight of self-sufficiency in sugar. The Chief Executive of the British Sugar Corporation, Mr. JOHN BECKETT, stands by the Corporation's £100 million programme of modernization and expansion and argues[1] that the UK would have greater security of supply at one of the most competitive prices in Europe with a crop that produced valuable residues for animal fodder. He sees cane as demonstrably unreliable, because in 1974 supplies due for the UK were diverted to more lucrative markets, and is of the opinion that expansion of the beet sugar industry would help to ensure that the UK "does not suffer another sugar crisis when it can so easily be held to ransom by outside suppliers". On the cane side, it has been argued by the Chairman of Tate & Lyle, Mr. JOHN LYLE, that recent beet sugar crops have fallen well below expectation and that the existence of two possible sources of sugar supply is vital for consumers. The relative costs of beet sugar production and cane sugar refining have also been brought into the debate, with claims and counter-claims being made. With the future of the refining industry at stake, the battle may be somewhat prolonged.

* * *

World sugar production, 1975/76

F. O. Licht have recently published[2] their third estimate of world sugar production for the crop year 1975/76. As can be seen from the table reproduced elsewhere in this issue, the world figure is approximately 1 million metric tons lower than that given in the second estimate[3]. Of this, 700,000 tons is represented by a reduction in the expected USSR crop, while the EEC figure has been reduced by 80,000 tons, a sharp fall in the UK crop figure and reductions in those for Denmark, France and West Germany not being balanced by increases in the figures for the other EEC countries. For the whole of Europe, however, the figure is still some 1,800,000 million tons up on that for 1974/75, despite severe and prolonged periods of high temperature and drought. Of the 580,000-ton reduction given for cane sugar, the bulk is represented by a drop in the figure for India, where output is given as 4,850,000 tons against 5,375,000 in 1974/75. Much blame for the disappointing 1975/76 crop is attached to poor weather throughout the world, and plantings at the same level for 1976/77 should give a higher quantity of sugar provided normal climatic conditions occur; however, some concern is already being expressed about the very dry springtime conditions in Europe and the effects these can have on the beet crop.

* * *

Symposium on EEC beet sugar

Some 40 leading users of sugar in the UK, between them responsible for more than half of the country's annual consumption, participated in a 2-day symposium on 6th–7th May to gain a closer insight into the economics of using EEC beet sugar. Entitled "Sugar in the EEC", the symposium was held at Versailles and included talks by leading EEC sugar producers, explaining their traditions, methods and problems, and by major users on the advantages and disadvantages of EEC sugar. M. CHRISTIAN BONNET, the French Minister of Agriculture, addressed the meeting, at which the UK Government was represented by Mr. JOHN DIXON, Head of the Sugar Division at the Ministry of Agriculture, Fisheries & Food.

The symposium was the idea of a recently-established UK company, Sugar Traders, based at Heswall, Merseyside. According to one of its senior directors, because of the fundamental differences between the marketing and production of cane sugar, on which the UK has relied so heavily in the past, and beet sugar, on which the country will rely increasingly in the future, the time was ripe to explore and discuss these differences.

* * *

World sugar prices

During the first two weeks of May prices moved violently, the London Daily price for raw sugar reaching a high of £205 before some first-hand producer selling sent it falling nearly £20 to a low of £186 before steadying around the lower £190's. The reason for the sudden rise, according to E. D. & F. Man[4], was once again rumours of further Soviet purchases, the knowledge of the Venezuelan need and a large speculative and commission house interest brought about by the exceptionally dry weather in Europe. With denial of purchasing interest by the USSR, fulfilment of Venezuela's requirements and arrival of some rain for the beet fields of Europe, the LDP fell and gently eased to £186 by the 1st of June.

The LDP(W) or white sugar daily price started May at £2 below that of raws but, with speculation about the possible effects of the dry weather on the beet crop in Europe, it overtook the LDP and the gap between the two widened, eventually reaching £9 on the 1st of June.

* * *

European beet area, 1976

F. O. Licht recently published his third estimate of European sugar beet areas for the 1976 crop[5] which, at a date of 21st May, probably represents figures very close to the final ones since it is unlikely that any re-sowing would take place after his enquiries were made. There are a number of changes for individual countries in Western Europe compared with the 2nd estimates but the overall area is about the same, at 2,689,015 hectares, compared with 2,532,371 in 1975, a 6·19% increase. East European beet sowings are also only very slightly up on the previous estimate, with a total of 5,216,244 ha as against 5,100,880 ha or a 2·26% increase in the 1976 crop area compared with last year.

Computer system for sugar brokers.—A demonstration was recently made by the Matra Consulting Group of a new system designed for commodity brokers which, by use of a Varian minicomputer, aided by a line printer and television terminal, provides extremely rapid, multi-access information retrieval and report generation. The computers maintain a data bank of up-to-date information on physical and future contracts, customers and suppliers and provides information on a basis of simple commands which can be used by the brokers themselves without the need of specialist computer staff.

---

[1] *The Times*, 13th April 1976.
[2] *International Sugar Rpt.*, 1976, **108**, (12), 1–4.
[3] *I.S.J.*, 1976, **78**, 95.
[4] *The Sugar Situation*, 28th May 1976.
[5] *International Sugar Rpt.*, 1976, **108**, (15), 1–3.

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 II

Total sugar

The total sugar per root was increased by irrigation at each density and, overall, whole unirrigated beet contained 184 g/root whereas irrigated beet contained 220 g/root. On average, sugar contained in the crown was increased from 17·3 to 25·8 g/root by irrigation, a proportional increase from 9·4 to 11·8% of the total amount present. The amount of sugar in all plant sections decreased with root size, but with the dense crop more than 90% of the sugar present was in the normally-topped beet, whereas at 19,000 plants.ha^{-1}, less than 85% of the sugar was in the normally-topped beet.

Effect of harvest date and storage on quality

Averaged over two years, whole beet weighed 14% more than normally-topped beet, whilst scalped beet were 11% heavier than the normally-topped beet. The scalp and crown weighed most in December and were a higher proportion of the total weight than in the previous harvests (Table IV). On average, the roots increased in weight between first and second harvests by about 10% and the normally-topped beet increased from 552 g to 592 g in this period. The sugar concentrations were at a maximum during November in all root sections, and all marginally declined by December. The normally-topped beet decreased from 18·82% to 18·56%, whilst the sugar concentration in the scalp and crown in November of 13·21 and 15·47% respectively, decreased to 12·93 and 15·24% in December.

and 18·04% respectively,; normally-topped beet weighed 575 g, scalped 636 g and whole beet 651 g.

Total sugar contained in each untopped root was maximal in the second harvest (122 g/root) but declined to 120 g/root by the December harvest, whilst after two months' storage, total sugar/root decreased to 114 g.

Table V shows the major impurities present in the beet at each harvest and in the stored sample. The results confirm those of 1970–71, in that the scalp and crown contained a greater concentration of each impurity than the normally-topped beet. The relative concentrations of the impurities in the scalp and crown showed some variation throughout the sampling period, but for potassium, sodium and invert sugars the concentrations in the crown and scalp were greatest at the first harvest.

Potassium concentration per 100 g of sugar in the normally-topped beet decreased from 908 to 812 mg during the autumn, but decreased only marginally in the crown. Sodium was most concentrated at the first harvest in all three root sections, although sodium levels of 505 mg/100 g sugar in the scalp were reduced by half in the subsequent harvest. Storage of roots for two months caused large increases in α-amino-N concentrations in all root sections, amounting to 17, 15 and 12% in the whole, scalped and normally-topped beet, respectively, relative to the amounts present two months earlier; because of loss of sugar during the storage period, these showed larger increases when related to 100 g sugar—25%, 23% and 22%, respectively (Table VI).

Table IV. Weights of whole, scalped and normally-topped beet and of each constituent section with associated sugar yields. Means of 1972-73

	October harvest	*November harvest*	*December harvest*	*Stored beet (from Nov. harvest to mid-Jan.)*	*Standard Error of Differences*
			Root weight (g/root)		
Scalp	15·3	14·5	16·0	17·2	±1·5
Crown	56·9	57·5	69·1	61·2	±2·7
Normally-topped beet	551·5	591·7	581·1	566·9	±13·1
Scalped beet	608·4	649·2	650·2	628·1	±13·7
Whole beet	623·7	663·7	666·2	645·4	±14·9
			Sugar %		
Scalp	11·60	13·21	12·93	12·16	±0·17
Crown	15·15	15·49	15·24	14·59	±0·26
Normally-topped beet	18·06	18·82	18·56	18·18	±0·21
Scalped beet	17·79	18·53	18·20	17·84	±0·20
Whole beet	17·64	18·41	18·08	17·68	±0·19
			Total sugar (g/root)		
Scalp	1·81	1·91	2·08	2·09	±0·37
Crown	8·61	8·94	10·54	8·93	±0·66
Normally-topped beet	99·65	111·5	107·8	103·1	±2·83
Scalped beet	108·3	120·4	118·3	112·0	±2·62
Whole beet	110·1	122·3	120·4	114·1	±2·57

After storage for nearly two months, the sugar concentration in the scalp and crown decreased to 12·16% and 14·59%, respectively, and in the normally-topped beet by 0·64% to 18·18%. Averaged over the three monthly samples, normally-topped, scalped and whole beet had sugar concentrations of 18·48, 18·17

The concentration of invert sugars decreased throughout the harvesting period in all plant sections, but storage caused sharp increases in the amount of invert sugars, particularly in the scalp where invert per 100 g sugar increased from 1·342 to 2·179 g. In the same storage period, invert sugars in the normally-

Table V. Impurities present in the scalp, crown and normally-topped beet and the calculated amounts in whole and scalped beet. Means of 1972-73

	October harvest	*November harvest*	*December harvest*	*Stored beet (from November harvest to mid-January)*	*Standard Error of Differences*
		Potassium (mg/100 g sugar)			
Scalp	2525	1965	1930	2201	±64
Crown	1454	1423	1429	1485	±51
Normally-topped beet	908	838	812	856	±21
Scalped beet	952	881	867	906	±24
Whole beet	974	898	885	930	±25
		Sodium (mg/100 g sugar)			
Scalp	505	256	272	269	±29
Crown	204	164	191	176	±18
Normally-topped beet	68	55	64	66	±7
Scalped beet	79	63	75	75	±8
Whole beet	85	67	78	79	±8
		α-amino-N (mg/100 g sugar)			
Scalp	898	963	1008	1199	±48
Crown	511	587	582	721	±43
Normally-topped beet	176	181	164	221	±9
Scalped beet	202	211	201	261	±12
Whole beet	213	223	215	278	±13
		Invert sugars (g/100 g sugar)			
Scalp	2·226	1·342	1·148	2·179	±0·106
Crown	0·770	0·750	0·682	0·946	±0·057
Normally-topped beet	0·399	0·382	0·358	0·458	±0·025
Scalped beet	0·429	0·410	0·386	0·497	±0·028
Whole beet	0·457	0·426	0·400	0·527	±0·030
		Juice purity (%)			
Scalp	81·85	83·42	83·43	81·90	±0·94
Crown	87·08	87·80	88·23	87·33	±0·76
Normally-topped beet	93·90	93·97	94·12	93·77	±0·22
Scalped beet	93·26	93·42	93·50	93·14	±0·27
Whole beet	92·98	93·20	93·25	92·84	±0·29

Table VI

1972–73

(*i*) Percentage increase in each major impurity in whole (B_1) and scalped beet (B_2) compared with the amount present in normally-topped beet (D_3), relative to 100 g sugar.

		α-amino-N	*Invert sugars*	*Potassium*	*Sodium*
Mean of 3 harvests:	B_1	25	13	8	24
	B_2	16	7	6	16
November harvest:	B_1	23	12	7	22
	B_2	17	7	5	15
Storage sample:	B_1	26	15	9	20
	B_2	18	9	6	14

(*ii*) Percentage increase in impurity per root caused by harvesting crown and scalp, relative to the amount present in the normally-topped beet

		α-amino-N	*Invert sugars*	*Potassium*	*Sodium*	*Root yield*	*Total sugar*
Mean of 3 harvests:	B_1	39	25	20	38	14	9
	B_2	29	18	15	27	11	8
November harvest:	B_1	34	22	17	32	13	8
	B_2	23	15	10	23	10	7
Storage sample:	B_1	39	27	20	33	14	8
	B_2	28	18	15	24	11	7

(*iii*) Percentage increase in impurities caused by storage, relative to the amount present in the previous November

	α-amino N	*Invert sugars*	*Potassium*	*Sodium*
B_1	17	16	Unchanged	
B_2	15	13	,,	
D_3	12	10	,,	

topped beet increased from 0·382 g to 0·458 g/100 g sugar.

The main effects of storage on juice purity are shown in Table V. When averaged over the two years the juice purity of the normally-topped freshly harvested beet increased by 0·22% from October to December, but storage of the beet resulted in a lowering of juice purity by 0·20%. However, the large increases in α-amino-N in the scalp during storage not only caused the juice purity of the scalp to decrease from 83·42 to 81·90%, but contributed to a lowering of the juice purity in whole beet from 93·20 to 92·84%.

If whole and scalped beet were harvested for processing, their juice purity would be lowered by 0·85% and 0·60% compared with normally-topped beet, which averaged 94·00% over the three monthly harvests.

Total sugar

The amount of sugar per root was greatest in beet which were harvested in mid-November when the normally-topped beet contained 111·5 g sugar (Table IV), decreasing to 107·8 g by the following month. After storage, the beet harvested in November contained only 103·1 g sugar/root. The amounts of sugar

present in the normally-discarded tissues were at their highest values in December. Although the scalp weight increased little during the harvest period, the crown increased to 10% of the total weight in December.

Analysis of dry matter

Table VII shows percentage dry matter and analyses of the dried beet sections for phosphorus, magnesium and calcium.

in the December sample. The concentration of magnesium in the dry matter was also highest in the scalp section, on average 0·124%, but decreased in value from 0·15 to 0·11% from October to December; in the normally-topped beet it was 0·11% throughout the harvesting period. The calcium concentrations in the beet sections were greater than either the phosphorus or magnesium concentrations, but again the largest concentrations were found in the scalp and

Table VII. Chemical analysis and dry matter percentage

1972–73	*Phosphorus % dry matter*	*Magnesium % dry matter*	*Calcium % dry matter*	*Dry matter*
Scalp	0·250	0·124	0·53	22·5
Crown	0·185	0·098	0·52	23·2
Normally-topped beet	0·120	0·105	0·29	24·0

1970–71	*Phosphorus*		*Magnesium*		*Calcium*		*Dry matter*	
	I_o	I_w	I_o	I_w	I_o	I_w	I_o	I_w
Scalp	0·23	0·27	0·102	0·121	0·62	0·53	25·1	24·0
Crown	0·16	0·19	0·077	0·091	0·70	0·60	26·2	25·7
Normally-topped beet	0·11	0·13	0·088	0·096	0·31	0·25	25·6	24·5

Table VIII. Weights of magnesium, calcium and phosphorus in each root section, and their percentage increase in whole and scalped roots, relative to the amounts in normally-topped beet

(*i*) g/root section

	1971*			1972–73		
	Magnesium	*Calcium*	*Phosphorus*	*Magnesium*	*Calcium*	*Phosphorus*
Scalp	0·006	0·033	0·015	0·004	0·019	0·009
Crown	0·018	0·128	0·036	0·014	0·074	0·026
Normally-topped beet	0·143	0·391	0·188	0·144	0·399	0·165

* S_3 spacing only (75,000 plants/ha)

(*ii*) Percentage increase in magnesium, calcium and phosphorus uptake, relative to the amount present in the normally-topped beet

	1971			1972–73		
	Magnesium	*Calcium*	*Phosphorus*	*Magnesium*	*Calcium*	*Phosphorus*
Whole beet	16·8	41·1	27·1	12·7	23·2	21·2
Scalped beet	12·6	32·7	19·2	9·6	18·5	15·7

1970–71: The concentration of phosphorus was highest in the scalp, 0·25%, and lowest in the normally-topped beet at 0·12% when averaged over density and irrigation treatments, and the pattern was unaltered either by plant density or irrigation. Irrigation increased phosphorus concentration in the dry matter in all plant sections. Increasing the plant density decreased phosphorus percentage on dry matter in the normally-topped beet but had no consistent effect on the phosphorus in the scalp or crown.

The magnesium concentration of the scalp at 0·112% was greater than in either of the two larger sections of the root but, as in the 1972–73 investigation, when averaged overall, the crown contained the lowest concentration of magnesium, 0·084%. Irrigation increased the magnesium percentage on dry matter in all three sections averaged over all plant densities. The effect of plant density on magnesium concentration was irregular in the crown and scalp but decreased the magnesium percentage on dry matter of the main storage root consistently as the density increased and root size diminished. The concentration of calcium in dry matter of the crown was unaffected by plant density, but was increased markedly in the normally-topped beet and to a lesser extent in the scalp by growing the plants closer.

1972–73: Averaged over years and harvests, the concentration of phosphorus followed the pattern of the major impurities and was greatest (0·25%) in the scalp, decreasing to 0·12% in the normally-topped beet. All concentrations in each section were lowest crown. The concentrations of all three constituents decreased in the scalp as the plants aged, but results were more variable for the other two sections. Storage had no effect on the concentration of phosphorus, magnesium or calcium in any plant section.

Discussion

Both investigations showed that appreciable amounts of sugar were left in the field by following the topping procedure defined in the contract between the British Sugar Corporation and growers and the amount was greatest with large roots obtained by irrigating crops of low plant density. All major impurities were, however, increased by harvesting the crown and scalp, confirming results published by CARRUTHERS *et al.*[9], and the largest increase was in α-amino nitrogen compounds. The initial trimming procedure used in the preparation of the beet samples eliminated some material from the upper and outer parts of the crown (epicotyl) where invert sugars are concentrated[2]. Analysis of the scalp and crown in our experiments in 1970–71 showed them to contain, on average, invert sugar concentrations, respectively, of 1·50 and 0·71 g/100 g sugar. This would cause processing problems[10], but the invert sugars in the crown never exceeded 0·95 g/100 g sugar even at very low plant densities or after storage for two months, although the amount of invert sugars in the crown was

[9] *I.S.J.*, 1966, **68**, 297–302.

[10] OLDFIELD: Symposium on "The Importance of Chemical Quality Determinations on Sugar Beet from Field Experiments" held at Broom's Barn Experimental Station, 1971.

Appendix Table IX

Effect of density and irrigation on the various plant sections in 1970-71

D_1 Scalp
D_2 Crown
D_3 Normally-topped beet
B_2 Scalped beet
B_1 Whole beet

	S_1	S_2	S_3	S_4	S_{4x}	I_o	I_w	*Mean*
Sugar %								
D1	12·94	13·27	13·28	13·07	12·77	13·52	12·62	13·07
D2	15·74	16·04	16·15	16·07	15·40	16·21	15·55	15·88
D3	18·13	18·48	19·36	19·34	19·61	19·17	18·79	18·98
B2	17·79	18·17	19·02	19·01	19·20	18·88	18·40	18·64
B1	17·59	17·99	18·84	18·85	19·00	18·70	18·21	18·46
Juice purity								
D1	84·70	84·67	85·01	85·25	84·53	85·42	84·24	84·83
D2	88·81	89·18	89·36	89·79	88·87	89·40	89·00	89·20
D3	92·40	92·71	93·54	94·05	94·14	93·02	93·72	93·37
B2	91·89	92·25	93·08	93·61	93·62	92·64	93·14	92·89
B1	91·59	91·98	92·82	93·39	93·34	92·40	92·86	92·63
Potassium (mg/100 g sugar)								
D1	1852	1829	1896	1774	1918	1809	1899	1854
D2	1281	1215	1268	1193	1327	1239	1274	1257
D3	1089	963	874	788	697	934	830	882
B2	1112	992	910	823	746	959	875	917
B1	1135	1014	931	829	773	980	892	936
Sodium (mg/100 g sugar)								
D1	436	394	390	362	405	379	416	398
D2	272	224	211	184	202	216	221	219
D3	166	160	110	86	79	134	106	120
B2	180	167	119	95	89	141	118	130
B1	187	172	125	100	96	147	124	136
α-amino-N (mg/100 g sugar)								
D1	922	946	888	898	938	862	975	919
D2	609	595	564	538	614	565	603	584
D3	245	240	177	142	156	218	165	192
B2	291	280	213	177	192	249	212	231
B1	309	297	227	189	214	264	228	246
Invert sugars (g/100 g sugar)								
D1	1·542	1·361	1·425	1·520	1·643	1·416	1·581	1·499
D2	0·800	0·632	0·689	0·691	0·767	0·731	0·701	0·716
D3	0·448	0·421	0·381	0·395	0·367	0·423	0·381	0·402
B2	0·492	0·444	0·411	0·421	0·394	0·452	0·414	0·433
B1	0·525	0·468	0·432	0·442	0·419	0·475	0·440	0·458
Root weight (g/root)								
D1	93	57	25	15	12	37	43	40
D2	323	188	81	55	36	109	165	137
D3	1917	1292	669	482	333	863	1014	939
B2	2240	1480	750	537	369	972	1179	1076
B1	2333	1537	775	552	381	1009	1222	1116
Total sugar (g/root)								
D1	11·9	7·5	3·2	1·9	1·5	5·0	5·4	5·2
D2	50·7	29·9	12·9	8·7	5·6	17·3	25·8	21·6
D3	347·4	238·4	129·2	93·2	65·1	161·7	187·6	174·7
B2	398·2	266·9	142·2	102·0	70·7	179·1	212·9	196·0
B1	410·1	275·8	145·4	103·9	72·2	184·1	219·5	201·8

greater than in the root by 33% in 1970–71 and 25% in 1972–73.

When averaged over the two investigations, the smaller sugar concentrations in the crown and scalp sections decreased sugar percentage from 18·73 in the normally-topped beet to 18·40 and 18·25, respectively, in the scalped and whole roots. Also, even if the crown and scalp material were accepted as suitable processing material, this would need about 20% extra root slicing capacity at the factories in order to maintain the present average length of campaign but would increase yield of pulp. Alternatively, greater quantities of beet might have to be stored, and in 1972–73 the whole beet tested under our storage conditions decreased in sugar concentration from 18·53 to 17·84% when stored for nine weeks. The α-amino-nitrogen and invert sugars were increased by storage and, overall, the gain in sugar obtained by harvesting whole beet in November would probably be nullified if these beet were stored for long periods prior to being processed. Invert sugars also increased during storage from 0·43 g to 0·53 g/100 g sugar in whole beet; this was particularly noticeable in the scalp where the invert sugars increased from 1·34 to 2·18 g/100 g sugar, making it even more unsuitable for processing. In the crown, the invert sugars increased from only 0·75 to 0·95 g/100 g sugar which, although undesirable, may be processable. Both potassium and sodium were present in much greater concentrations in the scalp and crown, compared with the amount present in normally-topped beet (Table II). They were both increased, relative to sugar yield in the normally-topped beet, by decreasing plant density, but effects in the crown were more variable. Irrigation increased the potassium and sodium concentrations per 100 g sugar in both crown and scalp, but decreased their concentration in the normally-topped beet.

Potassium and invert sugar concentrations/100 g sugar decreased in each section regularly from October to December but results were more variable for sodium and α-amino-nitrogen concentrations. The very large concentrations of sodium, potassium and invert sugars in the scalp during the October harvest resulted in a very low juice purity for these parts but their concen-

tration decreased greatly by the second harvest. Whilst the October-harvested beet, on average, contained the highest proportion of non-sugar in 1972–73, beet quality was lowered at each harvest by the additional crown and scalp material. Storage increased α-amino-nitrogen in whole roots from 223 to 278 mg/100 g sugar which was the largest proportionate increase. This was assumed to be mainly glutamine, whose breakdown products, glutamic acid and pyrrolidone carboxylic acid, have a deleterious effect on the buffering capacity of the carbonatation juices and thus increase sugar losses and molasses production.

For processing reasons, it is convenient to relate individual impurities to a fixed weight of sugar contained by the root; alternatively, Tables III and VI also show the percentage increase per root for each impurity caused by harvesting whole and scalped roots. This demonstrates the large increases in impurities resulting from including scalp and/or crown.

Higher topping or scalping would increase the offtakes of all major nutrients, potassium, sodium, magnesium, phosphorus and nitrogen (Tables III, VI and VIII). Large reserves of phosphorus and calcium are available in most United Kingdom soils, but the recommended fertilizer dressings for the other nutrients would need amendment, even though a large proportion of the magnesium and phosphorus enters the factory waste lime and is recycled between growers and processors.

Summary

Sugar beet from field experiments investigating effects of plant density and irrigation in 1970–71 and of harvest date and storage in 1972–73 were weighed and analysed for sugar concentration, invert sugars, α-amino-nitrogen and major inorganic constituents. After removing all green material, measurements were also made on the scalp and on the crown which are normally discarded in the United Kingdom. The weight of the completely untopped beet was 16% greater on average than the normally-topped beet and the scalped beet weighed 13% more. The sugar concentration in the crown and scalp was considerably lower than in the main storage root. Overall, the amount of sugar per root increased from 140 g/root for normally-topped beet to 155 g/root for scalped beet and to 160 g/root for whole beet. All the impurities which decrease sugar extraction were, however, also increased by inclusion of crown or scalp.

When whole beet were stored for two months, the α-amino-nitrogen and invert sugars increased by 17 and 16% respectively, compared with amounts present in November. In the normally-topped beet, α-amino-nitrogen increased by 12% and invert sugars by 10%. Early in the season and also when stored, the scalp contained more than 2 g invert/100 g sugar; thus it would be unsuitable for processing by current methods of white sugar manufacture. The crown contained no more than 1 g invert/100 g sugar which is an undesirable concentration but would not render it unacceptable. If more of the top was sent to the factory, the offtakes of all major nutrients would increase substantially and recommended fertilizer dressings would need adjustment.

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The evaluation of raw sugar quality

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RAW sugar is the product of sugar factories processing either cane or beet, but predominantly cane, which is purchased by sugar refiners who increase its quality for market purposes.

Normally raw sugar is evaluated in terms of polarization but a refinery is, in fact, concerned with a number of other parameters for effective quality specification. The extent to which the additional criteria are given consideration is largely influenced by the degree of competitiveness of the raw sugar market. The price of raw sugar, especially on the London market, is commonly accepted as an international criterion of the competitiveness, although only a small amount of sugar may actually be traded at this price, many sales being made on a long-term contract basis.

The price structure may be considered as being made up of two components which we might call the scarcity component which fluctuates very widely in response to the laws of supply and demand. The quality component is relatively stable and relates to the cost of converting the raw sugar to a refined product. The actual cost of refining any particular parcel of raw sugar has remained remarkably stable for many years.

To give an approximate indication of the relative magnitude of these two components, we might put a figure of £10 per ton for the quality component, which is not necessarily the cost of refining itself but is an attempt to evaluate the more stable component of the raw sugar price, which is sub-consciously part of the reckoning of the refiner when he makes a purchase.

The scarcity component has been subjected to wide fluctuations and during the past ten years has varied from £2.25 to a peak of £640. When the London market price of raw sugar is in the region of £20 much attention is given to a wide range of quality criteria and the supply so exceeds the demand that the purchaser is in a position to exercise selectivity in terms of quality criteria other than polarization. On the other hand, when the scarcity factor forces the price up to £300, £400 or even £600, the supply position is such that the refiner is usually glad enough to make any purchase without reference to quality criteria.

Nevertheless the refiner may well be beset with many problems arising from these criteria. Because of internal price controls within his country of operation he may be forced to carry out his refining process within a narrow range of cost.

No less than thirteen parameters of importance to the refiner have been indicated as contributing to the problem of evaluating the quality of raw sugar[1]. The very fact of the number being so large contributes to the complexity of the problem and it would be of substantial advantage to be able to amalgamate these into a single number for evaluation purposes.

This paper describes an endeavour to achieve this goal and is put forward as a first step or first approximation which, if basically acceptable, is of such a character that progressive refinements are possible.

The approach is made first of all in terms of a pictorial representation of quality and, secondly, a number evaluation of the picture.

A re-examination was made of the multiplicity of quality criteria with the object of reducing the number but still maintaining effective evaluation. Two answers were reached: (1) The total number was reduced from thirteen to twelve, and (2) an evaluation system was developed which can accommodate any desired number of criteria either more or less than twelve, according to the preference of the evaluator.

Pictorial representation

For pictorial representation a system involving polar coordinates has been preferred with radial evaluation of each parameter from the origin to the circumference of the circle enclosing the radii. Each radius represents one parameter which is graduated on a linear scale with ten units of value from the centre to the circumference.

It is necessary to observe consistency such that "good" qualities are at the circumference in all cases and "poor" qualities at the centre.

The quality value for each parameter for a particular sample of raw sugar is then point-marked on each of the appropriate radii. If adjacent points are joined by straight lines then a pictorial representation of the overall quality of the raw sugar may be observed, and styled the quality profile of the sample.

If quality profiles for different samples are superimposed then specific variations may readily be sighted and because of effective scaling the comparisons are quantitative.

Evaluation of criteria

The twelve parameters recognised by the author are as follows:

Polarization
Dilution indicator
Purity: impurity ratio
Reducing sugar: ash ratio
Mean average crystal size
Total crystal colour
Crystal shape
Filtrability
Crystal conglomerate concentration
Concentration of colour inclusions
Starch content
Coefficient of variation of crystal size

It is not essential to retain this particular order of arrangement—to a certain extent it has been randomly selected—but polarization necessarily remains in first position.

It is then necessary to devise a suitable means for numerical evaluation of each criterion for which a scale of 0—1 is preferred with decimalized steps as a first approximation and finer graduations according to the degree of precision which can be achieved.

Each criterion we may consider as an "influence" on the refining procedure and each has its own specific "effect". So we shall write the general equation

$$\% \text{ Effect} = \alpha(\text{influence} + \beta)^{\gamma}$$

where α, β and γ are constants in a generally applicable mathematical relationship.

We then need to specify appropriate units of measurement for each particular parameter. These are set out in Table I, together with suggested values for α, β and γ which will give suitable representation on the polar coordinates. In Fig. 1 is illustrated the twelve polar coordinates to be used for representing the raw sugar value profile.

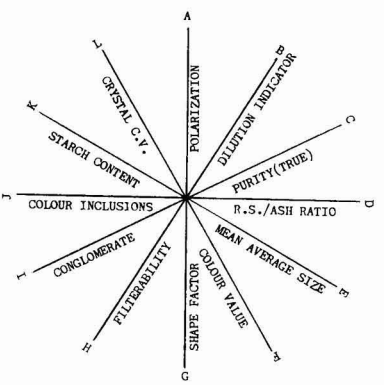

Fig. 1. Polar coordinates for radial representation of raw sugar quality parameters

In assessing values for α, β and γ for Table I, the influence of filtrability is not clear. It has generally been conceded that there is some relationship between the specific filtrability of raw sugar and the filtration characteristics of the calcium carbonate precipitate in the refinery. This has not been reduced to a mathematical relationship, nor an alternative suggested; hence a simple linear relationship has been used here.

[1] KELLY: *Proc. 15th Congr. ISSCT*, 1974, 1307.

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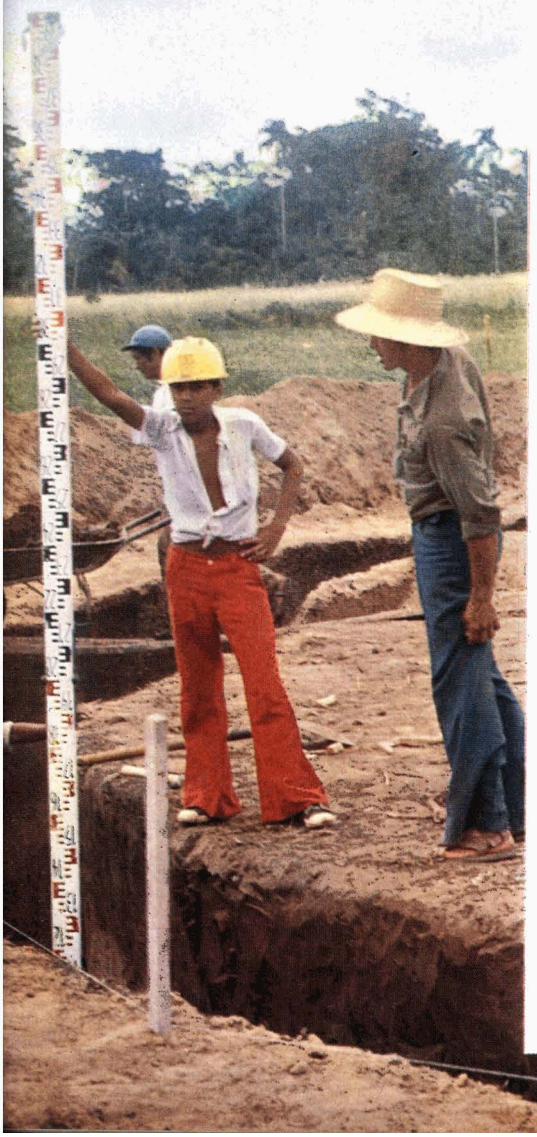

Bolivia's Santa Cruz project, designed to employ 300 people and process between 600,000 and 800,000 tons of cane a year, is a major element in the systematic expansion of the country's sugar industry.

Tate & Lyle first visited Bolivia in 1971 for initial discussions. The following year the company carried out a detailed study of the Bolivian sugar industry. In 1973, the Union Agroindustrial de Cañeros S.A. invited Tate & Lyle to prepare a detailed feasibility study. In 1974, against international competition, Tate & Lyle was awarded the contract for a turnkey sugar mill, refining facility, distillery and can-making plant with a total value of £10.6m. Local contractors are participating in the civil engineering and construction work. Tate & Lyle's continuous involvement in the Bolivian sugar industry has proved invaluable. It is utilising the company's ability to plan and carry out everything from site clearance and manufacture of heavy machinery through to final commissioning and technical aid with the cane cultivation programme.

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Table I

Parameter symbol	*Value Parameter for raw sugar*	*Measurement units for value parameter*	α	β	γ
A	Polarization	Optical rotation in standard units to 100 for pure sucrose	0·1	—90	1·0
B	Dilution indicator	$\frac{\text{Moisture content}}{100 - (\text{Pol} + \text{moisture})}$	—1·0	—1·0	1·0
C	Purity (True)	By direct analysis expressed as a percentage	—0·5	—100	—1·0
D	Reducing sugar:ash	Ratio of percentage concentration from direct analysis	0·8	0	—0·2
E	Mean average size	Size in mm below which 50% of the sugar crystals by weight are recorded by sieve analysis	1·0	0	2·0
F	Colour value	Standard technique for value in International Colour units	-10^{-4}	-10^{-4}	1·0
G	Shape factor	Sphericity of crystals (Ψ) = Surface area of sphere of same volume as crystal:S.A. actually exposed	0·5	0	—1·0
H	Filtrability	Specific filtrability relative to that of pure sucrose	1·0	0	1·0
I	Conglomerate	Specific concentration by weight	—1·0	—1·0	1·0
J	Colour inclusions	Specific volume occupied by inclusions occurring in crystals	—1·0	—1·0	1·0
K	Starch content	Concentration by analysis expressed in parts per million (ppm)	-10^{-3}	-10^{-3}	1·0
L	Crystal size variation (C.V.)	Coefficient of variation of crystal size as a "specific" value	—1·0	—1·0	1·0

Numerical evaluation

It is frequently more convenient to be able to express the profile in terms of a single number if such can be devised to give quantitative significance.

Since all numerical data for the twelve specified parameters have been reduced to linear relationships relative to a desired value of unity, we can take a simple arithmetic mean and specify such precision criteria as standard deviation or standard error. Two sugars may be compared by reference to the ratio of the arithmetic mean or by reference to a value obtained for a hypothetical average raw sugar representing the average of criteria for a twelve-month or other suitable period of time.

Alternatively the ratio of profile areas may be calculated and this is thought to have a more meaningful relationship to the actual cost of refining raw sugars of the quality indicated by the profile. This is likely to become more apparent if a lesser number of parameters (e.g. four) is employed for evaluation. Area values themselves are two dimensional whereas a one-dimensional measurement is really desired.

This may be achieved by calculating the radius of a circle of the same area as the profile and obtaining a specific value relative to the radius of the circle for which all parameter values are unity.

Such an evaluation is relatively straightforward, thus:

Area of profile for n parameters

$$= \tfrac{1}{2} \operatorname{Sin}\frac{360}{n} (OA.OB + OB.OC + OC.OD + \ldots + OL.OA)$$

$$\text{for perfect sugar} = \frac{n}{2} \operatorname{Sin}\frac{360}{n}$$

and the Profile Area Specific Radius =

$$\sqrt{\frac{OA.OB + OB.OC + OC.OD + \ldots + OL.OA}{n}}$$

In certain cases limits have been set for the parameters which may be adjusted to other values if desired. The following have been adopted for this exercise:

Purity (True) $\geqslant$ 99·5
0·5 $\geqslant$ R.S./Ash $\geqslant$ 3·0
M.A. Size $\geqslant$ 1·0 mm
Colour value $\geqslant$ 10,000 I.C.U.
Sphericity $\leqslant$ 0·5
Starch content $\geqslant$ 1000 ppm

Examples

Table II sets out the evaluation of analyses representing two shipments of raw sugar.

The ratio of the Arithmetic Mean Values is 1·4 whereas the ratio of the profile area specific radius values is 1·63. It should be possible from inspection of relative costs of refining the two shipments to identify which of the two numerical systems is more closely applicable.

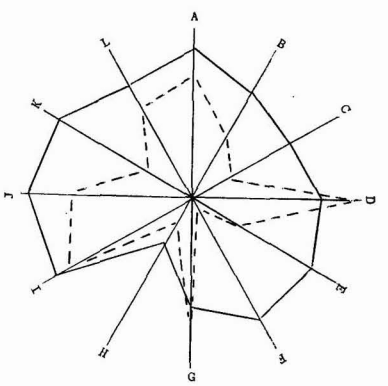


Fig. 2. Raw sugar quality profiles

It may well be that neither system is satisfactorily applicable and that one or more of the parameters should be more heavily loaded. For example, polarization and purity might require a threefold loading each. In the case of the arithmetic mean value such a loading is quite straightforward to accomplish arithmetically. In the profile area specific radius it is

simply necessary to add (p-1) and q-1) times the square of the polarization and purity parameter values and divide by ($p + q + n$) within the square root relationship (p and q are the loading factors for polarization and purity values respectively). For such a correction in the example given and for $p = q = 3$ the ratio of the profile area specific radius values would become 1·56 as compared with 1·47 for the ratio of arithmetic mean values.

Table II

	Parameter	Sample 1 Analysis	Sample 1 Parameter value	Sample 2 Analysis	Sample 2 Parameter value
A	Polarization	97·00	0·70	98·50	0·85
B	Dilution Indicator	0·60	0·40	0·30	0·70
C	Purity (True)	98·00	0·25	99·20	0·625
D	R.S.:Ash	2·00	0·92	0·70	0·75
E	M.A. Size	0·55	0·30	0·90	0·81
F	Colour	95·00	0·05	20·00	0·80
G	Shape	0·65	0·77	0·80	0·625
H	Sp. Filtrability	0·15	0·15	0·30	0·30
I	Conglomerate	0·20	0·80	0·10	0·90
J	Colour inclusions	0·30	0·70	0·05	0·95
K	Starch	7·00	0·30	1·00	0·90
L	C.V.	0·40	0·60	0·25	0·75
	Arithmetic Mean		0·50		0·72
	Profile Area / Specific Radius		0·46		0·75

Conclusion

Means for evaluating the quality of raw sugar with reference to a multiplicity of influencing parameters have been outlined but final selection must be in terms of real costs within a refinery. Furthermore, this evaluation bears little relationship to the scarcity component in the market price of raw sugar for which appropriate allowance should be made for fully effective evaluation.

Effects of frost on sugar cane and the behaviour of frost-affected cane in the factory

By HASAN ASKARI NAQVI, M.S. and S. MANSOOR ALAM, M.Sc.
(Fecto Sugar Mills Ltd., Darya Khan, Mianwali, Pakistan)

Introduction

AMONG the sugar cane-growing areas, frost is common in Louisiana, Texas, Iran, Pakistan and certain other temperate areas of higher elevation. In such places researches have been made with great emphasis on the selection and development of frost-resistant cane varieties, on the classification and nature of frost damage and on ways to prevent and minimize such damage.

In Pakistan, sugar cane is grown in the Sind, Punjab, and North-West Frontier Province. The last two provinces are at higher altitude and experience cold weather, including freezing and frosts, during the winter between December and February. The NWF Province, which is at higher altitude than the Punjab province, is severely affected by frost. Although light frost is common every year, there is a definite cycle of mild-to-severe frost every 3–4 years. The Fecto (Adamjee) Sugar Mills Ltd., Darya Khan, Punjab (FSM Ltd.) has experienced mild-to-severe effects of frost on its cane crop three times since it was established in 1966, i.e. 1966–67, 1970–71 and 1973–74. Heavy damage to the crop resulted, with a fall in tonnage as well as quality and great difficulty in processing.

Effects of frost on sugar cane

Frost damage to sugar cane is observed usually in low-lying areas where colder air moves down from high elevations. The nature and extent of damage to cane depends upon the type and number of spells of the frost, which may be light, mild or severe. Injury to cane is caused by the rupture of cells in the parts affected as a result of freezing of the cell fluid. This initiates injury, and the longer the freezing period the more serious is the injury. The first sign of injury with light frost is observed in the blades as cold chlorosis[1]. The first point of injury is the cane top situated about one inch above the apical bud in the central roll of immature leaves, and after several days this injured portion turns brown and decays. Severe frost causes not only very extensive leaf damage, but the apical bud and tissues immediately below and upper eyes are killed.

After the apical bud is killed, the stalk makes no further upward growth. Instead the injured eyes grow and these will produce several feet of cane, resulting in poor crop of stalks and multiple tops.

IRVINE[2] at Houma Station in Louisiana had observed 50% leaf and bud injury before the 1966 freeze. But the 1966 freeze caused more extensive damage—100% to terminal buds, 10 to 100% to lateral buds and at least 1 or 2 internodes damaged below the terminal buds. Similar observations were also noted at the same station by CHEN & CHEN[3] during the 1972 freeze. They further observed that lodged and machine-cut cane was more damaged than standing cane. Burnt cut cane also showed more deterioration as compared to standing and cut unburnt cane.

It is not possible to protect sugar cane completely from frost and freezing. But certain precautions can minimize the effect of such frost. Simultaneous rainfall followed by wind is of great natural help in protecting and minimizing frost effects on the crop. Whenever there is any danger of frost, cane fields should be irrigated. If the soil is wet because of rainfall or irrigation water, the temperature of the root system does not fall below the critical level.

Some frost-resistant varieties have also been observed. CHEN & CHEN[3] described CP 61-37 as

[1] HUMBERT: "The Growing of Sugar Cane". (Elsevier, Amsterdam), 1968, pp. 52–54.
[2] *Proc. 13th Congr. I.S.S.C.T.*, 1968, 837–839.

being more resistant to the freeze in Louisiana. OBEROI[4] carried out research on 10 varieties of cane at Rajasthan, India and observed Co 1223, Co 1243 and CoL 29 to be least affected, the last variety being recommended for the area. SINGH & SINGH[5] in researches carried out at Ludhiana found Co 1148 to be more resistant to frost while Co 312 was most susceptible. SIDDIQ *et al.*[6] found CP 48–103 as the least frost-affected variety in Mardan, Pakistan. D'HOTMAN DE VILLIERS[7] observed BL 19 to be a variety resistant to severe frost in Khanpur, Pakistan. HUMBERT[8] and IRVINE[2] reported that N:Co 310 showed tolerence to freezing temperatures. SUND[9] observed at Haft Tappeh Cane Sugar Project, Iran, that N:Co 310, CP 44-101 and CP 48-103 are early maturing varieties. N:Co 310 is an early maturing variety also in Lower Sind, Pakistan and is of great help in starting the crushing season earlier. HUMBERT[10] classified frost-affected cane into four categories based on the extent of damage, and put forward a schedule of harvesting of such classified cane. A valuable survey of methods for minimizing frost damage has been presented by GOWING[11].

Effect of frost on sugar cane at FSM Ltd

As previously mentioned, since the establishment of FSM Ltd. in 1966, the mills experienced mild-to-severe frost during the seasons 1966–67, 1970–71 and 1973–74. It was further observed during these years that there was more natural rainfall during the cane growth period of July–September. Ample water and cloudy weather results in under-development of the roots of the cane plant while the vegetative parts are more developed. Such vegetative growth results in late maturity and keeps the plant susceptible to freezes. In addition, standing water or floods may cause certain types of infections, and infected cane will be more severely affected by frost.

During the 1973–74 season, it was said that never in living memory had there been such a heavy frost in this area. There were two incidences of frost, one during the second fortnight of December 1973 and the other during the first week of February 1974. The cane affected by the frost of December 1973 was completely ruined by the frost of February 1974. Furthermore, there was no cane in the area after February 1974 which was not frost-affected. The leaves were yellowish, apical buds were damaged and, later, lateral buds were also affected. Even the stalks did not escape; within 10–15 days of the frost, considerable damage to the stalks of cane was observed. Such deterioration has also been reported by IRVINE[2] at Houma Sugar Research Station, Louisiana, when in 1966 a strong Canadian high pressure area lowered the temperature to give a minimum of —4·4°C.

It was also observed at FSM Ltd. that normally there is light rainfall followed by wind in December and January, thus minimizing the danger and effect of frost. But in the frost years 1966–67, 1970–71 and 1973–74 there was no natural rainfall during December and January and this resulted in heavy damage to the cane crop when the frost eventually occurred. The cane varieties which were affected the most were CoL 44, BL 4 and L 116; while more resistant varieties were CoL 29, CoL 38 and CoL 61. The frost damage to the plant crop was more severe than to the ratoon crop.

Normally it is observed that the cane at the start of the crushing season, i.e. by the 1st and 2nd week of November, contains less sugar and fibre; in January–March it reaches its peak maturity with higher pol. But during the season 1973–74 it was observed that the cane started with a lower recovery as compared with the other seasons. This could be explained on the basis that there was more rainfall and flood conditions in the area and the cane was still immature or in active vegetative growth. Similar observations were made during the 1966–67 and 1970–71 season when there was more rainfall as compared with the other seasons. The pol in cane was improving with the progress of the season until it reached 11·11%, the maximum for the season, on 18th December 1973 when the first spell of frost was experienced and the pol in cane, instead of showing an increase, started decreasing. However, it did not go below 9·73% till 22nd February 1974. There was a second attack of frost in the 2nd week of February and the cane was badly affected. Pol in cane started decreasing and the molasses and fibre % cane started increasing. With the increase in day-temperature in March and April the cane started deteriorating at a much faster rate and in the last two weeks of the crushing season, average pol in cane was 6·95%, fibre in cane was 19·16% and molasses on cane was 5·76%. The lowest pol in cane for the season 1973–74 was 5·92% and molasses on cane was 6·9% on 31st April 1974. Similar results were also obtained during the 1966–67 and 1970–71 crushing seasons. Gradual deterioration and the overall effect of frost in 1973–74 is noted in Fig. 1.

Table I shows clearly the effect of frost on the cane crop during the three frost years 1966–67, 1970–71 and 1973–74 and their comparison with the other normal crop years. During 1970–71 there was milder effect of frost on the cane crop as compared with the other two frost years.

After every frost year the cane crop in the area was considerably reduced—by 20–30%—in the succeeding year. The reasons were: less seed was available for planting, the growth and yield of the ratoon crop was considerably reduced, and there was a more intense insect pest incidence in the area. An alternative reason could be that, owing to the natural calamity, the cane growers in the area were very much discouraged and planted less cane in their lands. However the quality of sugar cane in the succeeding year after frost, e.g. during 1974–75, was normal.

Behaviour of frost affected cane during processing

CHEN & CHEN[3] reported complications in normal processing of frost affected cane. Decomposition products from cane deterioration are detrimental to juice clarification and also to the quality of raw sugar products.

BLANCHARD[12] noted a number of difficulties at Cowley Sugar Factory, Texas. Fibre % was high (maximum 24%), juice of low purity (minimum 58°) and acidic. He described the frost-affected season

[3] *Sugar J.*, 1975, **37**, (9), 21–24.
[4] *Indian Sugar*, 1973, **23**, 343–345.
[5] *I.S.J.*, 1975, **77**, 131–132.
[6] *Proc. 8th Ann. Conv. Pakistan Soc. Sugar Tech.*, 1970, 51–62.
[7] *Proc. 9th Ann. Conv. Pakistan Soc. Sugar Tech.*, 1971, 60–71.
[8] *Proc. 13th Congr. I.S.S.C.T.*, 1968, 614.
[9] *ibid.*, 608–614.
[10] *World Farming*, 1973, **15**, (9), 8–9, 26.
[11] *I.S.J.*, 1975, **77**, 326–329.
[12] *Sugar J.*, 1974, **37**, (2), 12–16.

Table 1. Technical results of the Fecto Sugar Mills Ltd., seasons 1966-67 to 1974-75

	1966–67*	1967–68	1968–69	1969–70	1970–71*	1971–72	1972–73	1973–74*	1974–75
Cane crushed, tons	221,415·33	154,553·71	242,483·25	374,963·28	281,206·45	192,689·63	177,062·68	280,585·50	219,086·42
Crushing rate excluding stoppage, tons/day	1625·69	1684·77	1814·85	1989·21	1951·56	1909·58	1900·94	1881·72	2102·66
Pol % cane	10·17	11·88	11·70	11·57	11·51	11·64	11·50	9·77	11·41
Fibre % cane	14·56	14·53	14·91	15·66	16·13	15·77	15·82	16·01	14·16
Imbibition % cane	18·49	19·10	17·33	20·97	21·91	23·20	23·56	28·38	25·42
Mixed juice % cane	86·80	89·25	85·53	87·91	87·24	89·21	89·50	96·04	95·01
Crusher juice Brix	17·02	17·52	18·50	18·31	18·73	18·65	18·00	16·85	18·07
Crusher juice purity	73·97	81·44	78·16	77·44	75·86	79·19	79·05	71·63	79·02
Sugar recovery % cane (99·8°Pol)	7·28	9·35	9·33	9·15	8·71	9·10	9·14	7·40	9·20
Molasses % cane (at 90°Bx)	4·20	4·03	3·91	4·05	4·55	4·01	3·83	4·43	4·03
Steam consumption % cane	—	—	—	—	—	—	61·39	63·78	59·71

* Frost year.

1973-74 as a most difficult one. Normal processing was not possible, and a number of innovations had to be utilized; 50% of the knives in the second set of cutters were removed, and wear and tear was increased.

Micro-organisms play an important role in the deterioration of juice from frozen cane and subsequently cause difficulties in processing. MEADE[13] reported that MCCALIP investigated the formation of dextran and its effects in increasing the viscosity up to a certain stage after which it decreases with increasing acidity.

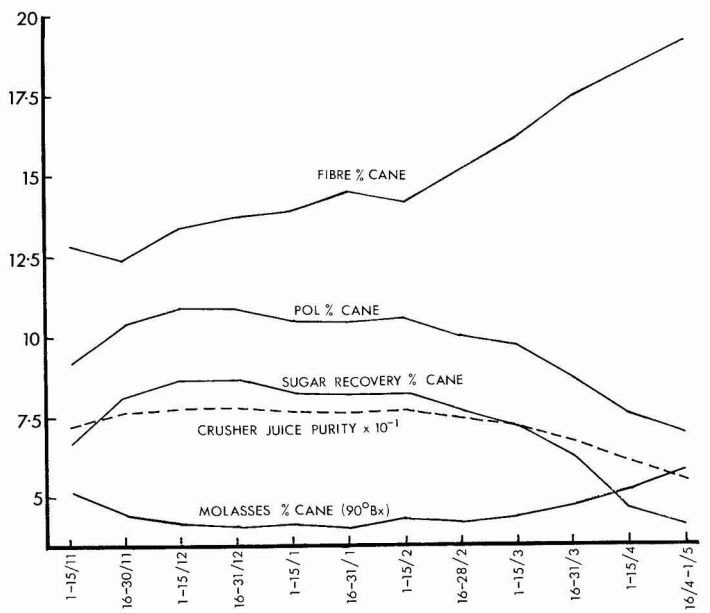


Fig. 1. Fortnightly technical results at FSM Ltd., crop year 1973–74

Processing of frost-affected cane at FSM Ltd.

It was observed at FSM Ltd. that during the frost year 1973–74, the corrosion of cane cutter knives as well of the mill rollers was 20–25% higher compared with other years; low pH and high acidity of juice were the main reasons for this. During the pre-frost period, the pH of mixed juice was always above 5·5 but in the post-frost period it came down to 5·0 and below. Although many authors regard pH to be a poor yardstick for the determination of cane deterioration, we have noted decreasing pH with increased deterioration. There was also an increase in titrable acidity. Significant increase in acidity was observed when the temperature after the frost period increased substantially. The quantity of reducing sugars also increased (Table II).

Table II. Chemical analysis of cane juice, crop year 1973-74

	Minimum	*Maximum*
pH	4·9	6·1
Titrable acidity (cm^3 0·1N NaOH/10 cm^3)	2·2	3·7
Reducing sugars %	0·98	1·75

It was noted during the frost years that the Brix of crusher juice was high and purity was low and that mixed juice % cane was comparatively low. The abnormally low juice purity created problems in clarification, boiling and storage of the large quantity of molasses, and subsequently affected the crushing rate. The crushing rate per day for the 1973–74 season was 1881·72 metric tons, which is 1·12% lower than the previous year and 11·74% lower than the year 1974–75 (Table I). Heavier scaling in the evaporator tubes was observed; this resulted in frequent shut-downs for cleaning. The centrifugals were found to be 25–30% under capacity. Steam consumption was increased by 5–7%. Sugar losses under each individual heading were also higher and increased by 7–13% as compared with the succeeding seasons (Table I).

Summary

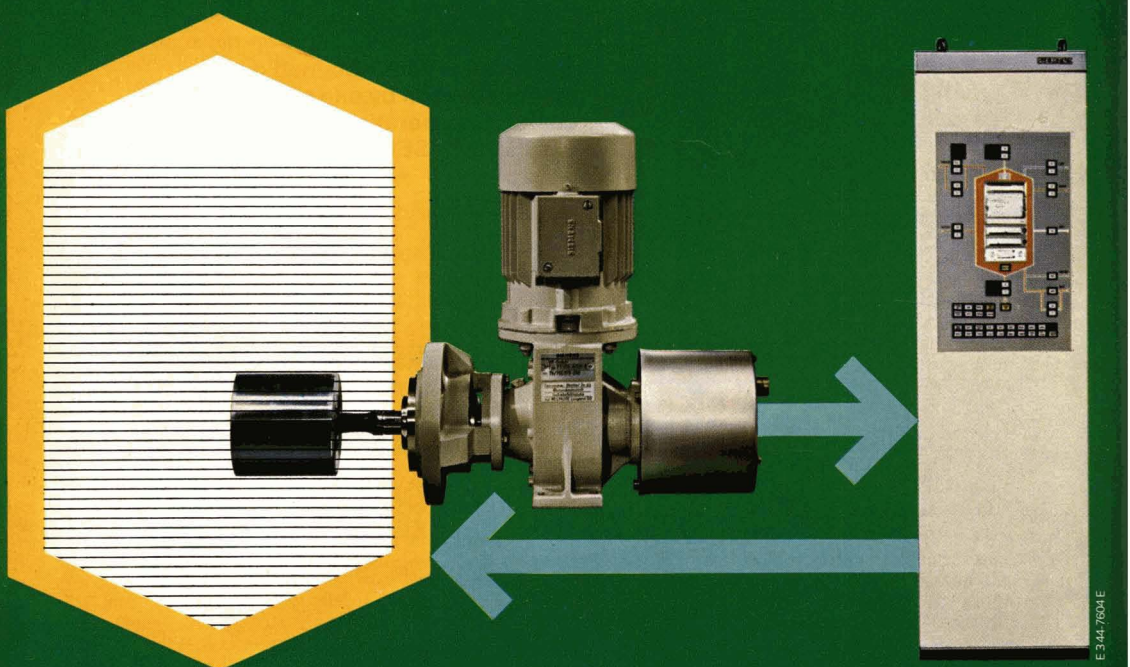
At FSM Ltd. there has been a cycle of frost every 3–4 years especially when there is more rain in the growing period (July–September) and absence of winter rain and wind in the harvesting period (December–February). Whenever there is low temperature and any sign of frost, quick irrigation has proved to be of great help in protection.

(*continued on page 203*)

[13] "Cane Sugar Handbook", 9th edn. (Wiley, New York), 1964, pp. 71, 308, 684.

SIEMENS

Better control of the sugar boiling process



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Sugar cane agriculture

The evaluation of chemical herbicides in Louisiana sugar cane. E. R. STAMPER. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 125–126.—A brief survey is presented of the chemicals used for weed control in plant and ratoon cane. "Asulam", alone or in combination with other chemicals, has shown good control of Johnson grass growing from rhizomes, while other herbicides have shown promise for weed and grass control. However, several grasses and broadleaved weeds now occur in cane fields for which no control has been found. Weed and grass infestation of ratoon cane fields is increasing annually because, it is stated, of poor management practices in the plant cane year. Many of these weeds are difficult to kill.

* * *

Development of mechanical sugar cane planter at Sugar Cane Growers Cooperative of Florida. L. G. FOWLER and F. STEIN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 138–140.—A cane planter is described which has shown promise in the planting of cane on 150 acres, germination appearing to be satisfactory; however, it is considered that insufficient cane has been planted for comparison to be made with hand planting.

* * *

Napier grass eradication: a cooperative effort. H. H. SAMOL. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 155–157.—Problems created by Napier grass (*Pennisetum purpureum*), one of the most serious weeds in southern Florida, are examined and currently recommended control methods briefly described. Of chemicals tested, "Roundup" as a foliar spray has proved the most effective. An eradication programme formulated by the Florida Sugar Cane League is outlined.

(*continued from page 202*)

Injuries to the cane crop depends upon the type, duration and number of spells of frost. CoL 29, CoL 38 and CoL 61 showed tolerance against frost and freezing. At FSM Ltd. the worst effect of frost on cane was during the crop year 1973–74, when both quantity and quality suffered. The deteriorated quality was reflected in low pol and higher fibre % cane; juice was of low purity and high acidity which resulted in corrosion and wear and tear on the cane knives and mills. In processing, deteriorated juice caused difficulties in clarification, pan boiling and molasses handling. Sugar losses under individual heads increased by 7–13% and more scaling in evaporator tubes was noted.

The overall effect was reduced rate of crushing, lower sugar recovery and high molasses losses. In the succeeding year, after the frost there was a 20–30% reduction in the cane crop.

Changes in row spacings in Louisiana. R. J. MATHERNE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 178.—The traditional cane row spacing in Louisiana is 6 ft, with a single drill per row. However, research over seven years has shown that yields can be increased by reducing the row width or by double-drill planting. Rows 3–3½ ft wide yielded 49% more cane than the standard width and a width of 4 ft increased yields by 35%. However, narrow rows are difficult to manage and are easily damaged by equipment. Double drills on 6- or 7-ft rows are more difficult to manage than single drills on 6-ft rows but are easier than on narrow rows. Two drills 15 inches apart on 6-ft rows increased yields by 23% compared with the standard, but failed to increase yields of 1st ratoon cane because of the narrow spacing between drills. Two drills 30 inches apart on 7-ft rows gave yields 28% higher than with standard rows, and such spacing between drills might maintain this advantage in ratoon crops.

* * *

Changes in row spacing in Louisiana. H. WILLETT. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 179–180.—The use of double drilling and how this would benefit mechanical harvesting in Louisiana cane fields are discussed.

* * *

Will double-drill planting pay? R. C. HODSON. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 182–184. The financial benefits of planting cane in double drills, 30 inches apart, on 7-ft rows are discussed by comparison with single-drill planting on 6-ft rows.

* * *

Processing response of cut-chop harvested cane—1973 studies. J. J. SEIP, M. A. GARCIA and F. L. GAYLE. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 185–199.—Investigations showed that cane cut by a chopper-harvester gave juice which was of higher quality than that from whole-stalk harvested cane. Full details are given of the test procedures and analytical techniques and results.

* * *

Influence of the processes of cleaning of samples in the foliar diagnosis of sugar cane. J. O. FILHO, O. C. BATAGLIA and H. DE CAMPOS. *Brasil Açuc.*, 1975, **86,** 115–129.—Samples for foliar diagnosis of nutrient status of cane consisted of the central 20-cm portion of each +3 leaf without the mid-rib. Analyses were made on samples not cleaned and cleaned by use of a vacuum cleaner with brushing and by use of various washing techniques. It was found that the different cleaning methods did not affect the macronutrient determinations but influenced the micronutrient figures, especially for Fe, Cu and Mn. The best treatment for micronutrient analyses was washing in a detergent solution (0·1% ODD), rinsing with distilled water and again in demineralized water.

Heat therapy of sugar cane seed. K. KAR. *Sugar News* (India), 1975, **7**, (4), 19–20.—Reference is made to trials on hot water treatment of cane setts of CoS 568 variety to control grassy shoot. Highest rate of germination was 45·9% after 2 hours' treatment at 50°C. This compared with 44·5% average germination of untreated setts, but disease incidence was only 9·0% after treatment compared with 38·4% in the untreated control. Hot air treatment requires a much greater time (8 hours), is costly and calls for highly skilled labour.

* * *

Sugar cane harvesting—a new method. J. C. HUDSON, C. A. BOYCOTT and D. A. SCOTT. *S. African Sugar J.*, 1975, **59**, 457–465.—While burning of cane has a number of disadvantages, which are listed, green cane harvesting is not without problems. However, investigations have shown that green cane can be harvested by combing it into a neat, orderly row and then forcing it downwards to cause the stalks to snap. The use of the McConnel harvester for this is described; mention is also made of a cleaner-bundler (to retrieve cane left by the harvester) which is in the prototype stage.

* * *

Experiment Station steps up war on *Eldana* borer. ANON. *S. African Sugar J.*, 1975, **59**, 482.—The programme for detection and control of this pest in South Africa is described and a list given of 11 research projects concerned with the borer.

* * *

Cane agronomy and plant physiology research in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 32–42. — Trials comparing sulphate of ammonia and calcium ammonium nitrate showed little or no difference betwwen them in terms of cane and sugar yields. Sugar yields and leaf analysis data for 1st ratoon cane showed no difference between compound fertilizers and "straight" fertilizers. In potassium trials, optimum leaf K was never below 1·2% dry matter even though the level of response varied with soil type. It was found that K uptake increased with increasing application, even when there was no response in terms of cane or sugar yield, and that the same varieties in different soils exported different amounts of K. Pot experiments showed that increase in soil Mg but not Ca was accompanied by a fall in K uptake; depletion of K in the soil led to increased cane Mn. Silicate application was found to be necessary only when soil Si was below a critical level of 77 ppm. Changes in soil pH following application of lime were determined and are tabulated. Studies on physical and chemical changes in soil as a result of continuous cane cropping indicated that this causes a decrease in the organic matter content and base saturation as well as a reduction in the C:N ratio with soil depth down to 45 cm. The data were compared with the results of scrub growing on the same soil type. A survey of the nutritional status of small planters' cane farms showed that the number of small planters under- or over-fertilizing was greater than with large planters and estates, although the nutritional status of small farms appeared to be satisfactory. Details are given of overhead irrigation trials at three locations, but it is difficult to draw any conclusion from the results. From results of spacing trials with six different treatments it was concluded that spacing had no effect on cumulative yield of sugar from plant, 1st and 2nd ratoon cane. Flowering control tests were carried out with gibberellic acid and "MON 045" (N-N-*bis*-phosphonomethyl glycine) applied at rates of 100, 1000 and 10,000 ppm to defoliated and undefoliated stalks at three stages of development; "MON 045" at 10,000 ppm reduced stalk elongation and leaf emergence significantly when applied at any one stage, and suppressed flowering completely when applied at induction and partly suppressed it at early and late differentiation stages. On the other hand, gibberellic acid caused a slight increase in leaf emergence and stalk elongation rates while not affecting flowering intensity or time of emergence. Maturity trials with a number of varieties at various locations are reported, in which the effects of delayed, advanced and normal harvest were compared. "Azulam" was applied at 3 and 6 kg a.i. per ha to cane of one variety in September to determine if it could maintain or increase the sugar content under late harvesting conditions (December). The cane was harvested 4, 8 and 12 weeks after application. Although it increased leaf emergence and stalk elongation, particularly after 12 weeks, giving a significant rise in sugar content after 12 weeks, especially when 6 $kg.ha^{-1}$ was applied, no significant effect on sugar yield was detected.

* * *

Cane disease research in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 43–46. While the incidence of major diseases such as gummosis, leaf scald, chlorotic streak and yellow spot was the lowest in 1974 for some years, minor diseases such as rust and brown spot were more widespread and severe than usual. In gummosis resistance tests, infection in inoculated rows and susceptible controls was unusually low; this confirmed that, despite inoculation, it is difficult to maintain a high disease intensity in such trials when conditions are unfavourable for natural spread of the disease. Attempts to improve resistance testing by inoculating excised leaves did not give satisfactory results, since the precision obtained was inadequate in view of the work involved. Preliminary results of field and greenhouse tests with single-eye cuttings showed no difference in growth properties between long and short hot water treatments against chlorotic streak and RSD. In tests on gummosis control, complete elimination of viable bacteria from infected cane tissue could not be achieved even when cuttings were immersed in hot water for 1 hour at 58°C, although this did considerably reduce the number. Penicillin did not appreciably improve the effects of hot water treatment when a combination of the two treatments was used. Treatment of setts with hot "Benomyl" suspensions for 20 minutes at 52°C was found to be efficient and economical when an initial concentration of 30 g per 100 litres was used; daily topping-up with fungicide allowed for settling of particles provided tank circulation was adequate. Cane streak, eradicated from a plot in 1971, was observed on a stool of the same variety in the collection at Réduit. *Cicadulina mbila* transmitted it to four other varieties in investigations under insect-proof conditions. The disease was found to be caused by three distinct strains of virus: a sugar cane strain, a strain obtained from the grass *Coix lacryma-jobi* and a maize strain. The last two can also infect cane, but the maize strain causes only mild symptoms in cane. It is considered possible that the cane strain is not the same as that found in

Africa, since attempts to infect varieties well-known for their susceptibility to the disease in South Africa and East African countries were unsuccessful. Studies to establish whether "Dithane M 45" applied to potato for blight control caused poor ratooning in cane intercropped with potatoes showed no differences in counts of total and fungal microflora or nitrification potential between plots receiving varying doses of the fungicide.

* * *

Cane pests in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 47–48.—Details are given of parasitic hymenoptera introduced as a means of controlling the scale insect *Aulacaspis tegalensis*. Approximate numbers released are given for *Physcus seminotus* (obtained from Uganda), *P. subflavus* and *Metaphycus* sp. (obtained from Tanzania), *Physcus* sp.nr. *nigriclavus* and *Aphytis* sp. (obtained from Queensland). The total number of *Aphytis* sp. released is some three times greater than the number of any of the other parasites. Tests with 5% "Terracur P" applied in granular form to the soil for control of the stem borer *Chilo sacchariphagus* in 7-month plant cane showed that the proportion of canes and internodes bored and weight of cane damaged was the same regardless of the dosage (2 and 10 kg.ha^{-1} a.i.). Average infestation was 68% canes and 3·7% internodes bored. Investigations revealed that plant cane has considerable tolerance to loss of young shoots caused by the white borer *Argyroploce schistaceana* and is thus not materially affected by the pest even with high infestation. However, its effects may be greater with early ratoon cane.

* * *

Weeds in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 48–50.—At dosage rates in the range 1·34–5·38 kg.ha^{-1} a.i., "Velpar" proved the most effective of three new herbicides tested in the super-humid zone, closely followed by "Herbotan". Both were much superior to DCMU, while "Cobex" was not as effective as DCMU. "Velpar" completely controlled one generation of *Cyperus rotundus*, but only slightly checked the growth of the second generation. Both "Velpar" and "Herbotan" reduced growth of one cane variety at dosage rates which varied with location and cane variety, but their effectiveness at lower dosage rates than the critical was still greater than that of DCMU. DPX 2851 at 3·23 and 4·30 kg.ha^{-1} was superior to 4·30 kg.ha^{-1} "Atrazine" in the humid zone and to 4·30 kg.ha^{-1} DCMU in the super-humid zone, while HP 412 was inferior to "Atrazine" and DCMU. DPX 2851 and HP 412 did not adversely affect cane germination or growth. "Roundup" at 3·2 and 4 kg a.i. per ha gave nearly 100% control of *Paspalidium geminatum*, a troublesome grass. It was also highly effective at 1–3 kg.ha^{-1} against *Colocasia antiquorum* (97–98% kill). "Tordon 101", "Actril-D" and MCPA were less successful, although in the absence of "Roundup" frequent post-emergence application of "Actril-D" is recommended.

* * *

Basic sugar cane breeding at Houma, Louisiana. P. H. DUNCKELMAN and M. A. BLANCHARD. *Sugar Bull.*, 1975, **53**, (24), 8–11.—Flowering, crossing and seed production at Houma in 1974–75 are reported and data tabulated showing basic crosses and true seed production.

Studies on the life history and host suitability of *Trichogramma perkinsi* Girault (Hymenoptera: Trichogrammatidae) and a trial for establishing it in the Punjab (India). N. C. TUHAN and O. S. BINDRA. *Indian Sugar*, 1975, **25**, 169–171.—Details are given of trials on breeding of the borer parasite *T. perkinsii* and its recovery from host eggs. In host suitability tests, *Chilo partellus* was found to be preferable (in terms of % parasitization) to *C. infuscatellus* and *Bissetia steniella*.

* * *

Laboratory rearing of sugar cane stalk borer *Chilo auricilius* Dudg. through successive generations. A. VARMA, P. N. AVASTHY and T. N. SRIVASTAVA. *Indian Sugar*, 1975, **25**, 173–176.—Tests are reported in which four diets were compared for their efficacy in the rearing of *C. auricilius*. The most successful was a 12-ingredient diet in which the more important components (quantitatively) were French bean, powdered cane leaf sheath, casein and brewer's yeast. This was also found to be suitable for rearing other borer species.

* * *

Effect of micronutrients on sugar cane and its quality. B. S. MATHUR. *Indian Sugar*, 1975, **25**, 179–181. Trials in which 500 kg per ha of "Spartin" (containing Ca, Mg, S, Si, Fe, Mn, Cu, Zn and Bo) was applied to cane in addition to a normal feed of 150 kg N and 75 kg P_2O_5 per ha showed that it did not increase cane yield significantly but reduced juice quality by comparison with cane receiving only the N-P treatment.

* * *

Studies on incidence of smut in promising sugar cane varieties. S. MUTHUSAMY, S. SITHANANTHAM and T. L. BASKARAN. *Indian Sugar*, 1975, **25**, 183–185. The incidence of smut in a number of susceptible Indian cane varieties is indicated. The worst affected were Co 6411 (78% and 81% loss in weight in plant and ratoon crops, respectively, compared with healthy cane) and Co 6512 (70% and 76% loss, respectively).

* * *

Scope of intercropping in sugar cane in north India. R. S. KANWAR. *Indian Sugar*, 1975, **25**, 187–189. See *I.S.J.*, 1976, **78**, 176.

* * *

Biological control of sugar cane pests in Taiwan. W. Y. CHENG. *Taiwan Sugar*, 1975, **22**, 124–132. Information is presented on parasites and predators of cane borers, the woolly aphid *Oregma lanigera*, white grubs and the cicada *Mogannia hebes*. Details are given of tests and results achieved with certain parasites, and lists are given showing the hosts of specific borer parasites and predators and showing the year of introduction, country of origin, host and results for 25 imported parasites and predators.

* * *

Liberation of *Trichogramma australicum* for the control of sugar cane borers. H. T. TSENG. *Taiwan Sugar*, 1975, **22**, 133–134.—Details are given of the release of *T. australicum* in Taiwan cane fields during 1972–75. Latest results indicate a considerable reduction in the percentage of joints bored in old cane and of deadhearts in young cane in a liberation area compared with the percentages in a control area in which egg parasitism was not the result of active encouragement.

Pathological effects of the sugar cane white leaf agent on chlorophyll content and chloroplast ultrastructure. C. T. CHEN and M. J. CHEN. *Taiwan Sugar*, 1975, **22,** 135–137.—Comparison of healthy and white leaf-infected cane leaves showed that the disease caused a fall in chlorophyll to about 7·6% of that in the healthy leaves, while the chloroplasts of the diseased leaves were between one-quarter and one-third the size of those in the healthy tissue. The mesophyll cell plastids in the infected leaves appeared to have proplastid structures containing immature grana. The internal membrane of bundle sheath plastids was poorly developed. It is concluded that white leaf may affect chlorophyll biosynthesis quantitatively but not qualitatively, and so may disturb the development of both types of plastids.

* * *

Entomogenous fungi on sugar cane pests in Taiwan. Z. N. WANG and L. S. LEU. *Taiwan Sugar*, 1975, **22,** 138–140.—See *I.S.J.*, 1975, **77,** 110.

* * *

Occurrence of scale insect on sugar cane in East Godavari district. C. S. RAO. *Indian Sugar*, 1975, **25,** 237–238.—The scale insect (*Melanaspis glomerata*) is prevalent in Maharashtra and is reported as occurring in Andhra Pradesh as a result of introduction with seed cane from a Maharashtra district. Brief information is given on the nature and extent of damage caused by the pest, its natural enemies and chemical control. A number of insecticides have been found to be effective.

* * *

Relative resistance of a few promising cane varieties to red rot disease. L. N. PANDEY, R. SAKAL and R. P. SINGH. *Indian Sugar*, 1975, **25,** 241–245.—Of 56 varieties tested for resistance to red rot, only two were found to be resistant and 24 moderately resistant; the remainder were susceptible. The reactions of the varieties to 4 strains of the pathogen (*Glomerella tucumanensis*) are tabulated.

* * *

Co 6613—a new early variety for western Uttar Pradesh. B. S. MATHUR. *Indian Sugar*, 1975, **25,** 247–251.—The morphology and agronomic performance of this variety are reported.

* * *

Economics of transporting sugar cane to mill. B. J. COCHRAN and R. W. WHITNEY. *Sugar J.*, 1975, **38,** (5), 10–14.—Simulation of a cane transport system by a GPSS (General Purpose Simulation System) model and a theoretical analysis programme applying the queuing theory is described and a number of conclusions drawn.

* * *

Sugar cane: energy relationships with fossil fuel. J. C. HUDSON. *Sugar J.*, 1975, **38,** (5), 25–28.—See *I.S.J.*, 1975, **77,** 370.

* * *

A visit to Ghana, West Africa, in June 1975 with particular reference to *Eldana* borer. A. J. M. CARNEGIE. *S. African Sugar J.*, 1975, **59,** 523–529.—The situation with regard to *Eldana saccharina* in Ghana, where the sugar industry is only in its infancy and 90% of the cane grown is the soft variety B 41227, is reported. Observations included the fact that damage was more common in the lower stems than in the middle and upper sections. It is recommended to replace the soft variety with a harder one and thus reduce carry-over to the next crop. Weakening of ratoons by excessive rain and poor drainage increased the chances of severe attacks, while high nitrogen dosages also increased the number of borers. Parasites of *E. saccharina* are discussed; it has been found that a parasite common to stalk borers generally will show a preference for others than *E. saccharina* because of its tough texture, activity and ability to produce a repellant fluid. Four parasites considered for possible introduction into South Africa are listed: *Sturmiopsis parasitica*, *S. inferens*, *Descampsina sesamiae* and *Syzeuctus* sp. Naturally occurring colonies of ants have proved to be particularly active in attacking both eggs and young larvae of *E. saccharina*, and it is suggested that cane damage would be much more severe if the use of unsuitable insecticides reduced the ant populations. Ghana is planning to import the wasp *Bracon chinensis* for trials against the borer.

* * *

The Louisiana sugar cane variety census for 1975. R. J. MATHERNE, H. P. FANGUY and D. T. LOUPE. *Sugar Bull.*, 1975, **54,** (1), 12–14.—Details are given of the proportion of Louisiana cane area occupied by each of eight recommended varieties.

* * *

Sugar cane: mythology, history and technology. N. COUTINHO. *Brasil Açuc.*, 1975, **86,** 245–261.—A brief history of sugar cane and of its development in Brazil is presented, with a bibliography of 31 references.

* * *

Fertilization of sugar cane. J. ALOMÁ and I. CUELLAR. *ATAC*, 1975, **34,** (4), 54–65.—A brief history is presented of fertilization studies in Cuba up to 1941 and a survey then presented of the various soil types found in Cuba and their characteristics, with results of more recent studies on their fertilization, and records of trials with nitrogen, potassium and filter cake as a source of N and phosphate.

* * *

Harvesting the sugar with sugar cane. R. P. HUMBERT. *World Farming*, 1975, **17,** (11), 18–20.—The author refers to the results achieved at Big Bend, Swaziland, to illustrate that the key to maximum cane yields is full leaf canopy—this permits most of the sunlight reaching the leaves to be utilized by the cane during the months of greatest growth.

* * *

Hot water treatment for best results. ANON. *Producers' Rev.*, 1975, **65,** (9), 72.—A list of recommendations is given for handling and planting cane setts after treatment with hot water to control ratoon stunting disease. It is emphasized that cane already infected with RSD should not be sent for treatment, which is not completely effective against the disease, and that the nutrient content of the selected cane should be sufficient to ensure rapid growth after treatment.

* * *

Locusts in Queensland cane areas. B. E. HITCHCOCK. *Cane Growers' Quarterly Bull.*, 1975, **39,** 40–43.—Three locusts known to damage sugar cane are the spur-throated locust, *Austracris guttulosa*, the yellow-winged locust, *Gastrimargus musicus*, and the migratory locust, *Locusta migratoria*. The seasonal history, life cycle and habits of each are described. Four

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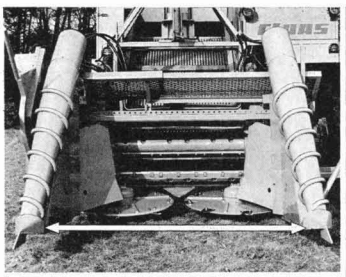

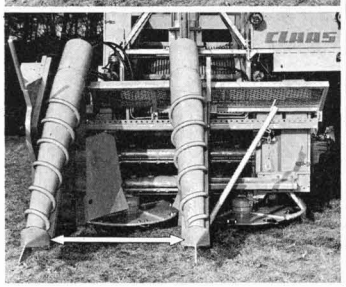

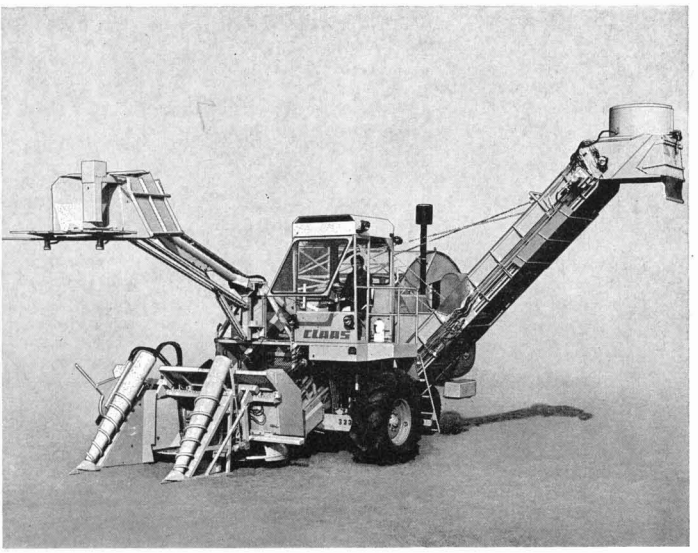

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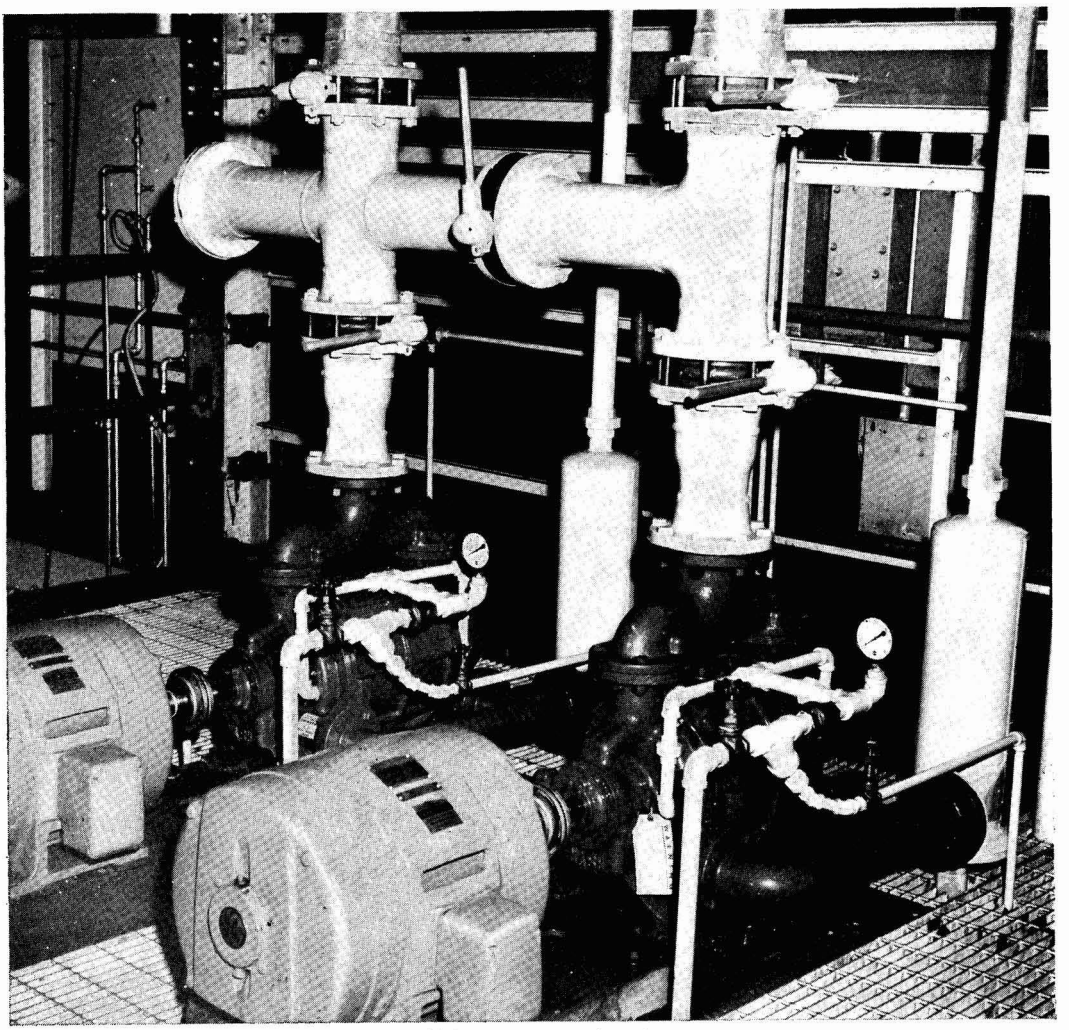

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chemicals are listed which have proved successful against *A. guttulosa* and *L. migratoria*; of these four, two have been tested against *G. musicus*. Major infestations in Queensland cane fields since the end of 1973 have been of *A. guttulosa*. (See also *I.S.J.*, 1975, **77**, 370).

* * *

On farm water storage. P. R. DOWNS and L. K. IZATT. *Cane Growers' Quarterly Bull.*, 1975, **39**, 44–45. Where there is need for irrigation but the cane farmer cannot obtain underground water supplies, the authors suggest building a dam for storage of rainwater. Factors to be considered in siting, designing and constructing a dam are briefly examined. It is pointed out that advice and financial aid can be obtained in Australia from official sources.

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Plant cane weed control at Mossman. L. G. W. TILLEY. *Cane Growers' Quarterly Bull.*, 1975, **39**, 46–47. While mechanical weed control in young plant cane has been popular in Queensland, many growers have adopted chemical control for various reasons. Although 2,4-D used to be the most popular chemical, there is a slight risk of damage to newly germinated cane, and farmers have tended to replace it with "Paraquat" ("Gramoxone") which can be sprayed over both cane and weeds without fear of long-term damage to the cane. On the other hand, 2,4-D is still favoured by some because of its 4–8 week control period during which no further spraying or cultivation is necessary.

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Irrigation requirements of Bundaberg soils. P. J. NIELSEN. *Cane Growers' Quarterly Bull.*, 1975, **39**, 48–50.—Factors to be taken into consideration in determining how and when to irrigate cane growing on the various deep and shallow soils of the Bundaberg district are examined. A list is given of irrigation or rainfall requirements for maximum cane yield in alternate months from August to June; both autumn-planted cane and September ratoon crops are covered.

* * *

The old nobles. T. G. WILLCOX. *Cane Growers' Quarterly Bull.*, 1975, **39**, 51–52.—A brief historical note is presented on the varieties of *Saccharum officinarum* which formed the basis of the Queensland cane sugar industry and constituted the major part of the crop until the late 1940's.

* * *

Q 87—a new variety for Bundaberg. C. L. TOOHEY. *Cane Growers' Quarterly Bull.*, 1975, **39**, 57–58.—The susceptibility of N:Co 310 to Fiji disease has necessitated its replacement with other varieties resistant to the disease but having the high yielding capacity of N:Co 310. While Q 87 is not highly resistant, it is less susceptible than N:Co 310; it germinates and ratoons well, is drought-resistant and gives yields comparable to that of N:Co 310. However, it suffers from three major faults: brittleness in the planting season, susceptibility to ratoon stunting disease, and susceptibility to leaf scald. The variety is considered suitable for commercial trials.

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Compulsory plant source inspection at Isis. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1975, **39**, 59.—Despite voluntary inspection of plant sources for ratoon stunting disease and Fiji disease in the Isis area, the two diseases have increased, so that compulsory inspection has been introduced. While such inspection will not guarantee that the plants are disease-free, since very light or very recent infections may be impossible to detect, it will prevent the use of obviously diseased and suspect plants, while also encouraging the farmer to take greater care in selecting and growing cane for use as plant source.

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P. I. J. STEWART. *Cane Growers' Quarterly Bull.*, 1975, **39**, 60–61.—The forms in which phosphorus is normally applied to cane are described, and advice is given on application of the fertilizer. It is pointed out that P is best applied at planting and that this is particularly important on new cane land. Data are given showing the highly beneficial effects in terms of cane sugar yield brought about by broadcast application of up to 240 kg P per ha on new land, followed by a further 22 $kg.ha^{-1}$ at planting and 75 $kg.ha^{-1}$ at each ratooning up to the 3rd ratoon crop.

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Borreria—trends in control. W. A. C. WEBB. *Cane Growers' Quarterly Bull.*, 1975, **39**, 62–63.—*Borreria* sp. has continued to spread in the Innisfail district of Queensland, and is causing some concern in the Babinda area; the author stresses that unless growers adopt control measures it could become a problem in most far northern cane-growing areas of the state. Pre- and post-emergence control methods are given, and precautionary measures to be taken in the use of specific chemicals are described.

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How to avoid hormone damage in Q 80. H. L. BOYLE. *Cane Growers' Quarterly Bull.*, 1975, **39**, 64–65.—It is pointed out that Q 80 is most susceptible to hormone herbicides when it is making rapid growth; unfortunately, this coincides with the most vigorous stage of growth of vine weeds. How this problem can be solved is discussed and recommended rates are given for those chemicals which have proved effective: 2,4-D, MCPA and 2,4,5-T.

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Standover lifts "minor" insect numbers. O. W. D. MYATT. *Cane Growers' Quarterly Bull.*, 1975, **39**, 66–68.—Standover of about 395,000 tons of cane in the Herbert River district of Queensland caused increase in two normally minor pests: the scale insect *Aulacaspis madiunesis* and the bud moth *Opogona glycophaga*. While the scale insect populations were not sufficiently large to cause losses of cane, the bud moth caterpillar did cause significant damage to a number of varieties, particularly the newly-approved Q 100; it destroyed up to 50% of the eyes in plant cane of this variety and led to many germination failures. However, chemical control is not considered justifiable, and damage does not affect milling losses. Cane burning reduces the numbers of bud moths. The situation described is given as a warning of what could happen if green cane harvesting and/or a 2-year cropping cycle were adopted.

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Guard your cane roots. J. F. USHER. *Cane Growers' Quarterly Bull.*, 1975, **39**, 71–72.—Factors over which control should be exercised by the farmer to safeguard the cane root system are discussed, including: soil air to provide oxygen for respiration, fertilizer application, soil moisture, pests and diseases, and soil tem-

perature (which will adversely affect root growth if it is too low).

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Recognizing and satisfying the micronutrient requirements of sugar cane. J. E. BOWEN. *Sugar y Azúcar*, 1975, **70**, (12), 15–18.—Micronutrient deficiency in cane is discussed with references made to specific deficiencies in various countries. It is emphasized that trace elements, although essential to the plant in small quantities, are usually toxic in higher quantities, such toxicity being more difficult to alleviate than any deficiency. Micronutrient imbalance can be detected by tissue analysis or, in the case of severe deficiency or toxicity, by visual observation of the symptoms. A key is given to deficiency symptoms for a number of elements, but toxicity symptoms are not so clearly definable. The point is made that interactions between two or more nutrients may make solution of a deficiency problem quite difficult, since the grower must not think only about his immediate problem, but must always consider the broad scope of effects that his actions may have on the availability of other nutrients. Thus, application of lime raises the soil pH and increases the molybdenum supply to the plant, but may similtaneously reduce iron availability to a level below minimum adequacy.

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Development and use of an aerated steam system for the control of ratoon stunting disease in sugar cane. B. J. COCHRAN, M. M. MAYEUX, R. STEIB and O. M. CIFUENTES. *Sugar y Azúcar*, 1975, **70**, (12), 19–23. A description is given of a system for treatment of cane setts with aerated steam for 3–4 hours at 49°C. Results of tests showed that such treatment completely prevented RSD in two varieties while permitting a very high rate of germination compared with the untreated control. Temperatures of 50° and 52°C with 2–4 hours' treatment also prevented RSD infection, but germination was not as good as with 49°C. The system is more economical than hot air treatment since oil and not electricity is used for heat generation, while injury to young seed cane is not as severe as with hot water treatment. Moreover, the unit is portable, is cheap to construct and can be built and packed for shipment.

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Cane transport: some thoughts on different methods used. R. T. SYMES. *Sugar y Azúcar*, 1975, **70**, (12), 27–29.—Factors to be considered in establishing a cane transport system are examined, and four basic systems described: the whole-stalk systems developed in Louisiana and Hawaii, and the chopped-cane systems developed in Florida and in Australia (involving the use of containers). Basic essentials of a system to make it economical are listed.

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Selection among sugar cane populations for resistance to froghopper *Mahanarva posticata* Stal. (Hom.: Cercopidae) in Pernambuco. E. J. MARQUES. *Brasil Açuc.*, 1975, **86**, 321–325.—The harm caused to cane by this pest is briefly discussed. Attempts have been made in Pernambuco to control it biologically using the fungus *Metarrhizum anisopliae*, but results are not conclusive and use of resistant varieties is a valuable counter-measure. The literature on varietal resistance is surveyed, and the technique employed by the Northern Experiment Station in Pernambuco for testing susceptibility of varieties is described. 50,000 seedlings of a number of varieties are planted out with one row of susceptible cane between every four rows of cane under test and the 10% of least attacked cane used for poly-crossing among themselves to give 5000 seedlings which are subjected to a similar trial. From this, the least attacked 40% cane is separated and the process repeated to give 2000 seedlings; the least attacked 50% are separated and poly-crossed. This yields 10 progenies from the original 500 and intercrossing provides 30 biparental crosses which are sent for the next stage of testing. 3000 seedlings of the 30 crosses are raised and selection of least attacked cane continued for four years to give finally three clones which are then multiplied asexually for distribution. The testing period occupies approximately eight years.

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Sugar cane improvement scheme for resistance to pests and diseases. R. CESNIK. *Brasil Açuc.*, 1975, **86**, 326–328.—Planalsucar (National Programme for Sugar Cane Improvement) has a germ bank of 728 cane varieties including imported varieties with characteristics required by geneticists for breeding improved cane. The programme for their use is outlined; it includes pre-selection to eliminate susceptibilities, selection of 500 out of the 728 with resistance to particular diseases and pests, and poly-crossing to provide 100 seedlings each for resistance testing, and subsequent selection and poly-crossing to obtain resistant clones. The system is in use in Paraná to obtain varieties resistant to mosaic and to cold, and in Pernambuco to obtain froghopper-resistant varieties (see previous abstract).

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Agro-industrial characteristics of some commercial varieties. A. I. BASSINELLO. *Brasil Açuc.*, 1975, **86**, 348–350.—The varieties described include CB 47-355, CB 53-98, CB 40-13, Co 740, Co 775, IAC 52/326, Co 413 and CP 51-22.

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Resistance to drought of sugar cane varieties (*Saccharum* spp.). O. BRINHOLI and O. P. GODOY. *Brasil Açuc.*, 1975, **86**, 361–367.—Greenhouse tests were carried out on nine varieties subjected to moisture stress by addition of NaCl to the soil and interruption of irrigation. Varieties showed different behaviour, NA 56-62 and IAC 52-179 being most resistant. Resistance varied with age, plants at 136 days of age showing the greatest resistance.

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The development of the Australian chopped sugar cane harvester. R. F. SPARGO and S. W. D. BAXTER. *Sugar y Azúcar*, 1975, **70**, (12), 31–34.—The authors describe the developments in the design and construction of the MF 201 chopper-harvester for the Australian sugar cane industry.

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Studies on deterioration of juice quality in cane. T. R. SRINIVASAN, C. RAMASWAMY and M. R. IRUTHAYARAJ. *Sugar News* (India), 1975, **7**, (5), 14–15.—Investigations of post-harvest cane deterioration showed that fall in sugar content, increase in the reducing sugars and loss of moisture were greatest where the cane was harvested and piled without any cover. The deterioration was less marked in cane heaped and covered with trash, while heaped cane sprinkled with water at frequent intervals suffered more deterioration than did the trash-covered cane but less than the uncovered cane, while the sprinkling reduced moisture loss.

Sugar beet agriculture

Chinoin "Fundazol 50 WP" spray. L. LUKÁCS and J. ZANA. *Cukoripar*, 1975, **28**, 161–164.—Trials on control of *Cercospora beticola* by spraying with "Fundazol 50 WP" (containing "Benomyl" as active ingredient) are reported. The tests were conducted on four beet varieties, to which 0·6, 0·9 and 1·2 kg.ha^{-1} was applied. Treatment increased beet and sugar yield, sugar content and leaf growth considerably while reducing conductimetric ash and noxious N, compared with untreated beet. Optimum dosage was 0·6 kg.ha^{-1}, after which increase in dosage was not accompanied by any significant improvement in results.

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Modern views on strip drilling. G. TÁTRAY. *Cukoripar*, 1975, **28**, 164–166.—The need for a re-examination of beet row width in view of the size of high-flotation tyres on the more powerful tractors is discussed, and it is stressed that by 1980 the spacing between rows will have to be increased to allow for this. Two schemes for harvesting beet planted by an 18-row drill are compared, both methods involving three harvesters. The effect of row spacing on the row length requirements for a given number of beet per ha is demonstrated by tabulated data.

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Problems of sugar beet cultivation in Rajasthan. K. SINGH, R. LAL, S. B. L. SHUKLA and R. SRIVASTAVA. *Indian Sugar*, 1975, **25**, 257–260.—Tests on commercial plots of varying size owned by 452 farmers are reported in which the effects of variety, irrigation and sowing time were determined. Sowing time for each variety could be at any time during a 40-day period, the range of dates depending on variety. Good yields were obtained, provided at least six irrigations were possible (five in the case of Ramonskaya-06, which can be planted up to 30th November).

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Structure and working of the soil. R. VANSTALLEN. *Le Betteravier*, 1975, **92**, (9), 9.—Aspects discussed include maintenance of a sufficient humus content by returning to the soil all crop residue, particularly straw, and by growing green manure (for which some advice is offered); application of lime (especially carbonatation mud) where the soil is heavy or muddy; and working of the soil—regarded as a necessary evil, since it does more harm than good to the structure but is required, e.g. in seed bed preparation, although should be avoided when the soil is too wet.

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Agro-economic feasibility of sugar beet cultivation in U.P. J. S. GARG and M. P. AZAD. *Indian Sugar*, 1975, **25**, 195–197.—Tabulated data are presented to show that beet is a more profitable crop than cane and can be grown where cane cannot in northern Uttar Pradesh. Where winter cane can be grown, intercropping with beet is considered worthwhile, since it would extend the sugar production season.

Harvesting demonstration at Sluiskil. A. VIGOUREUX. *Le Betteravier*, 1975, **92**, (9), 10–12.—Illustrated descriptions are given of beet harvesters demonstrated at Sluiskil in Holland which are particularly suitable for flat, heavy polder soil.

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Reflections on weed control in beet. I. Lessons of the present. G. PEETERS. *Le Betteravier*, 1975, **92**, (9), 20.—Possible causes of failures in chemical weed control in beet reported in 1975 are discussed, including inadequate dosages, cultivation carried out too early so that the herbicide"film" was cut, and post-emergence treatments carried out too soon. The author feels that insufficient attention has been paid to the fact that beet agronomy is now more complex and weed control is not as easy as it used to be, partly because the weed problems are completely different from those of some years ago.

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Improvement in beet quality in the supply region of Tulln sugar factory (Austria). L. WIKLICKY. *Zucker*, 1975, **28**, 616–619.—Results of applying optimum quantities of nitrogen to beet in the Tulln area are discussed. The reduction in N dosage from previous amounts considered excessive has led to an improvement in beet processing quality and increase in pol and sugar content compared with the gradual drop in quality experienced in Austria from 1960 to 1969, while the beet yield per ha has remained unchanged.

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Physiology of tuberization. J. CHRISTMANN. *Hautes Etudes Betterav. Agric.*, 1975, **7**, (31), 9–16.—The growth pattern of tubercles generally is explained, particular attention being focused on the role played by plant hormones. The action of auxins, gibberellins and cytokinins in sugar beet is described, and mention made of greenhouse tests cited in the literature in which these substances have been applied to beet. Application of artificial growth regulators having an auxin-type action was also tested; in only one case was both root yield and sugar content increased (by "Ortonil"). In tests with ripeners having an inhibiting effect, "Glyphosine" and "Cycocel" increased sugar content but caused a slight fall in root yield.

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X-ray analysis of beet seed in the laboratory. –. GRIMM. *Hautes Etudes Betterav. Agric.*, 1975, **7**, (31), 30–32.—The use and value of X-ray analysis of sugar beet seed are briefly discussed and some radiograms reproduced.

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Faster, easier deliveries with automatic openers. G. A. SAUER. *Sugar Beet J.*, 1975, **39**, (1), 2–3.—Advice is given on the use of automatic tailgate openers for beet delivery trucks as used in the USA.

Fall application of fertilizer for sugar beets. M. E. KROETZ and W. H. SCHMIDT. *Sugar Beet J.*, 1975, **39,** (1), 4–5.—The question of fertilizer application in the autumn rather than the spring is discussed. While P and K can be applied well before the beet crop is sown, N should be applied in the spring. For best results with manganese, this should be applied in the furrow, since broadcast Mn is quickly converted into an unavailable form in the soil. It is stressed that a Mn deficiency is usually a result of lack of available Mn rather than of total Mn.

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Perennial weeds—a perennial problem. P. B. BRIMHALL and R. C. BOND. *Sugar Beet J.*, 1975, **39,** (1), 6–7. Perennial weeds which are a major problem in US beet crops are indicated and their control discussed. Two herbicides particularly effective are "Roundup" and "Basagran", but some limitations exist on their use. However, they will enable most perennial weeds to be controlled at some point in crop rotation.

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Sugar beet storage. R. A. FOGG. *Sugar Beet J.*, 1975, **39,** (1), 8–9.—Various means of protecting and ventilating stored beet are illustrated and briefly discussed.

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Bring them in alive. F. B. RUSSELL. *Sugar Beet J.*, 1975, **39,** (1), 10.—The author emphasizes the importance of minimizing damage to beet during harvesting, since only living, healthy beets can be stored. Optimum speed of movement of the beets from the digger wheels via the cleaning rolls and conveyor to the transport is important to avoid damage, while accurate topping (for which ground speed is an important factor) is also essential.

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Variation in the processing quality of sugar beet during harvesting and storage. N. A. AL'DEKOV and N. F. KOSTIN. *Sakhar. Prom.*, 1975, (10), 56–58.—Investigations showed that the yield and sugar content of beet grown as a monoculture were lower than for beet grown after lucerne or winter wheat. Weight and sugar losses in storage also tended to be higher for beet grown as monoculture. Beet grown after lucerne or winter wheat were less subject to infection by *Cercospora beticola*, powdery mildew and root rot. The ash and total N contents of beet grown as monoculture were also higher, both before and after storage; these beet also provided more molasses and less white sugar. It is recommended that such beet should be processed as quickly as possible; if storage is unavoidable, it should be only for the shortest possible period.

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The pygmy mangold beetle and its control. M. KUBACKA-SZMIDTGAL. *Gaz. Gukr.*, 1975, **83,** 266–271. The incidence of *Atomaria linearis* on beet plants in Poland and the damage it causes are indicated and details given of tests on its control. Most effective treatment was dusting field perimeters with "Karbatox" at 30 kg.ha^{-1}, dressing the seed with "Mesurol" or "Furadan" at 900 g per 100 kg seed and spraying the rows with 0·02% "Mesurol" or "Hostation". An alternative method was application of 12 kg.ha^{-1} "Furadan" granules at sowing.

Beet harvester demonstrations. W. C. VON KESSEL. *Die Zuckerrübe*, 1975, **24,** (6), 6–11.—Illustrations and information are given on beet harvesting equipment demonstrated at two sites in West Germany.

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Formation and accumulation of sugar in the sugar beet. H. KRZYWON. *Die Zuckerrübe*, 1975, **24,** (6), 18–19.—The process by which the beet plant produces sugar is explained and factors having effect on the process and plant growth are discussed, particularly temperature and rainfall. It is shown that, under otherwise identical conditions, the maximum root weight obtained in pot experiments occurred when the temperatures in May–July (56 days) and July–September (75 days) ranged from 17° to 23°C, whereas for maximum sugar yield (g per pot) the optimum temperature range was 17–23°C in the first period and 12–17°C in the second period. Although beet exposed to a prolonged period of drought have a very much lower weight than well-watered beet, their sugar content is usually higher than that of "normal" beet. However, the sugar content could fall below that of normal beet where harvesting is late, since the leaves of severely affected beet wither and die; rainfall following the drought causes rapid growth of new leaves at the expense of the sugar content, such growth being promoted also by the residual N in the soil (unused because of temporary insolubility). Only where leaves remain intact after drought will rainfall coupled with warm sunshine and cool nights increase the sugar content. Hence, the optimum harvest time is dependent on the severity of drought damage.

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Leaf and root accretion by sugar beet seedlings in relation to yield. F. W. SNYDER. *J. Amer. Soc. Sugar Beet Tech.*, 1975, **18,** 204–213.—A number of beet seedlings were pot-grown on vermiculite to which an excess of mineral nutrient solution (made up of 13 components) was applied daily to induce flushing. Under identical growth conditions during an 18–30 day period, considerable variations were found in leaf area and weight and root weight between seedlings of the same variety. The leaf area of seedlings of different pairs of varieties showed up to 60% differences 21 days after emergence; where both leaf and root parameters were measured, the differences between varieties were similar. Generally, the variety having the greater leaf area in 21-day seedlings usually had the greater root yield in full-season field tests. Within a mean temperature range of 11–26°C, the relationship between the logarithm of leaf area and temperature was linear.

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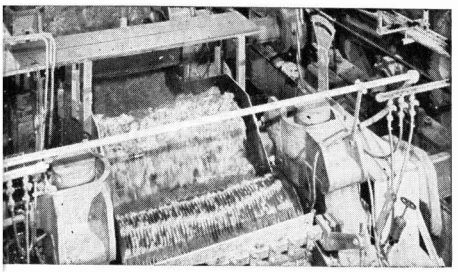
Regression analysis of chemical measurements on hybrid sugar beets to root yield, sugar percentage and impurity index. G. K. RYSER, J. C. THEURER and J. L. HADDOCK. *J. Amer. Soc. Sugar Beet Tech.*, 1975, **18,** 214–231.—A regression model-building programme was used in a study of the effects of beet inorganic constituents on growth parameters and sugar content and yield. Evaluation of model efficiency showed that linear models with 12–16 variables were the most consistent, while second- and third-degree polynomials were not substantially better than comparable linear models; they had excess terms when all variables were included, and the three-dimensional graphs were incomplete.



Cane sugar manufacture

Australia's Research Institute doubling computer capacity. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 41–43.—See *I.S.J.*, 1975, **77**, 364.

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The Abraham Lincoln sugar mill. The first agro-industry in the Amazon region. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 64–65.—Information is given on the first sugar factory to be built in the Amazon region of Brazil which is planned to produce 30,000 metric tons of sugar a year, representing one-third of the requirements of the region.

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Some observations on clarification (by addition of phosphate). P. L. APTE and B. R. MATH. *Sugar News* (India), 1975, **7**, (2), 17–19.—The amount of phosphate in mixed juice required for good clarification is discussed and guidance given on phosphate determination. Two series of tests with juice from Co 419 cane, in which the phosphate was made up to 300 and 400 ppm, respectively, demonstrated the benefits of phosphate addition in terms of pol rise from mixed to clear juice. Both di- and trisodium phosphate were used, but comparison is difficult since the initial pol levels differed.

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Cane syrup storage. F. CORDOVEZ Z. *Sugar J.*, 1975, **38**, (4), 12–14.—See *I.S.J.*, 1975, **77**, 119.

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The performance of continuous centrifugals. L. K. KIRBY and P. G. ATHERTON. *Sugar J.*, 1975, **38**, (4), 20–24.—See *I.S.J.*, 1975, **77**, 40–44.

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Performance of spreader-stoker furnace. R. LOKAN. *Sugar News* (India), 1975, **7**, (3), 7–11, 5.—Details are given of two boilers with spreader-stoker bagasse furnaces installed in a new Indian sugar factory. Advantages of this type of furnace are listed and performance data are compared with those obtained with other types of bagasse furnace, showing higher boiler efficiencies and generally the same or lower losses.

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Cane sugar mill setting by Farrel method. G. R. SWAMY. *Sugar News* (India), 1975, **7**, (3), 13–14. The Farrel system of calculating mill roller settings is explained with the aid of a worked example.

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Role of juice channels in a press plate towards its working capacity. D. P. GOEL and V. M. BHALWAR. *Sugar News* (India), 1975, **7**, (3), 21–24.—The performances of plate-and-frame filter presses used to treat 1st and 2nd carbonatation juice are reported. It is concluded that differences in filtration efficiency between two types of plates used were due to the much greater volume of juice channels in the more efficient filter than in the other. Both plates carried pyramidal studs for juice channel formation.

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Sugar technology research in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 52–57. Studies of post-harvest deterioration of burnt and unburnt cane, cut or left standing, showed that apparent purity fell during the test period of 9 days, that the rates of deterioration of burnt standing and burnt cut cane were almost identical (as expressed by apparent purity and reducing sugars % Brix), and that from the 5th day unburnt cut cane showed a significantly higher rate of deterioration than did cane subjected to the other treatments. Cane was divided into four portions: A included internodes 1–3, B internodes 4–6, C internodes 7–9, and D the remainder of the lower stalk section. From calculations of expected recoverable sugar % cane for each portion, portion A was of no value for milling, portion B gave inconclusive results, while portion D received no further consideration. Portion C is that normally sent to the factory, and it is thought that there should be no change in the general recommendation to top at the 6th internode. A Buchler-Cotlove "Chloridometer" proved reliable as a means of determining chloride in final molasses. Results of investigations, carried out to determine losses in evaporation on the basis of changes in the ratio between Brix, sucrose and reducing sugars on the one hand and chloride on the other, proved inconclusive, since all the ratios were found to be systematically higher in syrup than in clear juice; this could have been due to sampling and/or analytical errors or to inadequacy of the technique. "Floxin" flocculation aid used at the rate of 1–8 ppm (compared with a recommended rate of 2–3 ppm) gave no response in clarification trials; the flocculant did not dissolve properly despite use of the technique recommended by the manufacturer, while other techniques were equally unsuccessful. "Sp 95" bacterial enzyme in liquid form was added at various concentrations to juice and syrup of varying Brix in laboratory tests. Maximum starch elimination (83–96%) was obtained with 5 ppm enzyme added to 25°Bx juice and incubated at 90°C. However, it is considered that the high temperatures in the 1st effect of an evaporator would partially deactivate the enzyme, activity of which would also be inhibited in the 4th effect. Moreover, it has been found in Mauritius that enzymes occurring naturally in mixed juice have given sufficiently good reduction of the starch content for manufacture of raw sugar of high refining quality. Details are given of a laboratory boiling procedure used in tests aimed at deriving a simple formula for prediction of final molasses purity. High correlation was established between true purity and gravity purity for 22 molasses samples; multiple regression analysis gave a relationship of the form: expected

gravity purity $= A \times$ original gravity purity $- B \frac{\text{reducing sugars}}{\text{sulphated ash}} + C$. After a "Lainyl" filter cloth had been fitted over the drum of an Eimco rotary filter to enable it to operate along the same lines as the "Rapi-Floc" system, filtrate appeared to be better than previously at about the same filtering capacity. Mud retention tests are to be conducted.

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Use of hydraulic motors as crusher and mill drives. T. R. RAY. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 54.—The use of hydraulic motors to drive cane crushers and mills is discussed and information given on the system at Glenwood Co-operative where the world's first such drive was employed in 1973. Advantages and disadvantages are examined and possible means of improvement indicated. Design criteria are presented and possible applications of hydraulic drives shown. Power consumption data for the 2-roller crusher at Glenwood are compared with standard formulae for calculating power requirements.

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Polymers in cane juice clarification. J. C. P. CHEN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 61–69.—Results (mostly in graph form) of clarification tests with a number of polymer flocculation aids are reported. Both laboratory and factory trials were carried out, "Separan AP-30" being used as standard, and comparison being made with results obtained without flocculant. It is stressed that any one flocculant will have different effects according to juice, cane variety, growth conditions, and mud particle characteristics and may vary in performance from one country to another. Moreover, some flocculants gave good clarity but poor sedimentation; some had a rapid effect initially which slowed down. Sometimes, increasing the dosage had an adverse effect. Polymer molecular structure is important, and increasing the molecular weight may reduce the tendency to poor sedimentation effects. Of more than 50 polymers tested, the most effective have proved to be anionic.

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Vacuum pan performance. G. ALEMAN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 70–72.—The mechanism of massecuite circulation is briefly explained and the importance of rapid boiling in order to avoid increased sugar losses is stressed. In this connexion, the supply of low-temperature vapour is discouraged. Circulation can be helped, especially when vapour of below 10 psig is fed, by means of the Claassen steam injection system. While this does not provide the same benefits as mechanical circulation, it has been found by the author to be better than natural circulation because of greater massecuite quantity boiled per unit time and reduction in caramelization.

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Use of computers at Sugar Cane Growers Cooperative of Florida. D. SPOONER. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 141–150.—The punched card system used for general book-keeping and production of cane delivery and analysis reports as a basis for cane payment is described and flow charts for the various functions are reproduced.

The use of instrumentation in the sugar industry. P. J. FERNANDEZ. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 78–79.—The benefits of automatic Brix control in boiling are discussed and use of a differential pressure transmitter explained.

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Using bagasse as fuel. V. J. BAILLIET. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 200–201. Problems associated with bagasse burning are examined, and ways of overcoming these and raising bagasse furnace and boiler efficiency are briefly described.

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Sucrose loss in diffusion with reference to thermophilic bacteria and lactic acid. L. MCMASTER and A. B. RAVNÖ. *S. African Sugar J.*, 1975, **59**, 469–475.—See *I.S.J.*, 1976, **78**, 182.

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Economiser a solution for fuel shortage in the sugar industry. A case study. R. P. MITTAL. *Indian Sugar*, 1975, **25**, 233–235.—By means of steam generation and consumption data, the author shows how a Green's economiser solved the problem of fuel deficiency at an Indian factory.

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The proper selection of valves for sugar factories and refineries. ANON. *Sugar y Azúcar*, 1975, **70**, (11), 33–37.—An illustrated survey is presented of valves available for use in the sugar industry. Fields of application and modern trends in the industry are indicated.

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The proper selection of chain in the sugar industry. L. DE JAHN. *Sugar y Azúcar*, 1975, **70**, (11), 39–44, 52.—A representative of Rexnord International discusses types and features of drive and conveyor chains and their use.

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Cane preparation with special reference to knifing. G. N. NURICK. *Comm. Sugar Milling Research Inst.* (Durban), 1975, (104), 1–56.—Investigations of cane preparation at Felixton, Gledhow and Sezela factories are reported. Graphs of Preparation Index *vs.* power consumption per ton of fibre per hour and tabulated data indicate that while preparation at all three was satisfactory, only at Gledhow (where the Preparation Index was highest) did the power consumption approximate to that considered by ALLAN[1] to be adequate for a PI of 85–90%. At all three factories the 1st set of knives was more powerful than the 2nd set. It is thought possible that the number of knives per set could affect the result. The author makes a number of recommendations on cane preparation testing.

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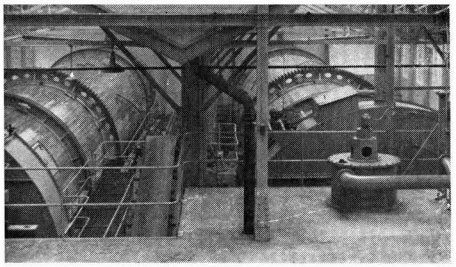
Waste fuel drying and the energy crisis. W. P. BOULET. *Sugar J.*, 1975, **38**, (6), 8–11.—The practice of burning wet bagasse in factory furnaces is criticized since it causes a drop in boiler performance and an increase in atmospheric pollution. With increase in the moisture content, the combustion rate falls and there is a marked increase in the volume of gases, as indicated by graphed and tabulated data. Hence, it is recommended that flue gases be used to pre-dry the bagasse to at most 40% moisture content.

[1] *I.S.J.*, 1975, 77, 182.



Beet sugar manufacture

Sugar factory expansion. Problems and suggestions. M. BARRÉ and H. DURET. *Ind. Alim. Agric.*, 1975, **92**, 717–719.—The problems involved in expanding a beet sugar factory, most of which can be undertaken only during the eight months between campaigns (allowing one month for tests and the unexpected), are discussed and the stages to follow in planning and in ordering materials and plant are set out, starting at a point 19 months prior to the date set for start-up. It is stressed that the scheme described is only an example and that each factory expansion must be considered as an individual case.

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Beet washing and factory supply. New processes in the face of dirt tare. J. N. DOUCERAIN. *Ind. Alim. Agric.*, 1975, **92**, 753–759.—The various systems of beet storage and conveying to the factory as used in France are described, including dry storage and dry conveying, dry storage in long piles and conventional fluming, storage in polar silos and fluming by water jets, and storage of washed beet and fluming. Various types of washers, weed and stone catchers are also described, including Venot-Pic, Maguin and RT equipment[1]. The advantages and disadvantages of the storage and washing systems are discussed and losses occurring in conveying and washing are briefly examined.

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1st carbonatation filter-thickeners. K. ANDERSEN. *Ind. Alim. Agric.*, 1975, **92**, 801–810.—The theory of juice filtration is briefly explained and the use of filter-thickeners in place of clarifiers discussed. Filter-thickener types are described and their operation examined with regard to filtration material, mud properties and automatic control.

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Present level of use of ion exchange resins in the sugar industry. J. J. UNGAR and R. LUMBROSO. *Ind. Alim. Agric.*, 1975, **92**, 825–830.—A brief survey is presented of ion exchange processes used in the sugar industry, including 2nd carbonatation juice deliming and demineralization, syrup decolorization, molasses treatment (by the Quentin process) and the Resindion RDI process which is designed to produce a white sugar from beet juice by deliming after carbonatation, 4-stage demineralization of the treated juice and decolorization of thick juice after evaporation.

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Study on the behaviour of continuous low-grade centrifugals. D. AHARI and J. GENOTELLE. *Ind. Alim. Agric.*, 1975, **92**, 837–842.—Problems involved in low-grade massecuite handling by a conical-basket continuous centrifugals are discussed. Results of investigations have shown that an increase in mother-liquor purity is due partly to the smallness of the massecuite crystals and partly to crystal erosion by the screen (a result of centrifugal operation as well as design). While loss of crystals in molasses could be reduced by decreasing screen perforation size, this would also reduce throughput; moreover, screen wear after a given time is reflected in enlargement of the perforations. Stroboscopic investigations have revealed the effects of irregular massecuite distribution on sugar quality; such irregularity can result from off-centre feeding or from blockage of the feed system by lumps or even slabs of sugar from the mixer trough. While steam injection has been found to improve massecuite curing and sugar quality while also raising centrifugal throughput, the need is stressed for correct control of pressure and flow rate. Measurement of the temperature difference between massecuite and molasses (regarded as probably a linear function of steam flow and temperature) has shown that at 1 bar pressure the massecuite can be heated to 10°C without any noticeable rise in molasses purity, whereas at 4 bar pressure molasses purity has risen appreciably (as a result of crystal dissolution) after a difference of 5°C.

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New complete lines for continuous low-grade crystallization. M. FRIML and R. STENGL. *Ind. Alim. Agric.*, 1975, **92**, 845–847.—Details are given of a Škoda continuous low-grade cooling system in which the massecuite was cooled from 78–82°C to 51–53°C during 40 hours' retention at a factory slicing during a prolonged campaign, despite which there were no snags and molasses exhaustion was relatively good, at a Brix of 84·1° and purity of 63·3 compared with a massecuite Brix on dropping of 94·4° and a purity of 78·4. The first crystallizer is provided with two stirrers, and from this the massecuite flows to four crystallizers linked by tubes, alternately at the top and bottom of the trough; these crystallizers are provided with water-filled disc-type cooling elements. In an emergency, each crystallizer can operate independently. Massecuite flow is controlled by two valves, one (manually operated) in the base of the trough, and the other (remotely controlled) mid-way up the crystallizer. The massecuite is finally dropped to a battery of three automatic centrifugals, two 1500 rpm machines for curing and one 1200 rpm centrifugal for affination. The sugar from the two high-speed machines is transferred to an affination tank from which the massecuite is pumped to the distribution trough feeding the affination centrifugal, while the affined sugar is melted.

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Beet reception. ANON. *Le Betteravier Franç.*, 1975, **45**, (282), 8–9.—The three stages in evaluating beet yield and quality as used in France are described, viz. (i) "geometric weighing", in which the individual beet field area is measured before the 1st August in each year and beets sampled for determination of

[1] *See also I.S.J.*, 1974, **76**, 266–269; 1975, **77**, 269–271.

the total number of plants and total yield per ha, (ii) sampling and weighing by the Rüpro system, and (iii) analysis of the beet brei in the tarehouse laboratory.

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Reduction of bacterial infection in diffusion. N. V. KULINICH, V. Z. NAKHODKINA and V. G. YARMILKO. *Sakhar. Prom.*, 1975, (9), 9–11.—By using ammoniacal water deammoniated by electrodialysis instead of condensate treated with SO_2 for beet diffusion, the bacterial counts and unknown losses were reduced. Acidified ammoniacal water is also a possible alternative to condensate. Press water should be sterilized by holding at a temperature not lower than 85°C.

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The effectiveness of adding lime to 2nd carbonatation. A. P. LAPIN, N. D. DRUCHAK and E. YA. KHILINSKAYA. *Sakhar. Prom.*, 1965, (9), 12–15.—Details are given of the carbonatation schemes used at the Czechoslovakian-supplied Chervonoznamenskii sugar factory (with hot preliming, with cold preliming, and without preliming) according to the beet quality. Experiments are reported with hot progressive preliming followed by two-stage 1st carbonatation, with 1st carbonatation juice recycled to preliming at the rate of 100% on raw juice volume. Despite the poor quality of beet, which necessitated greater consumption of lime (2·89% CaO) and maintenance of a higher 2nd carbonatation juice alkalinity (no lower than 0·035% CaO on weight of beet) than normally, a high purification efficiency was achieved, resulting in a sugar colour conforming to standard requirements. The lime salts content in the treated juice was 0·005% less than with the usual scheme applied for low-quality beet.

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Device for checking the level of juice-cossette mixture. M. E. FURER and V. R. TSYGURA. *Sakhar. Prom.*, 1975, (9), 34–35.—Details are given of a differential manometer system for measuring the level of the juice-cossette mixture in a vertical diffuser and its prescalder.

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Modernization of cyclone for sugar dust extraction. A. K. STRAUTNIEKS and YA. YA. LAZHE. *Sakhar. Prom.*, 1975, (9), 35–36.—A wet dedusting cyclone is described which has been modified to eliminate certain snags. Results have indicated almost complete absence of sugar dust or syrup droplets in exhaust air from a sugar dryer; at a drum throughput of 93 tons per 8-hour shift, the cyclone has trapped 1·03 tons of sugar dust.

* * *

Sugar factory planning. S. Z. IVANOV, I. P. OROBINSKII, M. V. GONCHARUK and V. A. GOLYBIN. *Sakhar. Prom.*, 1975, (9), 37–39.—For modern sugar factory planning, the authors recommend: provision of enough reserve space inside and outside the factory for possible expansion, installation of a single high-capacity D.C. generator for power supply to equipment in place of a number of small motor-generator types (for a number of reasons which are given), the use of the BMA-Zsigmond-Gryllus ion exchange process for juice deliming, evaporator cleaning without shut-down, reduction in the temperature at which 1st massecuite is boiled to 65–68°C and efficient use of beet wastes.

Heat calculation method for sloping scroll diffusers. A. A. KNYAZEV and V. N. GOROKH. *Sakhar. Prom.*, 1975, (9), 46–49.—A system of equations is presented for calculation of heat parameters involved in diffusion in a sloping trough diffuser of the A1-PDS-20 type.

* * *

Improving the condenser station of a sugar factory. V. I. DOVGOPOL, S. A. ZOZULYA, A. I. KHOMENKO and YU. F. TSYUKALO. *Sakhar. Prom.*, 1975, (9), 50–54.—Reasons for inadequate vacuum in the pan station are examined and a condenser system with a direct-flow pre-condenser described which is designed to overcome the problems. Tests have shown that such a system can achieve up to 90% condensation of the incoming vapour and heat the condenser water to a temperature approximating to that at which the outgoing steam is saturated. Hydraulic resistance under all test conditions did not exceed 0·005 $kg.cm^{-2}$.

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Improved scheme for carbonatation gas scrubbing. K. N. SAVCHUK. *Sakhar. Prom.*, 1975, (9), 55–57. A system of CO_2 gas scrubbing is described which includes a spray tube, wet cyclone, tray-type scrubber and a dry cyclone. Its performance at a number of factories has been sufficiently successful as to reduce wear of compressors and other gas-handling equipment while cutting the amount of water normally used for removal of impurities by 35–40% on weight of beet. The economics are briefly examined.

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Cossette extraction with addition of sulphurous acid and calcium bisulphite. S. ZAGRODZKI. *Gaz. Cukr.*, 1975, **83,** 231–232.—See *I.S.J.*, 1976, **78,** 26.

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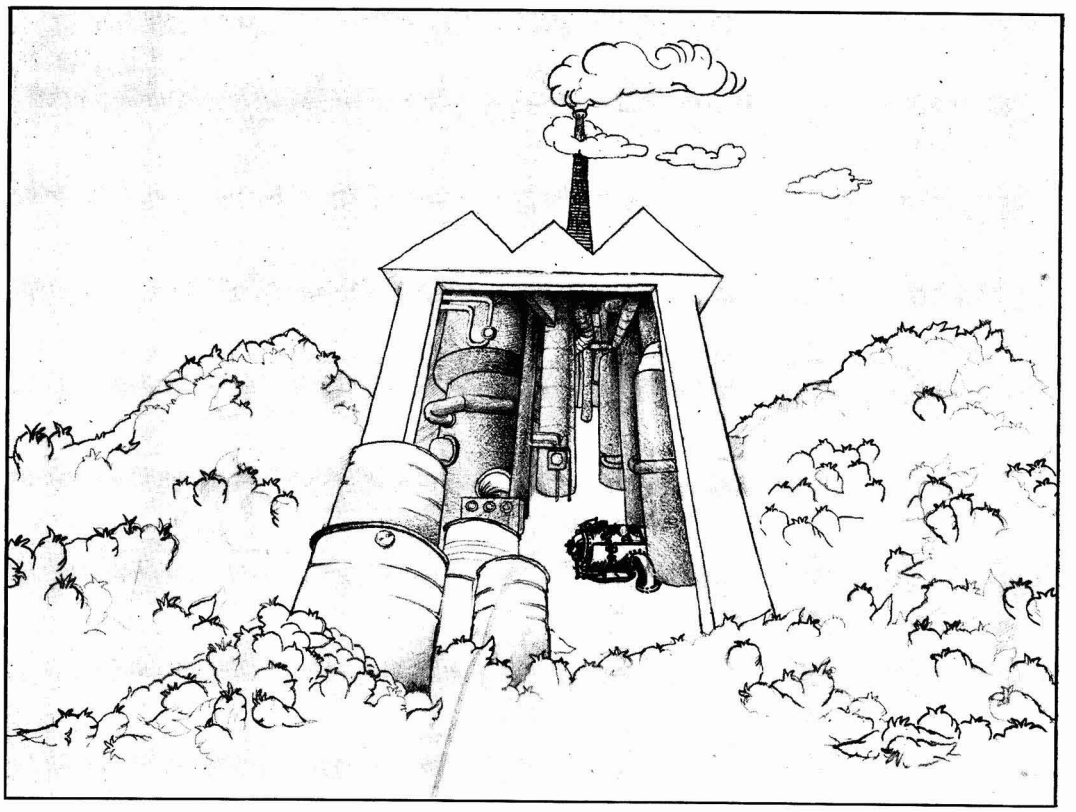
Optimum arrangement of massecuite and run-off purity. K. WAGNEROWSKI. *Gaz. Cukr.*, 1975, **83,** 233–238.—The viscosity of sugar factory products as a function of non-sugars composition and concentration is discussed and massecuite viscosity in various stages of boiling is examined. The high viscosity of low-purity products causes difficulties in low-grade boiling and in molasses exhaustion, so that there is need for optimization of 2nd run-off purity. This is discussed in some detail with the aid of graphs and diagrams, as is the correlation between required run-off and massecuite purities and the effect of massecuite crystal content and degree of concentration on boiling and curing. It is stressed that, while 2nd massecuite boiling on a magma obtained from low-grade sugar will not make processing any easier, it will increase throughput and raise sugar quality.

* * *

Molasses sugar extraction and increase in white sugar yield. I. SALÁNKI. *Cukoripar*, 1975, **28,** 170–174. A survey is presented of beet molasses sugar extraction methods, with particular mention of the RT saccharate system for which typical performance data are given.

* * *

"Dry" pumping of carbonatation mud. G. PÁL. *Cukoripar*, 1975, **28,** 193–196.—A system for undiluted carbonatation mud conveying by pipeline using a special centrifugal pump and compressed air is described. The scheme is used at Szerencs sugar factory.



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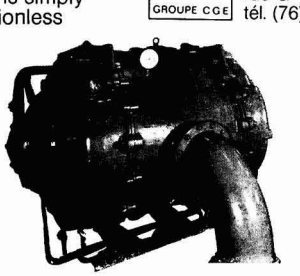

What problems are caused by trash in the sugar factories. ANON. *The Sugarbeet*, 1975, (79), 13–15. Problems created by extraneous matter accompanying beet are examined. They include respiration in beet piles through prevention of free passage of air, as well as generation of additional heat when trash decomposes, leading to increased beet deterioration; increased non-sugars introduced where topping is too high; blocking of flumes and beet knife damage by stones, as well as the costs of equipment needed to separate trash.

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Active alkalinity of sugar factory juices. K. VUKOV. *Sugar J.*, 1975, **38,** (5), 16–22.—See *I.S.J.*, 1975, **77,** 247.

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The conditioning of white sugar silos. V. MAURANDI and G. MANTOVANI. *Zucker*, 1975, **28,** 593–600.—See *I.S.J.*, 1976, **78,** 55.

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Investigations into juice coloration during sugar house work. L. WIENINGER and N. KUBADINOW. *Zucker*, 1975, **28,** 601–605.—See *I.S.J.*, 1976, **78,** 55.

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Adjustment of the pH of water for diffusion. K. ČÍŽ, J. GEBLER, Q. MANN and V. ČEJKOVÁ. *Listy Cukr.*, 1975, **91,** 202–207.—The optimum pH at which colloid transference to raw juice is minimum and cossette compressibility maximum was found to be 5–6; condensate and a mixture of condensate and fresh water having average pH values greater than 6 and used for diffusion had higher K, Na, Ca, Mg, Cl, NO_2 and NO_3 contents than did fresh water averaging pH 6·8. Press water at pH 5·5 had the highest impurities content. Acidifying fresh water with phosphoric acid to the optimum pH reduced the juice colloid content by 25% and raised its purity by 1–2 units compared with untreated fresh water; use of sulphuric acid was not as effective. Best results were given by 25–35 litres of 60% phosphoric acid added per 1000 tons of beet.

* * *

Water recirculation in sugar manufacture. F. KASTNER. *Listy Cukr.*, 1975, **91,** 207–212.—The water consumption in a beet sugar factory is discussed. A mathematical model for a factory slicing 1000 tons of beet a day shows an excess of water occurs in the form of water in the beet, while a 37% excess (on beet) occurs as condensate, representing some 15 $m^3.hr^{-1}$. It is suggested that the use of surface condensers and heat exchangers in the vapour bleed system would reduce the fresh water requirements without causing any drop in cooling water quality.

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Experience in the use of FiLS-60 units for 1st carbonatation mud thickening. YU. V. ANIKEEV *et al. Sakhar. Prom.*, 1975, (10), 11–14.—Performance data are given for the filter station at Yagotin, where FiLS-60 filter-thickeners were installed for treatment of 1st carbonatation juice in parallel with settlers. Results showed that, despite a filtration coefficient in the range 2·67–11·10, the juice was filtered at a high rate; colour change was negligible, but the final juice solids content was 0·23 $g.litre^{-1}$. Difficulties experienced in the operation of the settlers, which had been yielding a turbid juice, were not encountered with the filter-thickeners. Information is given of the FiLS-60 as installed at No. 2 Petrov factory; the design at this factory is different from the standard pattern.

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Preparation and centrifugalling of low-grade massecuite centrifugals. I. N. AKINDINOV *et al. Sakhar. Prom.*, 1975, (10), 14–18.—For low-grade massecuite curing to give high-quality *C*-sugar and reduce molasses purity, it was found that the amount of water to add in BMA K-750 continuous centrifugals should be less than the manufacturers stipulate and should not exceed 2·5% on weight of massecuite. The water, at 65–70°C, should be introduced into the bottom of the basket slightly below the massecuite feed point and before introduction of the massecuite.

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The temperature field in a 1st massecuite vacuum pan. V. P. TROINO, V. V. SHARKOV, V. I. DVOINYKH and S. T. GEPKE. *Sakhar. Prom.*, 1975, (10), 18–22. Data from 1st massecuite boiling in a floating calandria pan with relatively long boiling tubes and a tube plate slope of 25° showed temperature differences across the massecuite and non-steady boiling conditions. It is suggested that the tubes be shortened and the tube plates either made horizontal or given a slope which is "optimum".

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Determination of the frequency and amplitude of temperature fluctuation during sucrose crystallization. V. O. SHTANGEEV, V. YA. BORISENKO, I. S. GULYI and I. G. BAZHAL. *Sakhar. Prom.*, 1975, (10), 22–25. Crystal growth in boiling can be optimized by causing changes in the reheat steam pressure and hence massecuite temperature fluctuations, whereby recrystallization is promoted. Calculation of the frequency and amplitude of steam pressure change is best carried out by use of the frequency response method; it is shown that both change parameters are functions of the time-dependent dynamic properties of the pan.

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Transferring thick juice to a buffer tank for stabilization of sugar factory capacity. O. I. SHEPEL'SKII *et al. Sakhar. Prom.*, 1975, (10), 25–28.—The economic effect of experimental thick juice storage at Mironov sugar factory during 1974/75 is discussed. The calculations, based on an extra sugar loss of 0·2% on weight of beet, indicate the considerable advantages to be gained by storing thick juice as a means of stabilizing throughput.

* * *

A magnetic method of reducing scale formation in heat exchange plants in a sugar factory. S. I. TKACHENKO, A. V. SANDULYAK, V. A. KOVAL', YU. K. PINCHUK and E. L. STRASHEVSKII. *Sakhar. Prom.*, 1975, (10), 47–51.—Information is given on magnetic treatment of diffusion water and thin juice to reduce scale formation. At Stepanov sugar factory, no shut-down of the evaporator was needed throughout the 137-day campaign. The economic effect of this is calculated, and guidance is given on proper use of the magnetic equipment.

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Fuel economy in beet sugar manufacture by use of heat from condensates and pan vapour. M. L. VAISMAN, V. N. GOROKH and V. I. DOVGOPOL. *Sakhar. Prom.*, 1975, (10), 41–47.—While it is shown that some 41%

of the heat used in a beet sugar factory cannot be re-utilized, it is pointed out that condensate and pan vapour can be used effectively to provide heat for vapour purposes. Heat and steam requirements and condensate and pan vapour reheat availability are calculated per unit weight of beet.

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Crystal sugar fluidization. VIII. Threshold fluidization velocity. L. NEUŽIL and E. KOSTELKOVÁ. *Zeitsch. Zuckerind.*, 1975, **100**, 609–616.—From over 250 laboratory tests on white and refined sugar fluidization, equations have been derived for calculation of threshold velocity w_p (m.sec^{-1}), i.e. the minimum air flow velocity at which all the crystals in the bed of sugar are made to "float". At a constant air temperature of 25°C and constant pressure of 745 torr, w_p is given by $0{\cdot}413\ d^{1{\cdot}17}$, where d (mm) is the equivalent diameter of the crystals given by the expression $\Sigma x_i d_i$, where x_i is the mass proportion of each fraction of crystal diameter d_i. Since air temperature and pressure exert less influence on w_p than does d, for normal temperatures and pressures w_p can be easily calculated as $0{\cdot}473\ d - 0{\cdot}059$, which is valid within permissible error at $d > 0{\cdot}3$ mm. A nomogram is presented which relates w_p to d.

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The effect of addition of sulphurous acid and calcium bisulphite during cossette extraction on the quantity of exhausted cossettes. H. ZAORSKA. *Zeitsch. Zuckerind.*, 1975, **100**, 616–618.—See *I.S.J.*, 1976, **78**, 26.

* * *

Corrosion behaviour of chemically stable steels in the sugar industry with particular reference to chemical cleaning. H. J. HEPPNER. *Zeitsch. Zuckerind.*, 1975, **100**, 622–626.—The three types of local corrosion which can affect stainless steel used in juice heater and evaporator construction are discussed: pitting, stress corrosion and intergranular corrosion. Particular mention is made of the harmful effect of chloride on stainless steel in its passive state. Advice is given on tube cleaning with HCl in the presence of a suitable corrosion inhibitor. Since local corrosion will not take place when the steel is in an active state, the role of the HCl is to remove the passive film—this occurs at a concentration greater than 0·8% by weight and a temperature above 50°C. The various stages of a cleaning procedure are set out.

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Increase in pulp quantity under the effect of H_2SO_3 and $Ca(HSO_3)_2$ during diffusion. H. ZAORSKA. *Gaz. Cukr.*, 1975, **83**, 249–250.—See *I.S.J.*, 1976, **78**, 26.

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Contribution to knowledge on efficient flume mud handling. K. SKALSKI. *Gaz. Cukr.*, 1975, **83**, 251–254. Treatment of flume water with milk-of-lime (sufficient to give a pH of 11) has been found to give efficient coagulation and precipitation of mud; comparison was made with conventional flume water treatment in settling ponds and with settling after 2–3:1 addition of carbonatation mud. Liming gave the best results in terms of biological stability, although it did cause an increase in the COD of the supernatant water and the water percolating into the subsoil. Addition of carbonatation mud caused a considerable rise in the COD of both mud and water.

Ethylene-enhanced diffusion. A. H. FREYTAG and J. C. LINDEN. *Sucr. Belge*, 1975, **94**, 429–437.—Details are given of beet diffusion tests in which ethylene was bubbled into the cossette-water mixture to increase the diffusion rate and juice purity. Electron microscopy showed that ethylene causes the beet cell wall to swell as a result of increased hydration, so that larger spaces are formed between the cellulose microfibrils, thus promoting increased diffusion. Apart from increasing raw juice sugar content and purity, ethylene also contributed to a drop in pressed pulp moisture content. Patent applications for the process have been filed in a number of countries, and experiments are being continued.

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Device for measuring the relative saturation of sugar solutions. P. METZING and K. F. SCHLAG. *Tech. Information GRW* (Geräte u.Regler Werke), 1971, **9**, (5), 39–43; through *S.I.A.*, 1975, **37**, Abs. 75-1583. Starting from classic physico-chemical equations and an empirical equation found in the literature, it is shown how straight-line graphs may be constructed which give the supersaturation coefficient as a function of the vapour temperature T_v and the massecuite temperature T_H at constant purity. An electric circuit based on these relationships is shown in a diagram; it enables the supersaturation coefficient S of a massecuite in the course of boiling to be found by measuring T_v and T_H at a given purity. Factory tests were carried out on this system for a 1st massecuite. The reproducibility of values of S was below $\pm$ 0·02.

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Shear strength of some loose materials. J. FEDA. *Potravin Chladici Tech.*, 1974, **5**, (6), 162; through *S.I.A.*, 1975, **37**, Abs. 75-1590.—The angle of internal friction of crystalline sugar was 38° for loose, 50° for compressed material; it varied with the normal load applied (0·6–3·1 kg.cm^{-2}). Some crystal breakage was observed, and this decreased the angle of friction.

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Continuous crystallization of low-grade massecuites. M. FRIML and R. ŠTENGL. *Listy Cukr.*, 1975, **91**, 224–229.—The theory of low-grade massecuite cooling is examined and simple mathematical models of continuous cooling discussed. A description is given of a continuous cooling system, and results achieved are reported.

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Synthetic surface-active agents in the sugar industry. III. K. ČÍŽ, J. GEBLER, Q. MANN and V. HOBÍKOVÁ. *Listy Cukr.*, 1975, **91**, 230–233.—Tests on massecuite boiling with surface-active additives are reported. While none of the three additives investigated ("Slovapon N", "Intrasol" and a Hodag product) significantly reduced viscosity, they did have a marked effect in reducing surface tension and were very effective against foam formation, particularly the Hodag preparation; but the crystal growth rate was reduced by the additives, and "Slovapon N" and the Hodag additive caused formation of a crystal crust on the massecuite surface.

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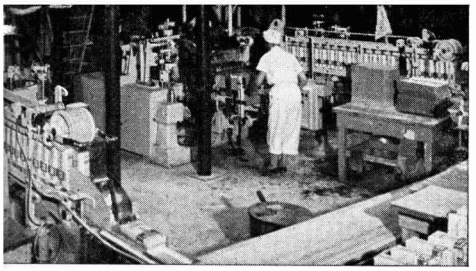
Diaphragm-type density meter. S. BOUČEK and V. VALTER. *Listy Cukr.*, 1975, **91**, 234–239.—Details are given of a diaphragm-type Brix meter and of tests to determine its accuracy, which was found to be of the order of $\pm$ 1% ($\pm$ 0·7°Bx).



Sugar refining

Investigation of sugar desorption from anion exchange resins and bone char. S. Z. IVANOV, V. A. LOSEVA, N. T. SHTANDAROVA and A. D. RUTSINSKAYA. *Sakhar. Prom.*, 1975, (8), 24–26.—Investigations at two refineries showed that recovery of sugar from anion exchange resin and bone char by water for use in melting was accompanied by desorption of colouring matter, the amount of which increased as the dry solids content fell, while the purity also fell. Hence, analysis of the eluates for colour is recommended, after which the most suitable use can be decided according to the colour level.

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Determination of the quantity of carbonatation raw sugar melt liquor recycled to liming. R. TS. MISHCHUK and A. YA. ZAGORUL'KO. *Sakhar. Prom.*, 1975, (8), 44–46.—For those factories refining raw sugar in the inter-campaign period and recycling some of the unfiltered melt liquor to liming (which brings a number of benefits, including stabilization of defecation melt alkalinity), formulae are presented for calculation of the quantity to recirculate as a function of alkalinity; allowance is also made for quantities of *A*-molasses and low-grade sugar melt which are also added to the liming tank.

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A study of factors influencing refinery carbonatation. J. P. MURRAY and F. M. RUNGGAS. *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 90–93.—Laboratory carbonatation tests are reported in which composite samples of raw sugar from Huletts refinery were used; the samples were obtained before the carbonatation system at the refinery was altered to a scheme of 1st carbonatation in twin vessels followed by 2nd carbonatation, in contrast to a former 3-stage scheme. Maximum raw sugar filtrability was found to occur at a pH (8·2) which is considered too low for practical purposes, although a reduction in pH from 9·6 to 9·3 (which is practical for 1st carbonatation) gave more than a 20% improvement in filter throughput. Conductivity ash content fell with pH to a minimum at 8·7, which is attainable in 2nd carbonatation; at a 1st carbonatation pH of about 9·5, the ash content would have to be reduced from 0·36% to 0·10% in 2nd carbonatation. Although maximum filtrability was achieved at a carbonatation temperature of 86°C, difficulties arose, e.g. formation of excessive foam and increase in Brix as a result of evaporation, so that a temperature of 75°C was adopted, at which the filtrability was still 75% of the maximum possible. Optimum milk-of-lime aging, i.e. retention at an elevated temperature between the slaker and carbonatation vessel, was 2 hours at 80°C; a longer period was not accompanied by any significant increase in filtrability. Maximum filtrability was also brought about by a lime dosage of 0·7–0·8% CaO on solids.

Granular activated carbon economic success for sugar decolorization. J. N. FORET and C. J. BERNARD. *Sugar y Azúcar*, 1975, **70,** (10), 44.—The economic benefits of replacing powdered carbon with granular carbon for melt liquor decolorization at Georgia refinery, Louisiana, are discussed. The new process is cheaper to operate and requires less labour while giving a final sugar which has 36% less colour than with the previous system. Filter aid consumption for liquor treatment has been halved, and there is no waste disposal problem, since the exhausted carbon is regenerated at 1725°F and returned to process; moreover, this makes more warehouse space available for other uses. Annual savings are calculated to be $300,000.

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Control of grain size in refined sugar. R. ESPARZA. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 73–76.—The POWERS method of reporting sieve test results is explained. While the method has been widely used, it is by no means universally adopted; whereas many beet sugar companies in the US use it for refined sugar, most US cane sugar refiners reject it on the grounds that it is inadequate at the two extremes of crystal size (coarse and fine) distribution, which are the parts of the scale of greatest interest to the commercial user. A method introduced by the author for grain size control in refined sugar consists of comparison between the size analysis graph obtained with the graph corresponding to the size required; this permits the quantity of powder used for full seeding to be varied and has provided an accurate means of grain size control.

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Prospects for the industrial production of liquid sugar. N. MARIGNETTI. *Ind. Sacc. Ital.*, 1975, **68,** 87–90. Liquid sugar production in other countries is surveyed and an estimate made that there is a market for 150,000 tons per year at present in Italy, increasing to 400,000 tons per year within the next decade. Types and qualities of liquid sugars are reviewed as are regulations in other countries concerning the types of ion exchange resins permitted for use in their manufacture. The types of raw materials are briefly discussed with mention of those other than beet and cane, i.e. sorghum, dates, etc. The author calculates non-sugar removal costs as 190–200 lire per kg for traditional processing and 120–190 lire per kg using only resins.

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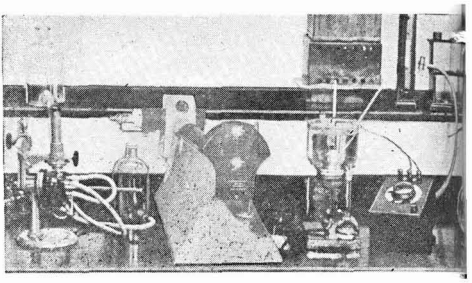
Two sugar dissolution problems. V. URBAN. *Listy Cukr.*, 1975, **91,** 283–285.—Mathematical expressions are developed for calculation of the factors involved in sugar dissolution under various conditions, e.g. in a melter.

Laboratory methods & Chemical reports



The wetting angle of sucrose solutions. K. Číž. *Ind. Alim. Agric.*, 1975, **92**, 833–835.—See *I.S.J.*, 1975, **77**, 283.

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The determination of sucrose in cane final molasses. E. C. VIGNES. *Zeitsch. Zuckerind.*, 1975, **100**, 561–564. Investigations conducted during the 1974 crop confirmed results obtained in 1973[1], viz that the JACKSON & GILLIS double polarization method was the best of four methods tested (the others being the A.O.A.C., Sugar Research Institute and Canadian National Committee methods) for routine analysis.

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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. *Sucre. Belge*, 1975, **94**, 385–393.—See *I.S.J.*, 1975, **77**, 299–305.

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The behaviour of free amino-acids during juice purification. N. KUBADINOW and W. HAMPEL. *Sucr. Belge*, 1975, **94**, 394–404.—See *I.S.J.*, 1976, **78**, 60.

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Saccharinic acids. L. SKÁLA and M. FRIML. *Listy Cukr.*, 1975, **91**, 175–183.—The formation and properties of saccharinic acids, which occur as a result of liming, are described and details given of their separation by paper, thin-layer and column chromatography.

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Post-freeze deterioration of standing sugar cane as affected by variety and time. J. D. MILLER and G. J. GASCHO. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 36–41.—Eleven cane varieties were frozen for about 9 hours in a controlled-temperature chamber and deterioration determined at 0, 2, 4 and 6 weeks after freezing. Sugar content and purity fell with each successive sampling date; Brix and raw juice pH fell up to the 4th week after freezing, after which there was a slight rise; titratable acidity rose with each sampling date; and dextran content increased at the 4th and 6th weeks after freezing. Generally, varieties having the highest sugar content after freezing also had relatively high purity and raw juice pH and relatively low titratable acidity. Interactions between variety and time after freezing were significant for all variables except Brix. Highest correlation was established between crusher juice sucrose content and (i) purity and (ii) pH.

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A simple and rapid method to determine moisture and fibre in cane. A. L. FORS. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 127–130.—See *I.S.J.*, 1976, **78**, 92.

Core sampling studies—1973. H. S. BIRKETT and J. J. SEIP. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 163–177.—Studies to evaluate the efficiency of a hydraulic press in processing cane samples by a J & L core sampler are reported. Results indicated high reproducibility of cane analysis following use of the press, the pol % cane provided by this method comparing favourably with the value given by cold water digestion. The press was highly responsive to trash, and increase in apparent fibre content was directly proportional to the quantity of trash in the cane sample. Multiple core sampling revealed cane quality variability within a single consignment, although location of the sampling point did not bias the results. Use of the press and core sampler provided an analysis which correlated well with analysis of factory mill juice.

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Laboratory multi-cell constant-temperature unit for analysis of sugar factory products. I. A. PRIKHOD'KO and K. V. UKRAINETS. *Sakhar. Prom.*, 1975, (9), 43–45.—Details are given of the construction and operation of a unit which comprises an electrically-driven horizontal-axis rotary assembly carrying up to 48 hermetically-sealed containers; the assembly is half immersed in heat-carrying liquid (water or oil), so that each rotation will bring all containers into contact with the fluid. Possible uses include determination of molasses standard purity, Brix determination by the 1:1 dilution method, etc.

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Staling of sugar cane—a study on the deterioration of juice quality of millable canes at the Sugarcane Research Station, Cuddalore, Tamil Nadu. N. RAMAMOORTHY, S. A. AHMED, K. T. NARASIMHAN, S. D. RAJAN and I. MAHAMUNI. *Sugar News* (India), 1975, 7, (4), 5–10, 22–23.—Juice samples were collected every 12 hours from four varieties of cane stored in the open for 96 hours after harvesting. In all cases there was a rise in Brix and reducing sugars, while pol and purity fell. The extent of change in these factors depended on variety as well as time, as demonstrated by tabulated data.

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The specific heat of prepared cane. T. B. DALE. *S. African Sugar J.*, 1975, **59**, 451.—Experiments were conducted at the SMRI to measure the specific heat of freshly cut cane after shredding in a laboratory hammer mill. Moisture was determined by drying in a current of hot air in a "Moisture Teller", and the specific heat was determined 3–5 times in sub-samples by the method of mixtures. Results were affected by the moisture content as well as the relative fibre and juice contents of the samples. At a moisture content in the range 70·8–72·6%, the average specific heat was 0·86 cal.g^{-1} per °C. An equation is given for calculation of specific heat as a function of moisture.

[1] *I.S.J.*, 1975, 77, 181.

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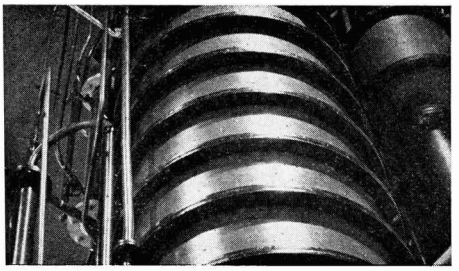

By-products

Sugar cane bagasse, a waste disposal problem. H. L. CHAPMAN. *Proc. Soil Crop Sci. Soc. Florida*, 1971, **31**, 22–23; through *S.I.A.*, 1975, **37**, Abs. 75-1225. Bagasse pith obtained by screening, or dried whole bagasse, was steamed, mixed with 5–8% cane molasses and pelleted. Cross-bred steers were fed on rations containing 7·5 or 15% bagasse pellets for 91 days, or 5 or 10% pellets for 135 days, or the same percentages of cottonseed hulls. Optimum results were obtained with 7·5 or 10% roughage; the cattle receiving bagasse pellets showed weight gains, feed conversions and carcass qualities comparable with or slightly superior to those of cattle receiving cottonseed hulls.

* * *

Vegetal activated carbons obtained from cachaza. R. CETINA, O. CHAO and L. CUERVO. *Rev. Soc. Quim. Mexico*, 1973, **17**, (6), 237–240; through *S.I.A.*, 1975, **37**, Abs. 75-1230.—After drying at 110–120°C and grinding to finer than 40 mesh, clarification mud was carbonized, boiled with 10% HCl for 30 min, washed, dried and ground to finer than 200 mesh; variations in the method were (a) prior wax removal with CCl_4, (b) activation in steam, and (c) activation in CO_2. Specific surface area estimated by N_2 adsorption, and decolorizing capacity by methylene blue adsorption, are indicated for carbons prepared from muds from five factories by each method; values up to 402 $m^2.g^{-1}$ and 58·5% were obtained using the basic method.

* * *

Value, quality and feeding of dry pulp. E. THIER. *Die Zuckerrübe*, 1975, **24**, (5), 20–24.—The monetary value of beet pulp in West Germany is compared with that of other fodder products, and the nutritive value of dry pulp with standard or reduced molasses addition is examined. The feeding requirements for pigs, sheep and cattle are also discussed.

* * *

A note on the *in vivo* determination of the apparent digestibility of the matter of chopped whole sugar cane when fed to goats. D. FIELDING. *Rev. Agric. Sucr. Maurice*, 1975, **54**, 27–29.—Ten-day trials are reported in which chopped cane was fed *ad lib.* to three goats which were also given a standard mineral mix, urea and cooking oil to facilitate digestion. The goats ate little of the feed (because of their normal feeding habits) and lost weight. Average apparent digestibility was 58·5%. It is thought that the results would be better in the case of cattle and sheep.

* * *

Facial-quality tissue paper. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 25.—Mention is made of the bagasse pulp and paper plant owned by Kimberly Clarke de Mexico S.A. which is undergoing expansion to make it the largest mill in the world producing facial tissue and paper from bagasse.

Bagasse utilization for paper. Major newsprint expansion in Mexico. ANON. *Sugar y Azúcar*, 1975, **70**, (10), 24.—Information is given on the bagasse newsprint plant under construction at Tres Valle (Veracruz) and of the companies involved in the project.

* * *

Carbon and tritium radioactivity in alcohols. J. GUÉRAIN and S. TOURLIÈRE. *Ind. Alim. Agric.*, 1975, **92**, 811–822.—Details are given of a method for determining synthetic alcohol which has been added to fermentation alcohol; it is based on measurement of beta-particle emission from ^{14}C and ^{3}H and is also suitable for monitoring industrial pollution and fall-out. Differences have been found in the C radioactivity between alcohols from grain and cane molasses on the one hand and from beet molasses on the other.

* * *

Fusel oil and its problems. A. C. CHATTERJEE and B. M. DUTT. *Sugar News* (India), 1975, **7**, (3), 19–20. Manufacture of fusel oil from cane molasses is described and its composition as produced by potato fermentation is indicated (that from cane molasses being approximately the same). Applications are briefly examined.

* * *

A source of cheap fuel for the island of Negros. A. M. HAIN. *Sugarland* (Philippines), 1975, **12**, (3), 8, 20, 26.—In view of the fact that 16 of the 17 sugar factories on the island of Negros which produce 75% of the Philippines raw sugar have a surplus of bagasse at the height of the cane season, the author suggests the installation of an electric grid system across the island to be supplied with power from the factories, this power being generated by burning the excess bagasse.

* * *

Study of a ration based on corn silage and dry beet pulp for high yielding dairy cows. M. JOURNET, A. HODEN and A. MULLER. *Le Betteravier Franç.*, 1975, **45**, (282), 27.—Tests are reported in which 10 lactating Holstein cows were fed a base ration of corn silage plus beet pulp and a concentrated feed containing corn, grain and beet pulp. At an energy source ratio of 1:1:1 corn silage:pulp:cereals+cake, the feed proved highly suitable, giving high yields of milk of high fats content. It would be better to include more non-protein N, preferably in the form of urea added at the rate of 3·5% to the pulp.

* * *

Sugar cane tops for cattle feed. F. M. PATE and S. W. COLEMAN. *Proc.* 1974 *Meetings Amer. Soc. Sugar Cane Tech.*, 131–136.—Dehydrated and pelleted cane tops containing (i) 5% molasses and (ii) 5% molasses plus 3% milk by-product were fed *ad lib.* to steers in a 226-day trial. Weight gain and carcass grade when 8·5 lb per head of pellets (i) was consumed were the

same as with steers feeding on pasture only. Consumption of 9·9 lb per head of pellets (ii) resulted in a 9% more rapid weight gain and carcass grade equal to that of pasture-fed steers. On the other hand, a supplement containing snapped corn, citrus pulp, cottonseed meal, molasses, mineral mix and vitamin A fed at the same level as cane top pellet intake produced 70% more rapid weight gain and a higher carcass grade than pasture alone. The cane top pellets are considered useful in a grazing programme as an extension to pasture. In a 121-day feedlot trial, finishing rations containing 17, 34 and 51% cane top pellets with molasses were fed to heavy steers. While those on the 17% ration converted feed as efficiently as did steers feeding only on a ration of the same qualitative composition as the supplement above and gained weight more rapidly than did the controls, there was a progressive reduction in weight gain and feed efficiency with the 34 and 51% rations; the amount of snapped corn and citrus pulp was reduced with increase in the cane top level, while the other ingredients remained the same. Cane top quantity in the finishing ration had little effect on carcass grade. These results suggest that cane top pellets would be an excellent substitute for other standard roughage feedstuffs such as cottonseed hulls.

* * *

By-products research in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1974, 57–58. Tests to assess the digestibility of steamed bagasse involved four sheep, which were fed the bagasse for a week. The apparent digestibility of dry matter in the bagasse was a high as 40%. Because of its low pH, distillery waste added to irrigation water has been found to cause severe corrosion of iron irrigation equipment. In laboratory trials conducted with the aim of raising the pH of vinasse by growing *Candida utilis* on it, the pH was increased from 4 to 7 in 18 hours. However, the need to cool the vinasse prior to fermentation may be a serious obstacle to use of this technique on an industrial scale. Studies were initiated on production of fodder yeast from distillery waste liquor. With a fermenter of 100 litres effective capacity and embodying a specially-designed air-inducing agitator, a *C. utilis* yield of 6·2 kg (dried yeast) per 100 absolute alcohol was obtained and the pH was raised to neutral. (Details are not given of the nitrate dosage, temperature and fermentation time to give maximum yield.) Fermentation of cane juice to give alcohol beverages was investigated with *Saccharomyces oviformis* and *S. carlsbergensis*. The result was a cider-type drink which could, it is suggested, become popular; semi-industrial production is recommended.

* * *

What can be used as preservative for silage? ANON. *Le Betteravier*, 1975, **92**, (9), 6–7.—Of various preservatives discussed, the only two considered economically suitable are molasses and formic acid. Molasses has the advantages of its feed value, although it is not easy to handle. In order to avoid loss of molasses in liquid draining from the silage, the latter should be stored at a dry solids content not lower than 20%.

* * *

The agronomic importance of certain by-products of use in large-scale farming. J. C. REMY, L. ORSINI and A. MARIN-LAFLECHE. *Hautes Etudes Betterav. Agric.*, 1975, **7**, (31), 17–21.—The chemical composition of a number of manures and industrial waste products is discussed and their value as fertilizers indicated. Among them are vinasse (divided into the concentrated residue from molasses distillation, that from distilled molasses after the Quentin ion exchange process, and vinasse from an alcohol distillery using beet molasses) and carbonatation mud.

* * *

Study on the use of dehydrated pulp enriched with urea and mineral salts. ANON. *Le Betteravier Franç.*, 1975, **45**, (284), 22–23.—Details are given of tests in which lactating cows were fed on 5 kg of a supplementary ration containing 84·5% dry beet pulp, 7·5% molasses, 3% urea and 5% mineral salts together with 30 kg corn silage and 3·5 kg meadow hay per day. Results indicated a considerable increase in milk yields compared with the controls not receiving the enriched pulp.

* * *

Evaluation and development of an experimental reactor for determining the kinetics of bagasse hydrolysis. H. KOLLNER and R. LOPEZ P. *Tecnologia Serie* 6, *Ing. Quím.* (Univ. La Habana), 1972, (8), 24 pp; through *S.I.A.*, 1975, **37**, Abs. 75-1549.—Much theory of sequential reaction kinetics is given, an analogue computer for processing experimental results is briefly described, and experiments with a laboratory-scale glass semi-batch reactor are briefly reported. Graphs of relative monosaccharide concentration *vs.* relative residence time are presented for hydrolysis of ground-and-sieved bagasse in 2% H_2SO_4 at 100°C and 5% H_2SO_4 at 101°C, with 15 cm^3 acid per g bagasse. The respective rate constants for up to 70% degradation of pentosans were $9·3 \times 10^{-3}$ and $3·45 \times 10^{-2}$; those for degradation of monosaccharides were $1·67 \times 10^{-3}$ and approx. 7×10^{-4}.

* * *

System of digesters in paper mills and its automation. R. A. ODIOT. *Rev. Tecnol.* (Havana), 1970, **8**, (3), 3–15; through *S.I.A.*, 1975, **37**, Abs. 75-1550.—Notes are given about the three large factories in Cuba which make paper from bagasse; diagrams of their instrumentation systems are included and variables governing the effectiveness of digestion (pressure, temperature and time of digestion, doses and concentrations of chemicals) are discussed. A scheme is proposed for controlling pressure and temperature in batch digesters, and a circuit for automatic prevention of blow-back (violent expulsion of bagasse) is given. Use of a predigestion stage is suggested.

* * *

Studies on the structure of alkali lignin of cotton stalks and bagasse. O. Y. MANSOUR and M. S. EL-DIEN. *Paperi ja Puu*, 1972, **54**, (4A), 189–191, 193–200; through *S.I.A.*, 1975, **37**, Abs. 75-1551.—Bagasse and cotton stalks were cooked with 20% NaOH at liquor ratio 5:1 and 150°C for 1 hr; under these conditions the bagasse was converted to pulp, but not the cotton stalks. Lignins were precipitated and separated by centrifuging, and washed with 1% HCl and with water. The washed lignins contained <1% ash. They were analysed for elemental composition and functional groups, submitted to alkaline nitrobenzene oxidation, and their infra-red, nuclear magnetic resonance and electronic spectra were studied. Results are discussed in detail. The bagasse lignin probably consists mainly of hemilignins containing condensed and uncondensed guaiacyl units and *p*-hydroxyphenylpropane units, and differing from the cotton stalk lignin in having β-aryl ether linkages.

World sugar production estimates 1975/76[1]

BEET SUGAR	1975/76	1974/75	1973/74
EUROPE	(metric tons, raw value)		
Belgium/Luxembourg	732,000	620,000	797,000
Denmark	432,000	424,000	376,000
France	3,302,000	3,013,000	3,240,000
Germany, West	2,593,440	2,492,714	2,509,566
Holland	937,000	795,100	850,589
Ireland	206,944	148,598	196,101
Italy	1,474,000	1,034,000	1,156,000
United Kingdom	641,400	613,864	1,068,778
Total EEC	*10,315,784*	*9,141,276*	*10,194,034*
Austria	523,180	402,660	371,096
Finland	90,256	84,231	82,789
Greece	313,343	191,114	161,927
Spain	906,000	584,184	805,126
Sweden	283,333	312,000	270,000
Switzerland	66,041	73,873	79,531
Turkey	1,022,000	852,182	752,330
Yugoslavia	493,333	571,000	468,751
Total West Europe	*14,013,270*	*12,212,519*	*13,185,584*
Albania	18,000	16,000	19,000
Bulgaria	218,000	200,000	240,000
Czechoslovakia	780,000	750,000	730,000
Germany, East	700,000	670,000	560,000
Hungary	338,000	345,692	326,022
Poland	1,830,000	1,588,900	1,817,114
Rumania	600,000	620,000	580,000
USSR	7,700,000	8,000,000	9,750,000
Total East Europe	*12,184,000*	*12,190,592*	*14,022,136*
Total Europe	26,197,270	24,403,111	27,207,720
OTHER CONTINENTS			
Afghanistan	10,000	9,000	8,259
Algeria	15,000	14,100	3,400
Azores	7,000	7,000	6,500
Canada	123,309	103,500	119,300
Chile	340,000	224,897	129,432
China	980,000	950,000	900,000
Iran	590,000	585,000	570,000
Iraq	75,000	9,000	10,000
Israel	40,000	28,000	13,300
Japan	249,197	286,170	408,889
Lebanon	18,000	7,940	11,584
Morocco	262,000	272,830	226,875
Pakistan	22,000	24,717	9,800
Syria	26,000	18,000	18,432
Tunisia	9,000	6,330	5,100
United States	3,538,000	2,767,000	2,899,457
Uruguay	94,600	84,650	57,203
Total Other Continents	6,399,106	5,398,134	5,397,531
TOTAL BEET SUGAR	32,596,376	29,801,245	32,605,251
CANE SUGAR			
EUROPE			
Spain	30,000	29,800	29,377
NORTH & CENTRAL AMERICA			
Belize	61,463	83,600	91,028
Costa Rica	185,000	177,990	164,020
Cuba	5,400,000	5,500,000	6,044,000
Dominican Republic	1,160,000	1,170,000	1,194,104
Guadeloupe	92,000	87,500	97,471
Guatemala	450,000	382,370	325,358
Haiti	71,225	73,039	68,503
Honduras	90,387	77,111	80,640
Martinique	15,000	10,889	10,512
Mexico	2,800,000	2,900,000	2,837,372
Nicaragua	248,500	195,727	160,400
Panama	148,000	134,065	108,860
Puerto Rico	275,000	274,896	260,607
El Salvador	256,045	253,000	232,227
USA—Mainland	1,650,000	1,325,034	1,288,626
Hawaii	986,587	1,001,538	944,151
West Indies—Barbados	114,900	99,944	111,807
Jamaica	368,800	392,500	382,390
St. Kitts	30,400	25,100	27,897
Trinidad	237,300	167,587	192,298
Total N. & C. America	14,640,607	14,331,890	14,622,271
SOUTH AMERICA			
Argentina	1,360,957	1,532,136	1,641,837
Bolivia	210,354	166,964	188,613
Brazil	5,950,000	7,230,000	6,933,354
Colombia	1,000,000	980,200	897,300
Ecuador	300,000	283,085	283,493
Guyana	386,600	344,177	344,615
Paraguay	57,600	78,214	76,278
Peru	995,668	970,000	1,020,816
Surinam	10,406	8,000	7,910
Uruguay	30,000	22,655	23,047
Venezuela	525,000	548,000	586,777
Total South America	10,826,585	12,163,431	12,004,040
AFRICA			
Angola	40,000	80,000	85,000
Cameroun	31,000	29,000	21,400
Congo (Brazzaville)	31,550	28,866	37,492
Egypt	610,000	581,994	611,000
Ethiopia	150,000	142,933	134,072
Ghana	18,000	12,607	8,784
Kenya	177,000	186,667	176,854
Madeira	1,900	2,606	2,778
Malagasy Republic	123,000	122,984	106,700
Malawi	69,000	53,347	52,000
Mali	10,000	10,000	10,000
Mauritius	496,164	737,966	760,782
Morocco	4,070	0	0
Mozambique	255,000	300,000	265,546
Nigeria	40,000	38,660	30,277
Réunion	230,000	227,949	239,210
Rhodesia	260,000	250,000	248,000
Somalia	30,200	39,000	35,000
South Africa	1,920,000	2,005,000	1,831,575
Sudan	189,000	142,946	134,413
Swaziland	214,000	197,319	172,651
Tanzania	121,000	114,909	117,889
Uganda	22,000	48,800	60,310
Zaire	65,000	64,000	63,000
Zambia	84,000	64,550	58,000
Total Africa	5,213,884	5,482,103	5,262,733
ASIA			
Bangladesh	112,000	111,162	99,793
Burma	75,000	72,000	70,000
China	2,800,000	2,600,000	2,550,000
India, excl. khandsari	4,850,000	5,375,000	4,375,000
Indonesia	1,300,000	1,084,414	936,628
Iran	85,000	83,000	98,300
Iraq	13,000	6,250	12,000
Japan	229,000	192,450	247,000
Malaysia	70,000	50,000	16,000
Nepal	7,000	6,768	8,778
Pakistan	566,000	525,896	612,273
Philippines	2,735,000	2,471,304	2,534,584
Sri Lanka	29,000	18,257	21,650
Taiwan	801,000	751,094	892,066
Thailand	1,530,000	1,162,109	926,312
Total Asia	15,202,000	14,509,704	13,400,384
OCEANIA			
Australia	2,933,000	2,921,000	2,593,000
Fiji	285,000	281,000	319,000
Total Oceania	3,218,000	3,202,000	2,912,000
TOTAL CANE SUGAR	49,131,076	49,718,928	48,230,805
TOTAL BEET SUGAR	32,596,376	29,801,245	32,605,251
TOTAL SUGAR PRODUCTION	81,727,452	79,520,173	80,836,056

[1] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (12), 1–4.

International Society of Sugar Cane Technologists 16th Congress, 1977

Copersucar, the Central Cooperative of Sugar and Alcohol Producers of the State of São Paulo, has given great support to STAB, the Brazilian Society of Sugar Technologists, and spared no efforts to assist STAB in seeking selection of Brazil as the site for the 16th ISSCT Congress, to be held during the 8th–30th September 1977.

In order to provide facilities for the successful organization of this event, STAB have requested that Copersucar be the sponsor and co-organizer of the 16th Congress, according to the constitution and practices of the ISSCT, and full cooperation has been provided. Thus, since Copersucar will be partly responsible for the Congress, its offices and temporarily those of STAB, will be located in the same building as Copersucar's offices. Consequently all correspondence dealing with the Congress should be sent, from now on, to the following address:

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Intending authors are reminded that the final date for receipt of manuscripts is 31st December 1976 and that copies of the rules for their preparation are available from Sr. CALZA at the address above.

Screening for ratoon stunting disease[1].—A new cane screening procedure for RSD uses phase contrast microscopy to increase the contrast between the medium and the organism so that an exact count of bacteria can be obtained and clones most resistant to the disease selected. Cane grown from RSD-infected seed cane in field plots at Houma, Louisiana, was tested for infectivity and bacterial counts made using the new technique. The juice from resistant clones contained fewer diagnostic bacteria than did juice from susceptible clones. Dr. A. G. GILLASPIE, the research plant pathologist who conducted the tests at Beltsville, Maryland, said that the bacterial counts and dilution end points of infectivity were directly related and the method was rapid and yielded bacterial count results which correlated well with resistance or susceptibility to RSD.

* * *

Japanese sugar imports from Australia.—It is reported[2] that Australia has agreed to a limited re-arrangement of shipping programmes within each of the first two years of the long-term contract governing the sale of sugar to Japan. The Chairman of the Queensland Sugar Board, Mr. C. LLOYD HARRIS, said that, following discussions between the Board's marketing agents, CSR Ltd., and representatives of Japanese refiners, agreement had been reached to the satisfaction of both parties. There would be no variation in the fundamental conditions of price and quantity to be shipped from each season's production, and CSR Ltd. had rejected a request for deferment of payment for some sugar to be shipped during 1976.

* * *

Chart of world and US sugar prices.—Lamborn & Co. Inc., the well-known sugar brokers, have prepared a chart showing world and US raw sugar prices on a monthly basis from January 1950 up to and including March 1976. The graph vividly depicts the sharp rise in prices in 1974/75, and also illustrates the much smaller difference between world and US prices in the last quarter of 1975 and the first quarter of 1976 than in previous years.

Norway sugar imports[3]

	1975	1974
	—metric tons, raw value—	
Belgium/Luzembourg ..	2,206	1,655
Colombia	190	0
Czechoslovakia	6,169	8,997
Denmark	32,753	41,949
Finland	11,216	12,733
Germany, East	147	783
Germany, West	2,894	2,713
Holland	2,115	1,620
Poland	315	9,576
Sweden	148	435
UK	40,449	44,941
Other countries	327	404
	98,929	125,806

Venezuelan contract for Tate & Lyle Ltd.—Tate & Lyle Engineering Ltd. has been awarded a £22 million contract for the design, supply and erection of a turn-key sugar factory project in Venezuela. The order is the third received by Tate & Lyle from Venezuela in recent years and the proposed factory will process 7000 tons of sugar cane per day, with facility for extension to 10,000 tons of cane per day. Sugar will be produced for both home and export markets. The contract has been placed by Cenazuca, the Venezuelan Government sugar company. The factory is to be built at Las Majaguas in the State of Portuguesa and is due for completion in November 1978. Much of the sugar processing plant and machinery is being manufactured by Tate & Lyle Engineering's Glasgow subsidiary Mirrlees Watson Company Limited.

* * *

The late Professor J. Vašátko.—On 14th April the death took place in Czechoslovakia of Dr.-ing. Dr.Sc. JOSEF VAŠÁTKO, Professor at the Faculty of Chemical Technology of the Slovakian Technical University in Bratislava and former Principal of the Institute for Chemistry and Sugar Technology. Dr. VAŠÁTKO was a member of the Scientific Committee of CITS, the Czechoslovakian National Committee of ICUMSA and a number of other organizations. He was particularly well-known for his work in the field of juice purification, collaborating with J. DEDEK to develop the Dedek-Vašátko progressive preliming technique. He was author of a monograph on beet juice purification as well as a large number of articles and patents.

* * *

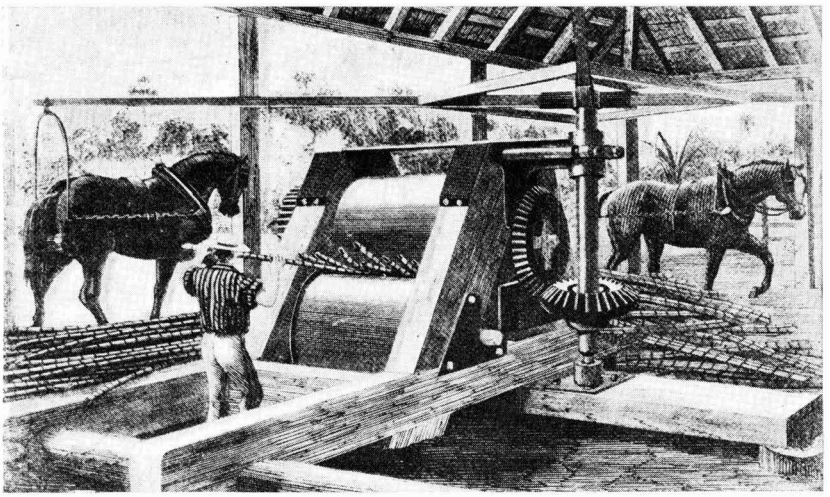
Cuban cane crop[4].—Official indications are that the bulk of the 1976 cane harvest in Cuba ended on April 30th; this is slightly earlier than normal, indicating that the quantity of cane available is reduced. Adverse climatic conditions have affected production plans, although the official Cuban daily, "Granma", has stated that improved efficiency in harvesting and processing operations will avoid "major negative consequences". A severe and general 3-year drought is still affecting some areas in the top-producing eastern provinces and has reduced the volume of cane, while areas of the high-yielding province of Orience were reported to have suffered serious damage from hurricane Eloise which swept past the eastern tip of the island last September. In the western provinces the drought ended too early. Unusual winter rains hampered operations in the provinces of Las Villas and Matanzas. It was reported by "Granma" earlier that dozens of sugar factories were standing idle for long periods. The cane quantity was below expectation, while rain slowed the ripening process and reduced the sugar content. However, foreign experts point out that a relatively cold winter probably increased the sugar content.

* * *

New Mexican sugar factory[5].—The Director of the Mexican National Sugar Commission has announced plans for the construction of a big new sugar factory in the State of Nayarit. Investment for the factory will be 180 million pesos, with funds provided by the Federal Government.

[1] *Research News* (US Dept. of Agriculture), March 1976.
[2] *Queensland Newsletter*, 7th April 1976.
[3] C. Czarnikow Ltd., *Sugar Review*, 1976, (1270), 23.
[4] *Public Ledger*, 10th April 1976.
[5] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 7.

From "Illustrated Sydney News", September 1868.



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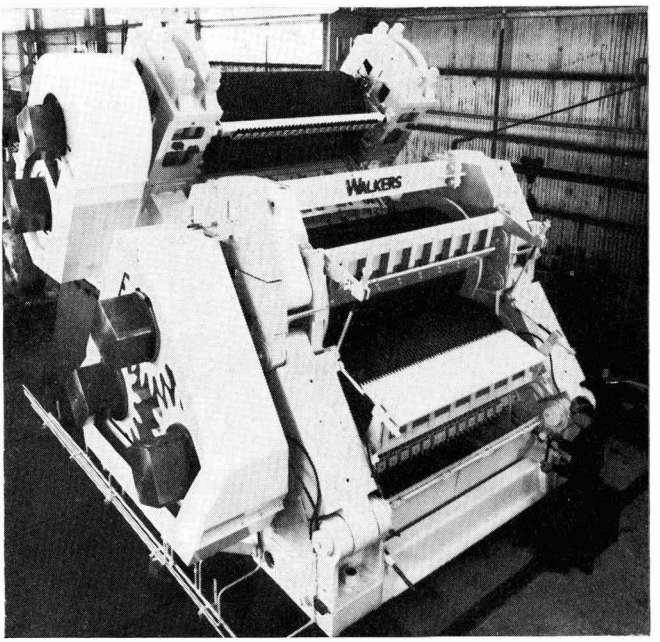

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