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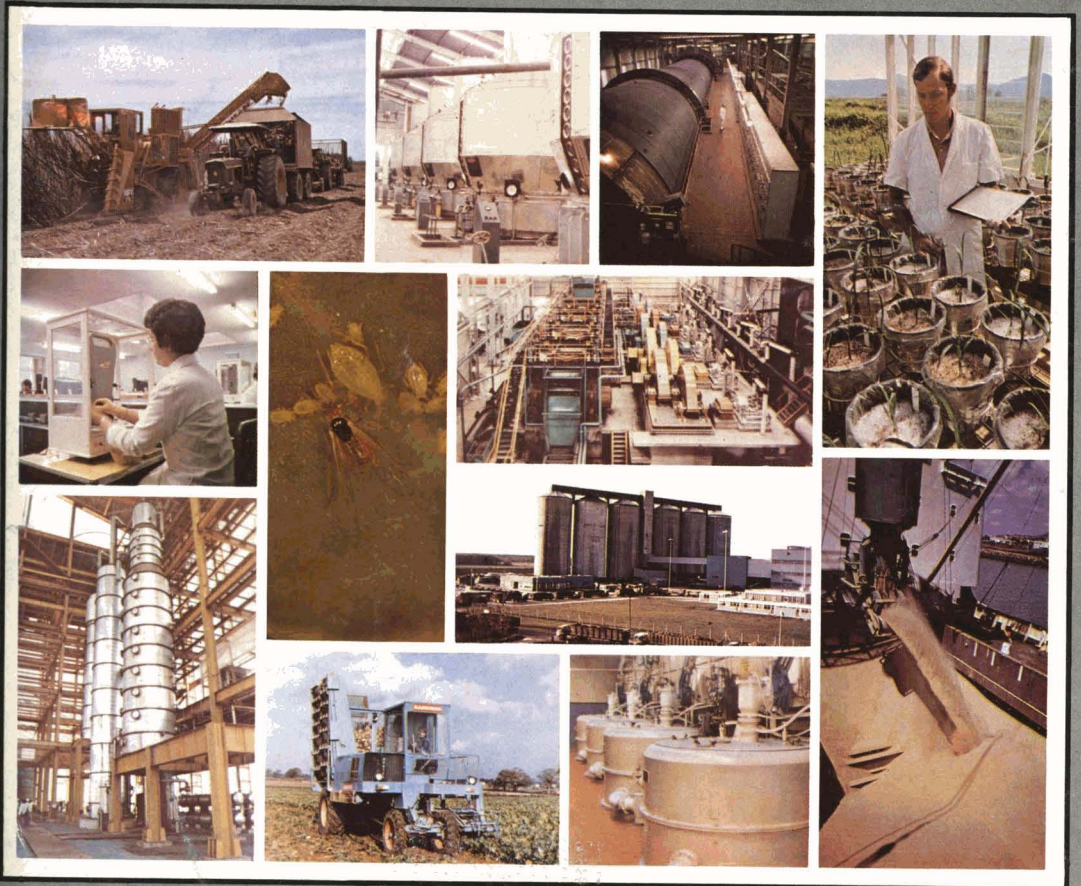

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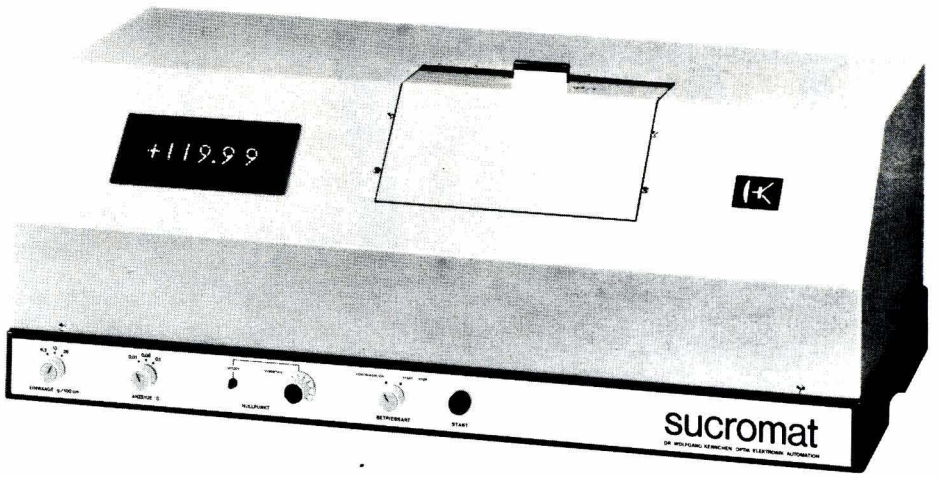

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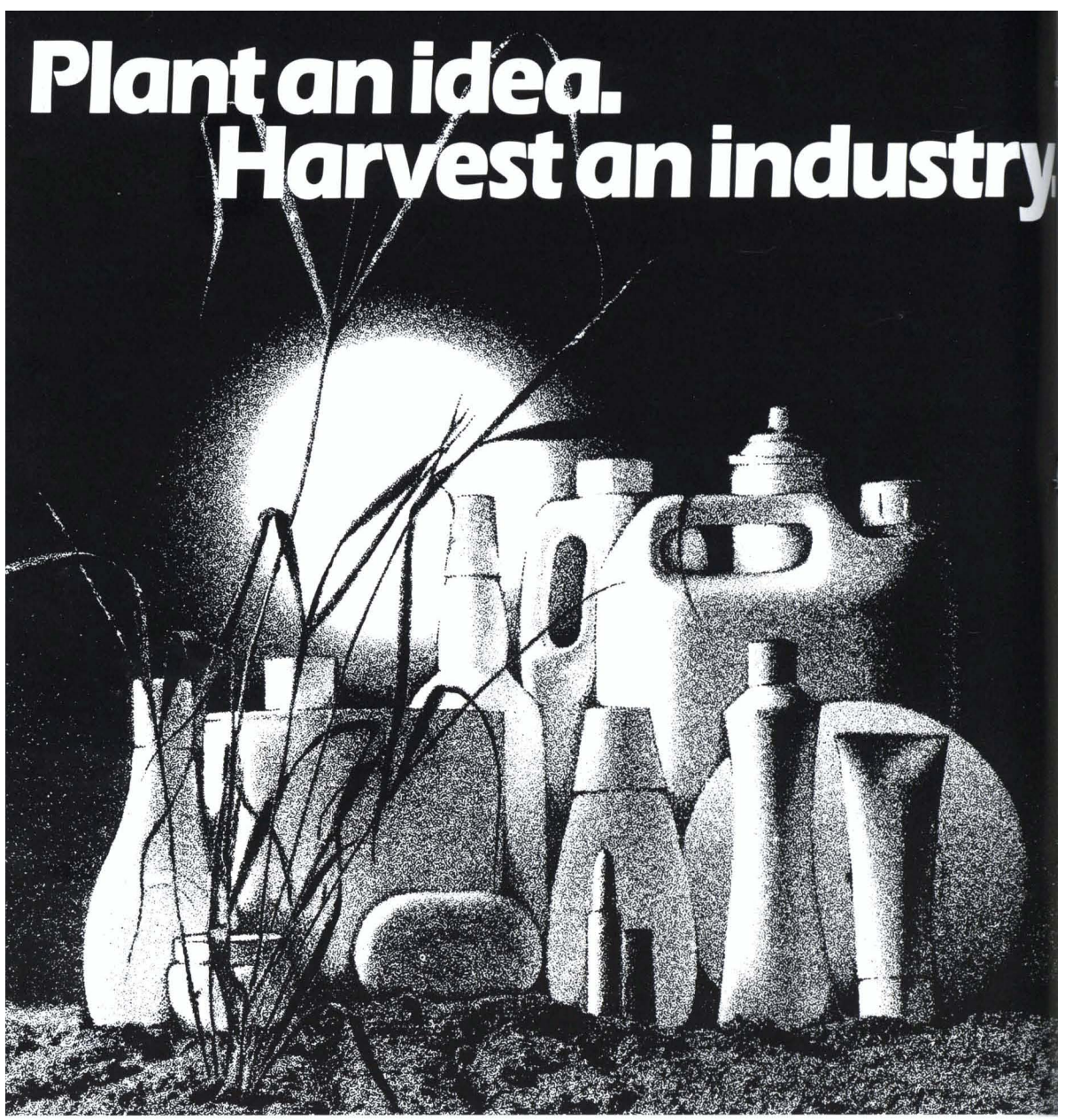

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NOTES AND COMMENTS

World sugar prices

The London Daily Price for raw sugar continued its slide throughout the month of March, falling from £166 per tonne to £149 on March 9 and thereafter making small gains and losses to remain within the range £145-£153 during the rest of the month and ending it at £149 on March 31. The low point came after it was announced that Brazil had returned to the market but the small rallies were usually due to rumours and reports of sales, although the market was very quiet, with few purchasers.

White sugar values did not fall so far and from an LDP(W) of £173 on March 1 the level dropped to £164 on March 8 and thereafter stayed between £160 and £169 during the rest of the month, ending it at £166.

Corn sweeteners barrier to ISA membership by EEC[1]

Both parties have indicated their requirements for eventual accession to the International Sugar Agreement of the European Economic Community. In recent months Brussels has appeared more amenable to the idea of regulating EEC exports in accordance with the terms of the Agreement and the Commission's decision to try to stockpile 2 million tonnes of 1981/82 sugar was seen in many quarters as evidence of this more conciliatory approach. But while the two sides may be moving closer on the question of sugar export control, one area which could well prove to be a major stumbling-block is that of corn-based sweeteners.

At the moment, such sweeteners, which are taking a growing share of the sugar markets of developed countries such as the US and Japan, are not covered by the ISA. The EEC, meanwhile, has effectively arrested the production of corn sweeteners in Europe by the imposition of high tariffs on imported maize (the feedstock for such sweeteners) under its cereals policy. The EEC fears that uncontrolled expansion of corn sweetener production capacity will seriously harm the interests of sugar producers in the years ahead and it has stated that production and exports of corn sweeteners should be incorporated into the ISA.

Sugar and sweetener taxation in Japan[2]

Heavy financial burdens are imposed on imports of raw sugar into Japan, which are not levied on the ingredients for corn-based sweeteners. At the same time domestic producers of cane and beet sugar are heavily subsidized. The beet sugar industry in particular is receiving government assistance as sugar beet is considered an attractive alternative crop to rice, which is in over-supply. Consequently the market for sugar in Japan has recently been in retreat; in 1978/79 refined sugar filled 92% of the sugar/corn sweetener market while the following year it fell to 90% and in 1980/81 was only 83%. Meanwhile, with domestic production increasing, the need for imports has been falling even more rapidly.

It now seems that the favoured position of corn sweeteners may change and the HFCS will no longer retain its advantage *vis-à-vis* sugar. It is expected that a Bill will shortly be introduced into the Japanese Diet which will aim to reduce the excise tax on sugar while imposing a duty on corn sweeteners, thereby putting the two on an equal footing. If passed, the measure will come into force from the fiscal year 1983.

The International Sugar Agreement calls for members to remove obstacles which restrict the growth of sugar consumption and mentions in particular the effect of duties and fiscal charges. The differential taxing structures applied to sugar and corn sweeteners have hitherto made it impossible for Japan to abide by this.

EEC sugar balance, 1981/82[3]

With the European beet crops over, and final figures available for most countries of the Community, apart from marginal revisions, it has been possible to examine the sugar balance of the EEC more closely and an even higher export availability is revealed. Sugar production is estimated at 15,016,000 tonnes, white value, or 22.46% (2,754,000 tonnes) higher than the figure for the EEC plus Greece for 1980/81. The breakdown appears below, together with the basic quota (A plus B quotas).

	Basic quota 1981/82	Production 1981/82	Production % basic quota
	tonnes, white value		
Belgium – Luxembourg	680,000	1,028,000	151.2
Denmark	328,000	480,000	146.3
France – Metropolitan	2,560,000	5,121,000	200.0
– D.O.M.	436,000	320,000	73.4
– (Total)	(2,996,000)	(5,441,000)	(181.6)
Germany, West	1,990,000	3,395,000	170.6
Greece	290,000	323,000	111.4
Holland	690,000	1,044,000	151.3
Ireland	182,000	167,000	91.8
Italy	1,320,000	2,048,000	155.2
UK	1,040,000	1,090,000	104.8
Total	9,516,000	15,016,000	157.8

With permitted imports (mostly from the ACP countries) of 1,565,000 tonnes, total availabilities are set at 14,173,000 tonnes, while domestic consumption of 9,522,000 tonnes plus exports, food aid and planned stocks provide outlets for 11,606,000 tonnes. This results in an availability for export of 2,567,000 tonnes, against a corresponding figure of 2,432,000 tonnes estimated as recently as January 2,1982.

ISA export quotas for 1982

The International Sugar Organization has released its calculations of basic export tonnages for 1982 and from these it has established minimum export entitlements. In general these are set at 85% of the B.E.T.'s, subject to a minimum of 70,000 tonnes, raw value. The quota in effect for India has been set at 700,000 tonnes in response to that country's request for an additional entitlement because of its remarkably higher sugar production from the 1981/82 crop.

The B.E.T.'s have been calculated on a basis which combines the initial quotas of the original agreement and also subsequent performance, including those when quotas were ineffective. As a consequence the total for 1982 is more than 19.4 million tonnes against 17.8 million tonnes for 1981. Even with the maximum possible reductions under the Agreement, the total of quotas in effect is 16,856,502 tonnes, considerably in excess of the outlets calculated by the Council in November at just under 13 million tonnes.

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[1] *Public Ledger's Commodity Week,* February 13, 1982.
[2] C. Czarnikow Ltd., *Sugar Review,* 1982, (1586), 36.
[3] F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 99-103.

Although it is likely that there will be shortfalls from some exporting members and that these will probably not be reallocated, the level of quotas in effect means almost inevitably that the Agreement will again be ineffective this year and will not be a factor in helping to raise the sugar price within the ISA range. The basic export tonnages and quotas in effect are tabulated below.

	B.E.T.	Quotas in Effect
	Tonnes, raw value	
Argentina	736,999.9528	626,450
Australia	3,329,262.5767	2,829,874
Austria	133,234.9960	113,250
Bolivia	134,670.3351	114,470
Brazil	3,291,875.6009	2,798,095
Colombia	357,688.9679	304,036
Costa Rica	101,570.2513	86,335
Cuba	2,827,168.9341	2,403,094
Dominican Republic	1,158,669.6934	984,870
Ecuador	92,686.6384	78,784
Fiji	343,793.3019	292,224
Guatemala	271,809.2797	231,038
Guyana	147,623.7738	125,480
India	457,558.3118	700,000
Jamaica	98,557.4231	83,773
Malawi	119,923.7584	101,935
Mauritius	185,773.3811	157,907
Mexico	70,000.0000	70,000
Mozambique	92,883.9607	78,951
Nicaragua	125,346.7482	106,545
Panama	192,669.7925	163,770
Peru	108,899.9900	92,565
Philippines	1,894,133.7218	1,610,014
El Salvador	140,274.1727	119,233
South Africa	1,033,034.7972	878,080
Swaziland	253,873.3328	215,792
Trinidad & Tobago	70,000.0000	70,000
Thailand	1,382,951.9444	1,175,509
Zimbabwe	287,561.9133	244,428
Totals	19,440,497.5500	16,856,502

World Sugar Journal criticises the ISO for their action in setting the B.E.T.'s so high[1]; they must have known that the increase is almost double the likely increase in free market outlets, and it is feared that adoption of the fall-back formula to calculate quotas – which ensures that the Agreement will not become effective – will cloud the prospects for the present Agreement before it expires in 1984 and also for a new Agreement after that date. *World Sugar Journal* considers that the best thing the I.S.O. could have done would have been to freeze the B.E.T.'s at their 1981 level for the duration of the Agreement; only then would there have been a remote possibility of balancing supply and demand in 1984, but this opportunity has now been lost.

US sugar import fee

The USA levies an import fee on sugar in order to prevent cheaper foreign sugar from undercutting domestic sugar prices. The fee is fixed at quarterly intervals and the level fixed for the quarter beginning April 1, 1982 was based on the average of the twenty successive No. 11 spot prices preceding March 20. With the fall in world prices from three months earlier, this resulted in a rise in the import fee which was set at 3.0703 cents/lb for raw sugar and 4.1782 cents/lb for white sugar, against the previous levels of 2.1418 and 3.0014 cents/lb, respectively.

Raw and white sugar markets in 1982

The French trade house Sucres et Denrées S.A. recently published a report[2] in which they discussed the differences between the raw and white sugar markets this year. They point out that the failure of the Soviet beet crop means that the USSR will require to import an amount they calculate as 2 million tonnes against an effective 1 million tonnes in 1981; in order to keep factories working in the absence of beets they will be used to refine raw sugar, but the demand will all be in the period February-June after which there is insufficient time to transport and refine raw sugar before white beet sugar again becomes available. The report also sees a recovery in Japanese raw sugar imports but shows that these and the Soviet increase are negated by the fall in US imports which it puts at well over a million tonnes, largely owing to a reduction in tolling operations (importing of raw sugar for refining and re-export). The report expects a surplus of 1 million tonnes of raw sugar over the 11,500,000 required by the world market and considers that the International Sugar Agreement mechanisms will not assist the situation; indeed, exporting members will have an incentive to fulfil their quotas in effect to protect high future quotas.

On the other hand, the white sugar market has been reasonably stable, largely owing to withholding by the EEC Commission of supplies which could have provided a major surplus of availabilities over demand. Reduction of refined white sugar offered by the US has also played a part, but the EEC stock has been the main instrument and this causes fears for the future since the beet area for 1982 has not been reduced to a level which will reduce 1982/83 production sufficiently to restore a balance of supply and demand. With good yields the EEC could be faced with the problem of stocking enormous quantities of sugar.

Fiji sugar expansion plans[3]

Production of sugar has expanded steadily over the past thirty years, and exports rose from 116,087 tonnes, raw value, in 1950 to 220,595 tonnes in 1960, 331,840 tonnes in 1970 and 433,784 tonnes in 1980. During the first nine months of 1981 the demand for cane contracts from persons wishing to enter the industry was so great that it became apparent that milling capacity and resources available might not be able to cope with the potential increase in cane supply. The Sugar Advisory Council decided in October that the time had come to take stock of the situation, and to consider measures needed to permit achievement of a sugar outturn of 550-600,000 tonnes by 1985.

The extra cane will require planting of an additional 4860 hectares and this will mostly be in the Labasa and Lautoka mill areas with smaller increases in the Rarawai and Penang mill areas. About 10% extra cane is expected to come from improvements in existing cane farms. Factory capacity will need to be raised from an aggregate 920 tch to 1160 tch and this is expected to be achieved in two stages, requiring $50 million in all to cover factory expansion, upgrading of ancillary services and facilities, plant replacement and loan servicing costs. The Fiji Sugar Corporation recognises that, with the current level of sugar and molasses prices, and rising costs of production, it cannot look forward to any significant contribution from its operating profits. The FSC will thus have to resort to outside agencies to finance the bulk of the program.

[1] 1982, **4**, (9), 4-5.
[2] *International Market Rpt.*, 1982, (4).
[3] *Fiji Sugar*, March 1982.

Cane yield response to ratoon stunting disease*

By H. KOIKE*, A. G. GILLASPIE, Jr.† and G. T. A. BENDA‡

Ratoon stunting disease (RSD), caused by a xylem-limited bacterium[1] is a major, worldwide disease of sugar cane (interspecific hybrids of *Saccharum).* The disease has no distinctive external symptoms, but it causes significant yield losses, especially when sugar cane is grown under moisture stress[2]. These yield losses are quantitative (lower height, less weight, and smaller diameter per stalk). All commercially-grown sugar cane cultivars are susceptible to infection by the bacterium, which is readily spread mechanically from diseased to healthy plants by cultivating and harvesting equipment. Among cultivars, the reduction in yield of cane tonnage and sugar per unit area caused by RSD may be as high as 67%[2].

Field testing has proved to be a reliable method of determining the effect of RSD on yield of sugar cane cultivars. However, the complexity and size of the field experiments limit the testing to about 20 cultivars at a time, and the environmental conditions that affect growth and yields may vary from year to year. Sugar cane breeders need a simpler, faster method of testing the RSD tolerance of a large number of sugar cane selections. One possible alternative method of testing is to correlate yield reduction and bacterial number in stalk juice. In an initial experiment with a few RSD-infected cultivars, stalk juice was examined by phase-contrast microscopy. The results indicated that cultivars differed in bacterial numbers and suggested that cultivars which over the years had been most susceptible to RSD injury also had the highest bacterial counts[3]. Thus, a 3-year experiment was conducted recently to relate yield effects with numbers of the RSD bacterium in 20 cultivars.

Materials and methods

The 20 cultivars tested (Table I) were grouped as follows: (i) tolerant = four cultivars; (ii) intolerant = four cultivars; and (iii) intermediate = 12 cultivars.

The experiment was of a split-plot design. The main plots were a comparison of RSD-infected and heat-treated plants. The subplots were planted to 20 cultivars. The treatments were replicated four times to give 160 plots. These were harvested in three successive years to give data for one plant cane crop and two ratoon crops.

Nurseries were established in 1976 with RSD-infected and hot water-treated (50°C for 2 hr) canes for each cultivar. The hot water treatment (HWT) does not always eliminate all of the RSD bacteria from the cane stalks[2].

Seed cane for the experiment was from the nursery and was hand cut to lengths of 1.2 to 1.8 m. In order to prevent mechanical spread of the disease, the cane knives were disinfected with a 15% Lysol§ solution after cutting the seed cane of each cultivar for the control test plots. Seed cane for the RSD-infected test plots was spot checked for the vascular discoloration in the nodes that indicated presence of the disease[2]. All seed cane was selected to be free of mosaic disease symptoms.

The experiment was begun on November 8, 1977. Seed cane was planted in a Commerce silt loam at the Ardoyne Farm of the U.S. Sugarcane Field Laboratory. The individual plots consisted of three adjacent rows, the distances between rows being 1.8 m and along each row, 4.6 m; the walkway between plots was 1.2 m. The planting rate for each plot row was six stalks; i.e. two stalks side by side in a furrow, with the ends of the stalks overlapping the ones ahead by approximately 0.3 m; 18 stalks per plot were planted. The experiment was bordered on all sides with healthy buffer cane to neutralize border effects. Standard plantation practices were followed for fertilization, cultivation, and weed control.

Just before each harvest in November, three mature stalks were selected at random from each plot, and their juice was extracted with a small mill. The mill was thoroughly washed between samples. Aliquots from each three-stalk sample were immediately frozen in capped tubes for counting the RSD bacteria later. Bacterial counts from aliquots of three-stalk samples had previously been found to be similar to those from 15-stalk samples extracted with a large mill for sucrose analysis. Counts from fresh and frozen juice samples were observed to be similar; clumping of bacteria was infrequent from these samples.

From each juice sample, after thawing and thorough mixing, a 10 µl drop was placed on a glass slide and

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§ Mention of a trademark, proprietary product or vendor does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products or vendors that may also be suitable.

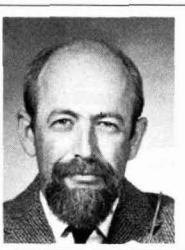
1 Davis, Gillaspie, Harris & Lawson: *Science,* 1980, **210,** 1365-1367.

2 Steindl: "Sugar Cane Diseases of the World. Vol I." Ed: Martin, Abbott & Hughes. (Elsevier, Amsterdam), 1961, pp. 433-459.

3 Gillaspie, Flax & Koike: *Plant Disease Reporter,* 1976, **60,** 573-575.

H. Koike

A. G. Gillaspie, Jr.



G. T. A. Benda

covered with a 22 x 22 mm cover slip. The bacteria were counted with phase-contrast optics[4] at ca. 1000X to 1250X magnification. The numbers of RSD bacteria in five microscopic fields, chosen at random, were determined for aliquots both at Houma and at Beltsville. Bacterial numbers were obtained for a total of 120 microscopic fields derived from 10 microscopic fields x four plots x three harvests for each treatment.

The experiment was mechanically harvested with a soldier-type harvester, and plot weights were obtained in the field after burning the dried leaves. Fifteen-stalk samples were taken from each plot for Brix and sucrose analyses. Apparent sucrose was determined by polarization, Brix by hydrometer [5], and the results were used to calculate sugar % cane by the standard method[6]. The following calculated yield values were obtained: (i) tonnes of cane per hectare, and (ii) kilograms of sugar per hectare.

Yield data for the plant cane and two stubble crops were combined and analysed statistically. Comparisons of yield parameters within cultivars utilized the Duncan Multiple Range Test. Mean % yield reductions were calculated for each treatment and cultivar for the three crops. Bacterial numbers were correlated with yields of RSD-infected cultivars as a percentage of the respective HWT cultivars (Table I).

Table I. Relationship between bacterial counts and yields of sugar cane cultivars with a history of different tolerances to injury by ratoon stunting disease.

	Bacterial counts/ 120 fields (3 crops)		Mean yields of RSD/cane for 3 crops			
			Cane tonnage		Sugar	
Cultivars:	RSD	HWT:	TC/ha	As % of HWT	kg/ha	As % of HWT
Intolerant						
CP 53-1	1031	56	37.2*[4]	72.2	3990*	82.5
L 62-96	589	154	46.6*	87.1	6053*	88.4
F 36-819	408	25	21.2*	49.6	2407*	54.4
L 65-69	329	153	32.2*	76.8	4242*	76.6
Average	589	97	–	71.4	–	75.5
Intermediate						
CP 44-101	234	9	56.2*	87.6	5947	94.0
CP 67-412	179	1	55.0	95.1	6772	101.3
CP 65-357	157	3	52.7*	88.3	6744*	88.6
CP 36-105	124	2	52.3*	89.1	5198	92.4
CP 48-103	110	5	33.0*	80.0	4105*	81.6
CB 41-76	85	5	38.2*	87.2	2417	87.2
N:Co 310	75	7	62.3	97.0	6306	101.5
Co 281	71	0	44.8*	83.5	3998	94.5
CB 36-14	56	10	42.3*	86.4	3208	94.5
CP 61-37	49	2	48.4*	75.8	5388*	79.4
CP 63-588	34	4	57.5	106.6	6444	107.5
Co 419	25	3	30.3*	77.8	2173	81.1
Average	100	4	–	87.9	–	92.0
Tolerant						
L 60-25	21	3	44.0	93.4	5830	92.0
CP 52-68	16	1	51.3	90.5	5452*	86.6
CP 29-116	14	4	39.0*	120.8	3416	121.5
H 60-6909	11	13	31.6	95.7	2743	99.5
Average	16	5	–	100.1	–	100.0

Key: RSD = progeny of cane with ratoon stunting disease; HWT = progeny of hot water treated cane; TC/ha = tons of cane per hectare.

* Data for means, when RSD is compared with HWT, are significantly different ($P < 0.05$) according to Duncan's multiple range test.

Results and discussion

The historically tolerant cultivars had the lowest numbers of RSD bacteria (Table I), while the intolerant ones had the highest numbers. The intermediate cultivars ranged in bacterial numbers from a low of 25 (Co 419) to a high of 234 (CP 44-101). The bacterial counts for each cultivar were generally uniform in the three crops.

With the exception of Co 281, the cane from all the plots planted with heat-treated progeny (HWT controls) harboured some bacteria counted as RSD bacteria. The cultivars L 62-96 and L 65-69 harboured the highest numbers of these; presumably, some infected stalks passed through the heat treatment without being cured. Other than L 62-96 and L 65-69, practically all of the cultivars from the control plots exhibited a few bacteria, even in the plant cane.

None of the four known tolerant cultivars suffered significant reductions in tons of cane per hectare (Table I); however, the cultivar CP 52-68 suffered significant reduction in kilograms sugar per hectare. Data for this cultivar indicated a significant reduction ($P<0.05$) in sugar yield in the plant and second ratoon crops. Although in previous tests CP 52-68 did not show significant yield reductions[7], the large size of the present experiment may have made this test more sensitive than the yield tests previously performed. The cultivar CP 29-116 exhibited a significant increase in cane yields when infected with RSD bacteria. Cultivars H 60-6909 and L 60-25 did not suffer significant yield reductions.

All four historically intolerant cultivars suffered significant reductions in tons of cane and sugar per hectare when infected with RSD (Table I).

Among the cultivars in the intermediate susceptibility group, eight suffered significant tonnage reduction, and three suffered significant sugar yield reduction when infected with RSD bacteria. Five cultivars suffered significant tonnage reduction only. The range of yield results (Table I) suggests that the intermediate group includes relatively tolerant cultivars (CP 63-588, CP 67-412, and N:Co 310) and intolerant ones (Co 419, CP 48-103, CP 61-37, and CP 65-357).

It is known that, when some cultivars are infected with both RSD bacteria and sugar cane mosaic virus, yields are less than when they are infected with either pathogen[7]. Data on natural spread of sugar cane mosaic disease in the experiment indicated that spread was very low in all three crops; therefore, it is unlikely that significant yield reduction in cultivars in the experiment was due to an additive or synergistic effect from the two diseases.

For each variety, the ratios for the two yield parameters of diseased over HWT-treated cane, expressed as percentages, are shown in Table I. Bacterial numbers and the percentage changes in yield, both as tons of cane per hectare ($r = -0.47$) and as sugar per hectare ($r = -0.38$), were inversely correlated, but only the former correlation was significant at the 0.05 level.

The results show that bacterial counts are useful in identifying sugar cane cultivars most tolerant and most intolerant to RSD injury. In terms of predicting yield reductions from RSD, only the highest and lowest bacterial numbers will identify cultivars intolerant and tolerant to RSD, respectively. For the cultivars with bacterial numbers in the intermediate range, yield

[4] Gillaspie, Davis & Worley: *ibid.*, 1973, **57**, 987-990.
[5] Meade & Chen: "Cane Sugar Handbook, 10th Edn" (Wiley, New York) 1977, 947 pp.
[6] Legendre & Henderson: *Proc. Amer Soc. Sugar Cane Tech.* 1973, **2** (NS), 10-18.
[7] Koike: *Proc. 15th Congr. Int. Soc. Sugar Cane Tech.*, 1974, 258-265.

reductions will have to be established by field testing. Within these limitations, this simple method will make it possible to predict yield responses of a greater number of sugar cane selections to RSD in a shorter period of time than the replicated field testing method now used.

Acknowledgment

We thank R. W. Harris and R. G. Mock of the Beltsville Agricultural Research Center, and P. Bergeron, S. Bibbins, D. Bourg, and V. Reeves of the U.S. Sugarcane Field Laboratory, Houma, Louisiana for technical assistance.

Summary

In a recent experiment with 20 sugar cane cultivars, the yield effects of ratoon stunting disease (RSD) in the field were related to the numbers of RSD bacteria in stalk juice. The four cultivars with a history of tolerance to RSD injury had fewer bacteria and less loss of cane tonnage and sugar per unit area than the four cultivars with known high susceptibility to RSD injury. Although the 12 cultivars historically intermediate in susceptibility to RSD injury varied widely, they were all intermediate in yield losses and bacterial numbers. The study indicates that bacterial counts can be useful in identifying cultivars that are most tolerant or intolerant to RSD injury.

La réponse du rendement en canne à la maladie du rabougrissement des repousses. Emploi de comptages bactériens pour identifier la réponse en rendement des sélections de canne à sucre

Au cours d'un essai récent avec 20 cultivars de canne à sucre, les effets de la maladie du rabougrissement des repousses (MRR) sur le rendement sur champ ont été ramenés au nombre de bactéries de la MRR dans le jus des tiges. Pour les quatre cultivars manifestant historiquement de la tolérance à l'égard de la MRR on a trouvé moins de bactéries et moins de pertes en tonnage de canne et sucre par unité de surface que pour les quatre cultivars dont la sensibilité élevée aux dégâts par MRR est connue. Quoique les 12 cultivars historiquement intermédiaires aux dégâts par MRR variaient en une large mesure, ils étaient tous intermédiaires en pertes en rendement et en nombres de bactéries. L'étude a révélé que les comptages bactériens peuvent être utiles pour l'identification des cultivars qui sont les plus tolérants ou intolérants aux dégâts par MRR.

Einfluss der Ratoon-Stunting-Krankheit auf den Rohrertrag. Die Verwendung von Bakterienzählungen, um den Einfluss der Zuckerrohrselektion auf den Ertrag zu bestimmen

Bei einem kürzlich durchgeführten Experiment mit 20 Zuckerrohrsorten wurde der Einfluss der Ratoon-Stunting-Krankheit (RSD) auf den Feldertrag in Beziehung zu der Anzahl der RSD-Bakterien im Stengelsaft gesetzt. Die vier Sorten mit einer bekannten hohen Toleranz gegenüber der RSD-Verletzung hatten weniger Bakterien und geringere Verluste im Rohr- und Zuckerertrag je Fläche als die vier Sorten mit einer bekannten Anfälligkeit gegenüber der RSD-Verletzung. Obwohl die 12 Sorten, die mittelmässig befallen werden, in ihrer Anfälligkeit gegenüber der RSD-Verletzung stark variierten, lagen sie alle auch in der Mitte bei Ertragsverlusten und Bakterienzahlen. Die Untersuchung weist nach, dass Bakterienzählungen nützlich sein können, um Sorten zu identifizieren, die gegenüber RSD-Verletzungen sehr tolerant oder intolerant sind.

Respuesta del rendimiento de caña al raquitismo. Uso de cuentas de bacterias para identificar la respuesta del rendimiento de selecciones de caña de azúcar

En un experimento reciente, los efectos del raquitismo sobre rendimiento de 20 cultivares de caña de azúcar se relacionan con los números de las bacterias causales en el jugo de los tallos. Los cuatro cultivares con una historia de tolerancia a daño por raquitismo contuvieron menos bacterias y presentaron menos pérdida de tonelaje de caña y de azúcar por unidad de área que los cuatro cultivares con alta susceptibilidad conocida a daño por raquitismo. Aunque los 12 cultivares de susceptibilidad historicamente intermedia a daño por raquitismo variaron ampliamente, fueron todos intermedios en perdida de rendimiento y cuentas de bacterias. El estudio indica que cuentas de bacterias pueden ser útil para identificar cultivares que manifestan la más y la menos tolerancia a daño por raquitismo.

Prospects for alcohol fuel*

By A. SPINKS

About 40 countries are seriously considering energy crops, mostly to obtain sugar or starch for fermentation to ethanol. This is undoubtedly the most attractive current alternative to fossil petrol, as well as the oldest – as old as the internal combustion engine. Hartmann in Leipzig promoted it as a motor fuel in 1894, and Henry Ford I gave much thought to it as an alternative and successor to fossil petrol in the 1930's. This resulted in the Dearborn conferences on what is now called gasohol, and to a major fuel alcohol plant in Kansas around 1936. The major prewar development, however, was in the Philippines. The huge Brazilian government programme began in 1973, and the US Government initiated a substantial programme in 1978. There has been continuous use of ethanol as a racing fuel, and as a high octane additive virtually throughout the history of petrol.

The Brazilian programme is based mainly on two energy crops, cane and cassava. They are complementary in that cane needs moisture and cassava stands drought. Other crops frequently discussed include maize, sweet sorghum, sugar beet, and potatoes. Cellulose has also had some consideration as an alcohol precursor. Hydrolysis of a rather intractable solid material whether as wood, bagasse, straw, paper, or cotton waste, is the main problem. Acid hydrolysis under pressure seems to be generally favoured, but much work has been done on cellulases, and it seems probable that enzyme hydrolysis will eventually replace acid hydrolysis, which has many disadvantages (e.g. product degradation, acid recovery, etc). The potential for use of cellulose, particularly waste cellulose, as an alcohol precursor, could be considerable.

* Abridged from a lecture to the Annual Congress of the Royal Society of Chemistry, 1981; *Chemistry in Britain*, 1982, **18**, 99-105.

Sugar cane programme

A typical programme involves growing sugar cane, harvesting it, transporting it to the factory, crushing, fermenting the expelled juice, distilling, using the waste bagasse as fuel, and disposing of residues. Most technology seems to be relatively conventional, employing the usual batch fermenters of moderate size, brewer's yeast *(Saccharomyces cerevisiae)* and conventional stills. There are many discussions of cost. Table I seems reasonably representative, although now three years out of date. It shows that ethanol was then two to four times as expensive as petroleum derived gasoline, and that sugar cane was probably the cheapest of the four precursors surveyed.

Table I. Cost of fermentation ethanol as fuel, US cents/US gallon. (Early 1979)

	Corn	Wood waste	Sugar cane	Cassava
Raw material	44	68	56	68
Processing cost	30	40	20	33
Capital charge	40	82	30	36
Distribution	13	13	13	13
Pump price	127	203 (gasoline 60)	119	150

Since 1979 the gap between sugar cane, ethanol and gasoline has probably narrowed still further, but not as much as the oil price alone would suggest. The cost of oil feeds back into the cost of all material competitive with oil, as one can readily see for coal as well as ethanol. In the end there will be an increasing dissociation, but, in my opinion, not before the end of the century. However, a doubling of overall ethanol efficiency might close the gap between ethanol price and gasoline price. This is highly desirable for countries which have the climate, excess land, and balance of payments problems that lead them to government gasohol initiatives. For the rest of us, halving the ethanol price would be a valuable retardant to oil price increases.

A 50% reduction in the cost of ethanol is unlikely to be achieved without thorough attacks at every point from crop to product yield. Recent remarkable achievements in plant breeding, particularly of cereals, encourages the hope that yields of sugar crops such as cane, beet or sorghum, or of starch crops like cassava or potatoes might be at least be doubled.

However, sugar cane is already much hybridized; it rarely sets seed, and has a high and variable chromosome number. Also it has C4 photosynthesis, using phosphoenolpyruvate rather than the phosphoglycerate of C3 photosynthesis. This reduces depression of CO_2 assimilation by high temperature or by photorespiration. Certainly, sugar cane is among the most efficient converters of solar energy so far known. Nevertheless, new techniques of genetic manipulation, and the increasing availability of so-called genebanks, ought to give more chance of controlled advance in crop performance than empirical hydridization has done. Recombinant DNA techniques can be reinforced by other advances such as cell fusion and plant cell cloning. Soon, it ought to be possible to aim at numerous specific targets, such as increased chloroplast density, reduced photorespiration, a more favourable sugar-cellulose balance, enhanced root growth, increased temperature tolerance, nitrogen fixation, and so on.

It should be possible to increase production further, by heavy applications of synthetic fertilizer, the manufacture of which is now carried out at a very high thermodynamic efficiency. It is sometimes objected that the high energy input involved in heavy fertilization is a waste of valuable energy, but it can readily be shown for many crops that there is an amplification, perhaps as much as three or four-fold, of energy input in the enhanced calorific value of the crop.

A similar energy amplification can normally be demonstrated for other modern farming aids such as herbicides, insecticides and fungicides, and their judicious use is a major factor in the steady growth in yields of most crops. But there are further possibilities. A grass like cane or sorghum might be expected to benefit from the hormones that cause internodal elongation, the gibberellins. ICI tests in Queensland some years ago did enhance cane sugar yield, but its effect was uneconomical. Cheapening of these fermentation products by modern biotechnology could reduce cost to a point where use on cane or other grass crops could be economical. There is also much current interest in promotion of specific plant organs such as leaf, or stem or root, by chemicals.

Taking all these possibilities together with other modern advances such as programmed irrigation, there ought surely to be a chance of increasing sugar cane yield by at least 50%. This would still be no more than 40% of the maximal efficiency to be expected of an eight quantum process. Obviously, there will be increased agricultural energy input to achieve this, and also to harvest and transport the larger crop. This needs careful study because, as many authors have pointed out, the energy in the ethanol is often less than the total agricultural and industrial input. Representative figures are shown in Table II. There is a substantial gain for cane and cassava only if full use is made of all residues. However, the major energy input is in the factory, not on the farm.

Table II. Energy balance of Brazilian alcohol crops, $GJHa^{-1}y^{-1}$

	Cane	Cassava
Input		
Agriculture	−17	−17
Industrial	−45	−35
Output		
Alcohol	+78	+55
Residues	+73	+38
Balance	+89	+41

Fermentation

Given improved cultivars, intensive, chemically aided agriculture, and economically mechanized harvesting and transport, the next important stage is fermentation. It is essential that fermentation for alcohol be improved since it suffers like all fermentations from inadequate process intensity as well as substrate cost. These are the main reasons why the cost of petrochemical alcohol has been one third that of fermentation alcohol.

One obvious improvement is a large increase in single stream fermenter capacity: what cane be done is illustrated by the ICI protein fermenter of 1500 m^3 capacity. As with all bulk reactors, fermenter capital costs tend to fall with the capacity to the power of two-thirds. A second major cost reduction could be achieved by

increasing substrate and product concentration. This might be attempted by using new organisms instead of convential yeast, and by genetic manipulation to reduce product inhibition. Genetic manipulation to concentate the organism's effects on making alcohol rather than protoplasm would also be helpful: this should be enhanced in a computer controlled steady state maintained by advanced sensors. The temperature of fermentation could usefully be increased to increase metabolic rate and reduce heat loss. Yet another possibility is to carry out the fermentation in a column using immobilized cells. A 30-50% cost reduction could be achieved by these means.

The next major cost is alcohol isolation. Conventional distillation is expensive, but the cost would be significantly reduced by higher ethanol concentration, by vacuum stripping, and by extraction with some such solvent as dodecanol. Solvent extraction might also avoid azeotroping to get rid of the 4% water content of distilled spirit.

Finally, nothing must be wasted. Dried residues such as bagasse must either be burned to raise steam, or hydrolysed to provide more sugar, or digested to yield methane. The stillage residue forms a most undesirable effluent, but the yeasts may be used as animal feed and the aqueous residue or, indeed, all the stillage, digested to yield methane. Any ultimate waste might be used as fertilizer to recover part of the nitrogen.

Adding all this up, perhaps rather optimistically, there is a fair chance of halving the cost of ethanol towards that of the current cost of gasoline. There is still the difficulty of finding adequate land, and in a competition for land between food and fuel no one could vote for fuel. There is a strong chance that this confrontation may arise quite soon in the US between corn for food and corn for alcohol.

There is no difficulty in modifying existing engines to cope with ethanol. Volkswagen have done much work on this for the Brazilian market. All in all the Brazilian programme seems admirable to me given the Brazilian situation, particularly lack of oil, adverse balance of payments, plentiful land, rural employment problems, and climate. Ethanol is not the only possible fermentation option. Isopropanol, butanol etc, could be considered instead, but insufficient work has been done on these to allow judgement of their promise.

Some characteristics of refining beet raw sugar*

By HELMUT EICHHORN
(Pfeifer und Langen, Elsdorf, Germany)

Introduction

In this report some different working methods for refining beet raw sugar will be explained and illustrated. In principle, the operations of Elsdorf refinery will be described.

Figure 1 shows a simplified diagram of the process flow of Elsdorf refinery. We work a three-boiling system for white sugar and a three-boiling recovery system. The daily refinery capacity amounts to 1000 tonnes of beet raw sugar (98° pol) and about 200 tonnes of second-crop syrup (75 purity) coming from outside. The white sugar output amounts to 1000 tonnes per day.

Liquor treatment

We work with two different liquor streams, the first originating from raw sugar, the second from recovery sugars.

First liquor

Because of the absence of starch, dextran, wax and gums in beet raw sugar, it is not necessary to carry out a liquor purification such as carbonatation, phosphatation or the use of Talofloc. Furthermore, the colour in the beet raw sugar is much lower than in cane raw sugar. For this reason no decolorization is necessary for affined beet raw sugar of normal quality.

The following values show the differences in colour:

	Colour, ICU at 420 nm	
	Cane	Beet
Raw sugar	3500 – 6500	700 – 2700
Affined raw sugar	900 – 1400	100 – 350

Figure 2 shows the process flow for liquor preparation. The affined raw sugar is melted to 70°Bx; powdered activated carbon (0.04%) and kieselguhr (0.06% on raw sugar) are added.

Precoat filters, of the Schenk type with horizontal discs, are used for filtration.

The colours of the raw sugar and 1st liquor are as following:

beet raw sugar	1100 ICU at 420 nm
1st raw liquor	190 „ „ „ „
1st fine liquor	160 „ „ „ „

Second liquor

The recovery sugars are melted to 60°Bx, and the carbon sludge, residual from the first filtration, is added. Filtration is carried out in the same manner as the 1st filtration. The filtered liquor is then passed to a resin decolorizing station. The density should not exceed 60°Bx for proper running of the ion exchange plant. Both fine liquors can be mixed and thickened up to about 74°Bx in an evaporator station[1] in order to reduce steam consumption.

The colour of the 2nd raw liquor resulting from recovery sugars is much darker than the 1st raw liquor. The colour value 650 – 900 ICU is similar to that of the raw liquor from affined cane raw sugar. Decolorization of the 2nd liquor is therefore necessary.

Since 1968 an ion exchange decolorizing plant has been in operation at Elsdorf refinery. A simplified flow diagram of this plant is shown in Figure 3. The plant

* *Paper presented to the 40th Ann. Meeting, Sugar Industry Technologists*, 1981.

[1] Braeckmann: *Paper presented to 39th Ann. Meeting, Sugar Ind. Tech.*, 1980.

Fig. 1. Process flow diagram

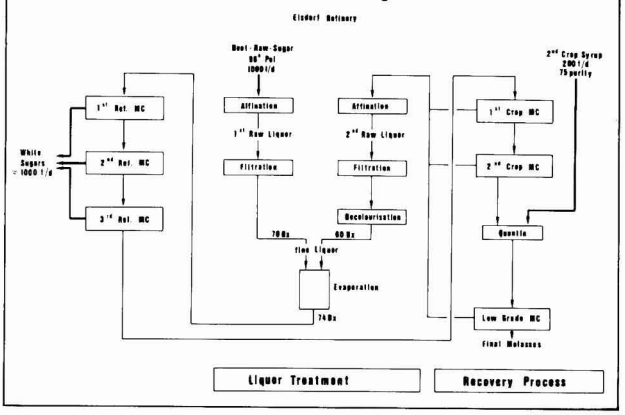


Fig. 2. Liquor treatment

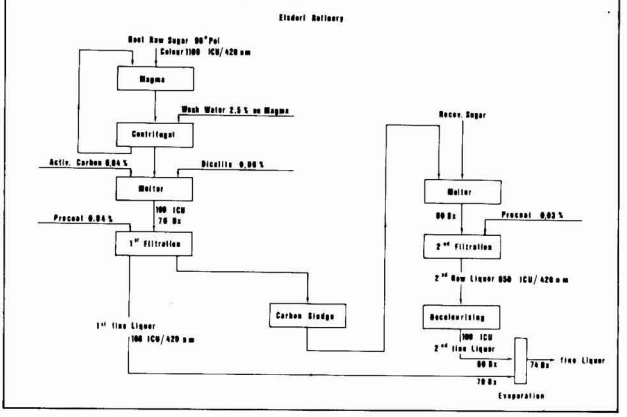
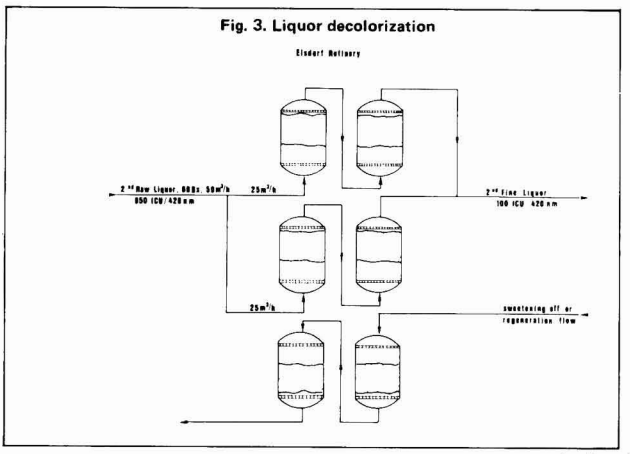


Fig. 3. Liquor decolorization



comprises 6 columns, in three batteries of 2 columns in series. Two batteries are in operation, while the third undergoes regeneration. Each column contains 5 m^3 of Lewatit MP 500 A anion-exchange resin. The capacity of each battery is 25 $m^3 hr^{-1}$ of raw liquor at 60°Bx, over a running time of about 60 hours.

A 10% solution of $MgCl_2$ is used for regeneration.

The efficency of decolorization is about 85%, which means that the 2nd raw liquor colour is reduced from about 650 ICU at 420 nm to 100 ICU in the 2nd fine liquor.

The double column battery is important for economical running of the plant. The first column of each battery works as predecolorizer and the second as a polish-decolorizer. When changing the resin, the new resin is filled into the polish column, the used resin from this second column being filled into the first column and the used resin from this discarded.

A colour reduction of 80% must be attained in order to reach the required sugar quality. Working with two single columns, without polish decolorizers, the decolorization effiency is reduced to 75% after 150 cycles, and the fine liquor colour increases to 165 ICU. When this happens the resin must be discarded, but it can continue to be of service for approximately an additional 250 cycles, when used in a predecolorizer column.

The tandem-column plant can operate for about 400 cycles, processing about 280,000 m^3 of liquor, before the resin must be changed. 150 cycles corresponds to 250 refinery working days, or about one working year; 400 cycles corresponds to 2.7 working years. Using a tandem plant, the resin costs are reduced substantially, and variability of the colour in the fine liquor is eliminated.

Recovery process

Figure 4 shows the flow diagram of the recovery process which is operated with a three-boiling system. The input syrup to recovery, affination syrup, jet 3 and 2nd affination syrup from recovery sugar, are used as feed for 1st crop boiling, the 1st crop syrup as feed for 2nd crop boilings. The 2nd crop syrup, together with 200 tonnes per day of 2nd crop syrup coming from outside, is used as feed for 3rd crop boilings.

Only continuous centrifugals are installed in the recovery house. Since continuous centrifugals have a lower purging efficiency than batch machines, we work a double purging system. The prespinning of all three crops is done practically without any wash water application. Wash water is applied for the second spinning, and an additional spinning is necessary for low-grade sugar. The melted recovery sugar is decolorized in an ion-exchange plant, as

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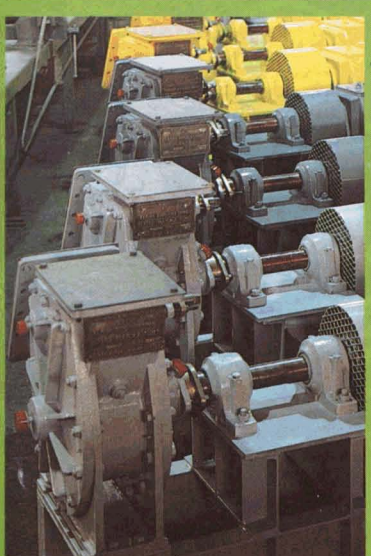

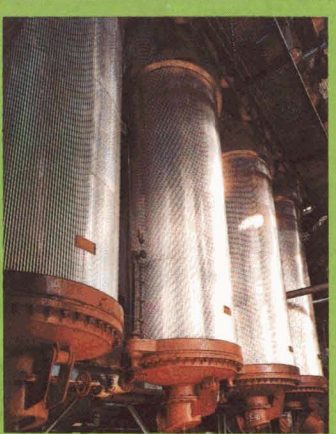

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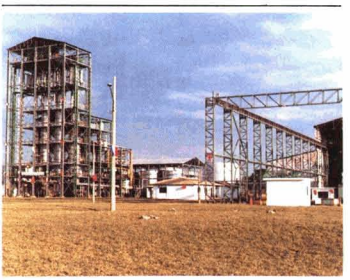

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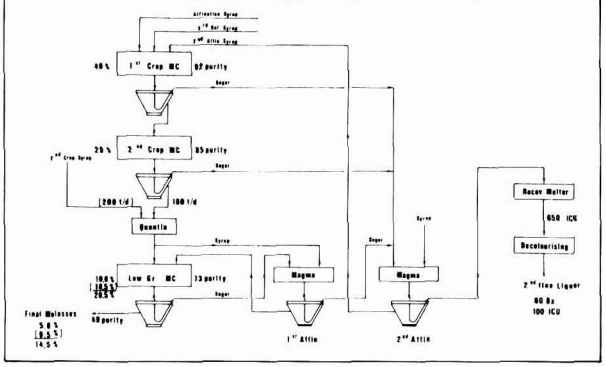
described above. A Quentin plant and a modern vertical crystallizer station have been installed to enhance molasses exhaustion.

Fig. 4. Recovery process, Elsdorf refinery

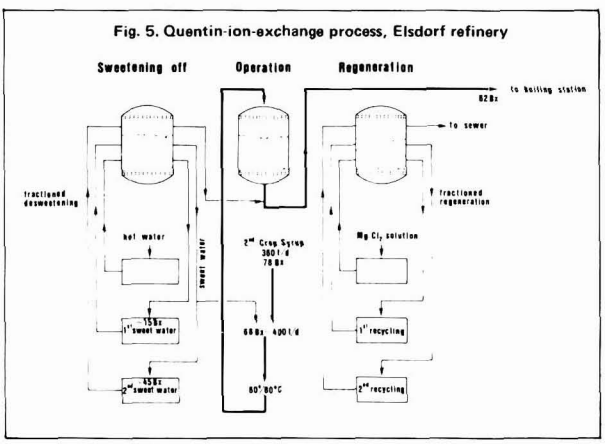


Quentin process

The presence of salts of sodium and potassium in syrup prevents the maximum exhaustion of molasses. In the Quentin process[2] most of the sodium and potassium ions are replaced by magnesium, using a cation-exchange resin. The result is significant reduction of sucrose solubility in the mother liquor and thus increased sugar recovery; it is possible to reduce the purity of molasses from 58 to about 49.

Figure 5 shows the principal flows in the Quentin process. The plant at Elsdorf contains three columns, each filled with 14 m^3 of strongly acidic IMACTI C16P cation exchange resin. One column is in operation, the 2nd is undergoing sweetening-off and the last one is in regeneration. The plant runs completely automatically.

Fig. 5. Quentin-ion-exchange process, Elsdorf refinery



It is necessary to dilute the syrup, normally from 75°Bx to 68°Bx, since otherwise the flow rate is reduced drastically and sweetening-off economics also become unfavourable. Fractional sweetening-off is usually employed; in this, second sweet water of about 45°Bx displaces the retained syrup at the end of the operation cycle. This dilutes the syrup from 68° and gives at a fraction of 62°Bx. The 1st sweet water of about 15°Bx is then used to displace the more concentrated sweet water and flows to the 2nd sweet water tank whence it is taken for diluting the 2nd crop syrup from 75° to 68°Bx. Hot water is used for the last stage of sweetening-off, this water flowing back to the 1st sweetwater tank.

The regeneration is also fractionated in order to reduce the quantity of regenerant.

The dilution of the syrup from 75° to about 62°Bx increases the steam consumption by up to 8% on input. By evaporating this syrup, the above increase can be reduced significantly.

The advantages of the Quentin process are indicated in Table II showing the extra sugar recovery which it affords.

The disadvantages of the Quentin process include: increased steam consumption by up to 8% on raw sugar, reduced molasses quantity by about 1.2% on raw sugar, lower value for the molasses, higher maintenance costs, and additional waste water. However, during the past 20 years at Elsdorf there has only been one period of 6 months when the Quentin plant was not operated on account of economics.

Table II

	Increase of sugar yield: Raw sugar	2nd crop syrup
	tonnes/day	
	1000	200
Molasses purity 49 (Quentin)	37	73
,, ,, 58	29	58
Increase in sugar recovery	8	15
Additional sugar for 250 working days/year	2000 tonnes	3750 tonnes
Total	5750 tonnes	

Low-grade massecuite handling

The success of the Quentin process can only be realized with optimal low-grade massecuite handling. We believe that optimal molasses exhaustion can be achieved with vertical crystallizers. Figure 6 shows the station installed at Elsdorf. The plant consists of: three "Toury" type crystallizers[3] of 150 m^3 volume each, having cooling/ heating elements of about 150 m^2 in each; two diluters and magma pumps, and two counter-current water circuits.

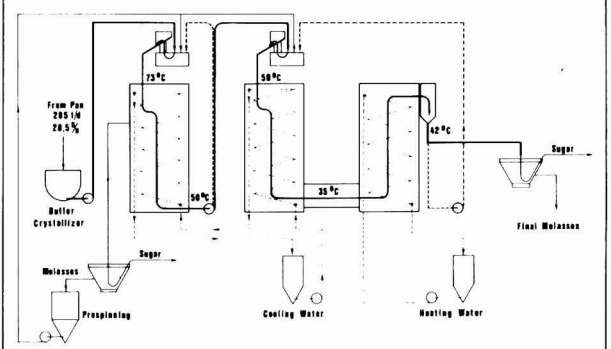
Two crystallizers operate as coolers, the third for re-heating. The massecuite is pumped from the buffer crystallizer by magma pump to the first diluter and cooler. Another magma pump sends the massecuite to the second diluter and cooler. In the third, re-heating crystallizer, the massecuite enters at the bottom and leaves at the top for delivery to the continuous centrifugals.

After the second crystallizer, the massecuite temperature is down to 35°C, at which its viscosity is too

[2] Schoenrock: "Beet Sugar Technology", 12th Edn., Ed. McGinnis (Beet Sugar Development Foundation, Fort Collins) 1971, p. 330.

[3] Genotelle: *Paper presented to the 23rd Tech. Conf. British Sugar Corp.*, 1976; *I.S.J.*, 1977, **79**, 64-67, 96-100.

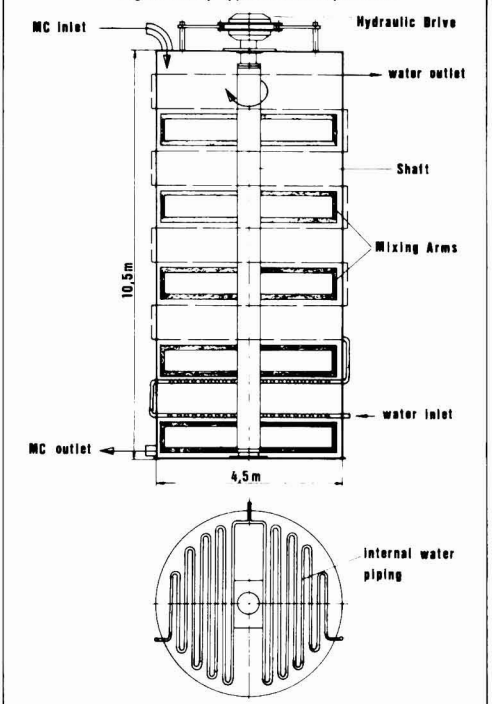
Fig. 6. Low-grade massecuite handling, Elsdorf refinery



high for good spinning. It is therefore passed to the third crystallizer when its temperature is raised to 42°C, no water being added for dilution.

However the process of cooling down to 35°C is normally not possible without dilution. In order to reduce the viscosity, we remove a quantity of crystals, by what we call "prespinning". Just at the start of cooling, part of the massecuite – sometimes about 50-60% – is spun in continuous centrifugals without any wash water application. The molasses mostly goes back to the diluter No. 2 for dilution of massecuite. This prespinning is especially interesting with the Quentin process which yields very high crystal contents.

Fig. 7. Toury-type vertical crystallizer

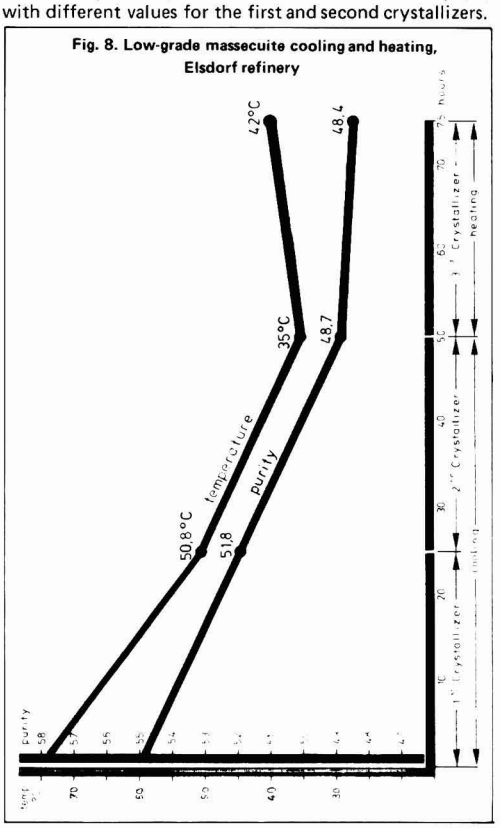


Vertical crystallizers are especially useful for accommodating refinery stops, at weekends for example. The broken line in Figure 6 shows this operation. The magma pump of the first crystallizer pumps back to its own diluter. The temperature is raised to 50°C by slight heating. The magma pump behind the 3rd crystallizer returns the massecuite to the 2nd crystallizer, and a selected temperature of about 42°C (or any other temperature) can be held for a long time. On restarting the refinery, the temperature and other conditions will be optimal.

Figure 7 shows a vertical crystallizer. The principle characteristics are: diameter 4.5 m, height 10.5 m and volume 150 m^3. The heat exchanger system consists of ten different banks of pipes for cooling or heating. The shaft is provided with mixing arms and is turned intermittently by a ratchet-type hydraulic drive.

Figure 8 shows the trend of temperature and purity during the retention time. The cooling curve, according to our experience, is a linear function of time, but with different values for the first and second crystallizers.

Fig. 8. Low-grade massecuite cooling and heating, Elsdorf refinery



In the first crystallizer we prefer a cooling rate of 1°C per hour, requiring a retention time of 25 hours.

For the second crystallizer, a cooling rate of 0.6-0.8°C/hr should not be exceeded. The reduction of purity shows a linear slope up to the point of minimum temperature.

The last crystallizer (or 2/3 of it) is needed for heating

the massecuite up to the spinning temperature of about 42°C. Optimal heating, without any local overheating, gives a gain of about 0.5 in molasses purity.

Summary

A description is given of the plant and process employed at Elsdorf refinery in Germany for the refining of raw beet sugar, attention being drawn to the differences arising by comparison with the processing of raw cane sugar.

Certaines caractéristiques du raffinage du sucre brut de betterave

L'équipement et le procédé utilisés à la raffinerie d'Elsdorf en Allemagne, pour le raffinage du sucre brut de betterave, sont décrits en attirant l'attention sur les différences qui se révèlent par comparaison avec le travail du sucre brut de canne.

Einige Charakteristika der Raffination von Rübenrohzucker

Beschrieben wird die Zuckerfabrik Elsdorf, eine Raffinerie in Deutschland für die Raffination von Rübenrohzucker, und das dort angewendete Verfahren. Besonders werden die Unterschiede gegenüber der Verarbeitung von Rohrrohzucker aufgezeigt.

Algunas características de la refinación de azúcar crudo de remolacha

Se presenta una descripción de la planta y el proceso empleado en la refinería de Elsdorf en Alemania para la refinación de azúcar crudo de remolacha, con atención a las diferencias que ocurren por comparación con el tratamiento de azúcar crudo de caña.

Mini sugar complexes for developing countries

By JEAN FORGERON
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Because the processing capcity of a sugar factory is not directly related to its capital cost, the "economies of scale" ensure that the unit cost of sugar manufacture falls as throughput rises. It is generally accepted that, at the present time, the optimum plant size corresponds to about 5000 tonnes of cane per day, after which the cost of bringing a cane supply from further away raises raw material cost so that unit cost of sugar begins to rise.

Such a factory will produce perhaps 50,000 tonnes of sugar a season and this will justify considerable capital expenditure on roads and a transport system as well as other aspects of infrastructure. But in many developing countries such an infrastructure does not exist, nor is the population large enough to justify such a volume of sugar production, and there is a lack of technical expertise and support. Furthermore, the enormous cost of such a project is well beyond the financial resources of many countries and it may not have the priority required for allocation of such funds as are available.

In the tropical countries of Africa, Asia and Latin America, people have often grown sugar cane for chewing and in some cases have developed small-scale cottage industries producing open-pan sugar of varying quality, usually with very low efficiencies. The cane, grown in small plots, is often subject to disease and pest damage but the scale of farming is too small to justify the development of specially suitable varieties. Nevertheless, the people are well aware of the importance of sugar in their diet and provide a ready, if limited, market for crystal sugar.

Without a commercial distribution system and sufficient qualified technical personnel, there is no way in which a large-scale sugar industry can be established; however, in recent years it has become possible to introduce efficient technology, combined with limited production of sugar to match the needs and capabilities of the developing country. This system, known as the "Mini Sugar Complex" is offered by Agrotechnip of France, specialists in agro-industrial complexes, especially sugar.

Like all cane sugar projects, the Mini Sugar Complex is in two parts – cane growing and cane processing. The land area to be planted is a function of local conditions and of the capacity of the mini-factory with, for instance, about 650 hectares needed to produce 6000 tonnes of sugar per year if irrigation is available or 900 hectares for rain-fed cane. Such a small area permits selection of land most suitable for cane growing, with consequent maximizing of yields. Generally, the heavier initial work of land clearing, levelling and ploughing is mechanized, but other operations in cultivation, stone-picking, spraying, harvesting, etc., provide work of the local labour force.

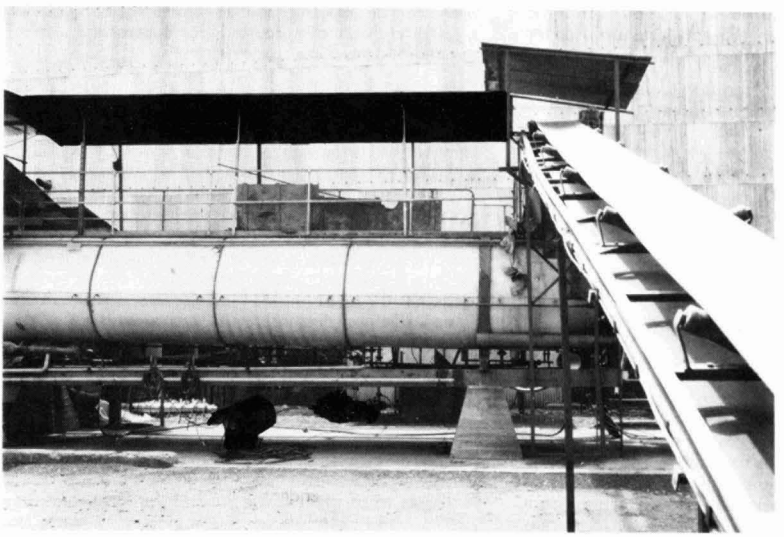
Initial preliminary trials need to be carried out to identify suitable cane varieties to be introduced and seed cane should be obtained from disease-free stocks by way of a quarantine station or experiment station. It is advisable to provide a heat treatment unit to ensure freedom from ratoon stunting and other diseases.

Assistance is readily available to identify the most suitable cultivation methods, precautions against pests and diseases, and to provide irrigation for the cane where rainfall is inadequate. Various irrigation systems can be considered, depending on the local conditions, but for a mini sugar complex the one found to be most suitable is usually sprinkler irrigation.

The cane may be grown by individual farmers or by the complex itself and will usually be cut green, using manual cutters. The trash is separated and the clean stalks loaded manually into special containers; these are hauled onto self-loading trailers when full and are towed to the mini-factory by tractors.

The cane processing part of the complex is especially adapted to the circumstances in which it will function. It

embodies specific processes suited to modular design and to unit processing capacities of 300, 450 and 600 tonnes of cane per day. The equipment is assembled in standard container modules which may be transported by regular haulage units to site. Préliminary work at the site consists only of pouring concrete for the foundations; the modules are unloaded and connected to one another, the container frames forming the steel structure of the factory. In other containers are shipped auxiliary buildings such as the office, workshop, laboratory and even housing. Under normal conditions, erection requires less than three months, the modular construction eliminating most erection problems and reducing construction time considerably.



The cane diffuser

The standard processing plant provides everything necessary to obtain raw crystal sugar from the cane supply, while a further option is the manufacture and packaging of white sugar direct from the cane, and even the production of lump sugar. The cane is weighed and sent to a storage area in its container; it is reclaimed, on a first-in first-out basis to avoid deterioration through excessively long storage, and the container carried to a feeder table by means of a tractor-drawn self-loading trailer. Here the cane is discharged onto a conveyor which carries it to a rotary drum-type cutter which chops the cane transversely into slices, preserving their cellular structure.

The slices pass through a diffuser against a countercurrent of water at 70°C which provides a reduced extraction of about 95% and a juice of purity higher than that achieved in a mill tandem under the same conditions. The wet bagasse, containing about 80% water, is dewatered in a twin-screw press and is then sufficiently dry to use as boiler fuel. The press water is returned unfiltered to the diffuser.

The raw juice is heated, limed to neutral pH and passed to a decanter-clarifier. The settled muds are returned to the diffuser where their sugar content is removed and they are discharged with the bagasse. This eliminates the filtration stage conventionally employed in the large-scale factory. The juice is concentrated to 65°Bx in a triple-effect evaporator.

Should the white sugar option be incorporated, the evaporator syrup is then subjected to a further purification by the Talodura method of Tate & Lyle Process Technology Ltd. of England. In this, the syrup is treated by phosphatation, combined with aeration in the presence of a special flocculant; the scum is separated in a clarifier of short retention time while the clear liquor is further decolorized by sulphitation.

From either the standard or Talodura process, the syrup goes to the vacuum pan section where a three-boiling system is employed, the details of which depend on the quality of the cane and so of the syrup and on the desired sugar quality. The massecuites are discharged into crystallizers which serve as buffer storage before the centrifugals as well as to enhance molasses exhaustion. Continous centrifugals are employed since they offer simplicity of construction, low energy consumption and economical price. The sugar is dried in a dryer especially designed for small throughputs, cooled in a screw conveyor and stored in a silo. Sugar may be packaged in 1-kg polyethylene bags, or filled into 50-kg jute/polyethylene sacks.

Bagasse from the press is used as fuel for a boiler which generates superheated steam at 20 bars pressure (about 300 psi) and this is used to drive a high-efficiency steam engine coupled to a generator providing power for the whole of the complex. A stand-by diesel generator is used in the off-season. Exhaust steam is used for the heaters, evaporator and vacuum pans. Surplus bagasse is stored for use in case factory operation is interruped. The complex is thus self-sufficient in energy.

It is advisable to provide a water treatment unit to ensure suitable boiler feed quality and also if a potable water supply has to be provided for employees housing.

Creation of a mini sugar complex promotes local employment without disturbing the existing social balance. For instance, for the production of 6000 tonnes of sugar a year, some 350 permanent employees and 450 seasonal workers are required, with a further 150 workers if the cane area is irrigated. Other advantages for the mini sugar complex in a developing country include easier financing, short construction period (less than two years for the whole complex), high technical performance and competitive cost of production.

Polish sugar production, 1981/82[1]. – Sugar production in Poland in the 1981/82 campaign reached 1,722,000 tonnes or 700,000 tonnes more than in 1980/81 and 100,000 tonnes more than the Plan target. This result, the third best to date, covers domestic consumption completely, permits the re-establishment of stocks, and will provide an exportable surplus of 300,000 tonnes.

[1] *Zuckerind.*, 1982, **107**, 172.

SUGAR CANE AGRONOMY

Tolerance of My 54129 cane variety to the herbicides Ametryne, Asulam, DCMU, Dalapon and 2,4-D. J. C. Díaz, F. Naranjo and N. Rodríguez. *Cienc. Agric.,* 1980, (7), 99-107 *(Spanish).* — A plant cane and two ratoon crops of My 54129 cane were grown on a red ferralitic soil and the effects on growth, tillering, yield and quality at harvest of herbicides determined, using hand-weeded cane as a control. The treated plots were weed-free at all times. No losses at harvest resulted from post-emergence treatment with 80% Ametryne at 2 and 4 $kg.ha^{-1}$, 40% Asulam + 46% 2,4-D amine salt at 10 + 2.5 $litres.ha^{-1}$ nor from pre-emergence treatment with 80% DCMU at 6 $kg.ha^{-1}$. Slight and short-lasting restrictions of growth and tillering were recorded with the first two of the above treatments. Post-emergence treatment with 90% Dalapon + Aminol at 10 kg + 2.5 litres per ha produced highly significant yield losses in all three crops, as well as severe and persistent restriction of stalk growth and tillering.

Phytotoxicity of Ametryne in 12 sugar cane varieties. F. Naranjo and J. C. Díaz. *Cienc. Agric.,* 1980, (7), 109-115 *(Spanish).* — Susceptibility to foliage-applied Ametryne was assessed in ten Cuban varieties as well as varieties B 41227 and B 4362; a logarithmic sprayer was used to apply the herbicide at rates of 0.64 to 16 $kg.ha^{-1}$ a.i. Growth and tillering were affected in three varieties, the remainder being tolerant; no adverse effect on sucrose content at harvest was observed with any variety.

Calibration of potassium in the soil and fertilizer recommendation for sugar cane. J. Orlando, E. Zambello and A. A. Rodella. *Brasil Açuc.,* 1981, **97,** 18-24 *(Portuguese).* — A series of 35 field trials were carried out to correlate the K content of the soil, determined by analysis of a 0.5N H_2SO_4 extract made using 10 parts of extract to 1 part of soil during 15 min, and the cane yield from the appropriate plot. An equation was derived (r = 0.79) from which it was calculated that soil K at less than 48 ppm was very low (relative cane yield less than 70%), 48-91 ppm was low (relative yield 70-90%), 91-156 ppm medium (relative yield 90-98%), 156-312 ppm high, and above 312 ppm very high. Recommendations are made for K fertilizer to be applied in the Centre-South region of Brazil, depending on the soil extract K and the relative prices of cane and fertilizer.

Soil preparation for planting of sugar cane. J. Fernandes, V. L. F. Neto and R. Stolf. *Brasil Açuc.,* 1981, **97,** 41-44 *(Portuguese).* — Comparison of different methods of soil preparation for planting showed that highest cane yields resulted when disc harrows were used, working to a depth of 45 cm; the advantage was greater when climatic conditions were unfavourable. The performance of a subsoiler was improved to near that of the harrow by fitting "wings".

NPK fertilization and fertilizer placement in sugar cane ratoons, variety CB 41-76. E. Zambello, H. P. Haag and J. Orlando. *Brasil Açuc.,* 1981, **97,** 45-55 *(Portuguese).* Complete factorial design of experiments was used in trials using four levels of N, two of P, three of K and two of placement (surface and sub-surface) in application of fertilizer to ratoon cane on four different soil types in one of which the trials also included the use and non-use of irrigation. Except in one soil, sub-surface placement of fertilizer did not affect cane or pol yield per ha, while the response to N and K was linear except for the K response in another soil. P raised the cane yield in three of the soils and also the pol yield in two of them. Irrigation did not raise the yield of cane in the soils studied.

Response of sugar cane (adsali) to rates of nitrogen on medium black soil. J. D. Chougule and B. R. Patil. *Maharashtra Sugar,* 1981, **6,** (5), 21, 23-24. — Trials in which 375, 400, 425, 450 and 475 $kg.ha^{-1}$ N was applied to cane showed that 400 was better than 375 $kg.ha^{-1}$ in terms of yield, but that any further increase in yield resulting from the higher dosages was too small to justify the greater application.

Role of the soil laboratory with the cooperative sugar factory. M. Jawale, *Maharashtra Sugar,* 1981, **6,** (5), 25-26, 28-29. — The activities of the soil laboratory set up by the author's sugar factory are briefly described and results obtained are indicated.

Irrigation of cane. E. Seoane C. *Bol. Técn. Divn. Técn. Inst. Central Invest. Azuc.,* 1979, **8,** 69-123 *(Spanish).* In view of the importance of water to cane growth and its scarcity in parts of Peru, it is necessary for efficient utilization to apply sufficient for good growth and at the right times. In regard to the first, a number of factors are discussed, including soil capacity for water and its wilting coefficient, irrigation depth and losses, the last being dependent on soil type, furrow layout and nature of the irrigations. The number of irrigations and interval between them are dependent on the time of the year, soil water capacity, whether the crop is of plant cane or ratoons, and the variety concerned. Commercial practice is also discussed.

Studies on the regenerative capacity of rhizomes of torpedo grass *(Panicum repens* Linn.). III. Effect of environmental distress on yield and nutrients of parent grass with relation to the growth of the clonal grass. S. Y. Peng and L. T. Twu. *Taiwan Sugar,* 1981, **28,** 10-17. — Torpedo grass is the most noxious perennial weed in Taiwan cane fields; it can absorb considerable quantities of soil nutrients and moisture, and thus produce vigorous rhizomes capable of withstanding the most adverse of environmental conditions. Experiments are reported in which the grass rhizomes were subjected to mechanical fragmentation, herbicide, drought and soil sterility. While yields of the weed were reduced by the various treatments, the grass was stimulated to absorb exceptionally high concentrations of soil nutrients; a close negative correlation was found between yield and N and P contents (r = — 0.74 and — 0.75, respectively). When harvested rhizomes of the parent grass were planted, those that had suffered reduced yield and therefore contained more N gave abundant stands; the correlation between yield of parent rhizomes and stem yields of the clonal grass was significant at r = — 0.59, while the relationship between N in the parent grass and the yield of the clonal grass had a regression coefficient of 0.75.

An investigation on nutrient content of filter cake in the 1979/80 milling season. T. H. Weng and Y. Y. Chan. *Taiwan Sugar,* 1981, **28,** 18-20. — The pH, organic matter, N, P_2O_5, K_2O, CaO, MgO and moisture contents of filter cake from Taiwan sugar factories in 1979/80 were determined and the results tabulated. The benefits of filter cake on cane yield are summarized and recommendations given on its application.

Fertilizer application technology for companion cropping of sugar cane and sugar beet. R. Kumar, A. Lal and M. Alam. *Indian Sugar,* 1980, **30,** 481-486. — Application of 120 kg.ha^{-1} N to beet grown as a companion crop with cane or 150 kg.ha^{-1} N to cane alone (either in a single dose or in split doses) was investigated. Application of the N to cane alone after the beet had been harvested increased the total sugar yield from both crops to 17.34 tonnes.ha^{-1} by comparison with 13.06 tonnes.ha^{-1} from cane alone. Both beet and cane yields were lower with companion cropping than when grown separately, although beets did not significantly affect cane sugar content.

Calibration of phosphorus available for sugar cane in soils of the states of Rio de Janeiro, Espírito Santo and Minas Gerais (Mata zone). M. S. Manhães, D. F. Azeredo, A. A. Robaina and J. R. Vieira. *Brasil Açuc.,* 1981, **97,** 122-128 *(Portuguese).* — Cane yields from 27 field trials were correlated with soluble P as measured by extraction with 0.5N H_2SO_4. From the regression analysis of the results the soils were classified in respect of available P: very low (<14 ppm), low (14-28 ppm), medium (29-51 ppm), high (52-102 ppm) and very high (>102 ppm). Economic levels of fertilization are suggested for the different classes, calculated with reference to the yield response, the price paid for cane and the cost of the fertilizer.

Effects of periodical flooding on sugar cane production. D. E. Cruciani and K. Minami. *Brasil Açuc.,* 1981, **97,** 129-134 *(Portuguese).* — Pot trials were made in which cane was flooded for 5 and 10 consecutive days, respectively, at the ages of 1, 2, 3, 6, 9 and 12 months as well as intermittently, for the same periods, at intervals of 30 and 60 days. The effects were measured in terms of root weight, stalk weight, height and juice Brix, and are tabulated. The root weight was sensitive to the water content of the soil, particularly during the period of maximum growth (6-10 months). The other parameters were little affected and the lighter treatment encouraged development, provided there was sufficient time for crop recovery between floodings.

Determinants of sugar cane yield gaps in different regions of Uttar Pradesh. J. Lal and K. Singh. *Indian Sugar,* 1981, **30,** 607-609. — An attempt was made to evaluate those factors responsible for differences in cane yield between trial results and results obtained by farmers in the same area. Generally, differences in fertilization, irrigation and plant protection were the main contributors to the differences in yield.

Improved pre- and post-harvest technology of sugar cane for reduction in sugar losses. K. C. Rao and J. T. Rao. *Maharashtra Sugar,* 1981, **6,** (6), 9, 11, 13-14, 16-18. Causes of deterioration of growing and harvested cane are discussed and indications given of means of reducing the losses. The problems created by dextran and inversion are the primary factors examined.

Proper maintenance of good sugar cane ratoon crop. J. D. Chougule and S. S. Wandre. *Maharashtra Sugar,* 1981, **6,** (6), 39-40. — Advice is given on practices to ensure a good ratoon crop.

Chemical ripening of Louisiana sugar cane. F. A. Martin, B. L. Legendre, G. M. Dill, G. J. Dimarco and R. J. Steib. *Sugar J.,* 1981, **43,** (10), 20-22. — Since it has been found that cane infected with ratoon stunting disease contains more sugar than uninfected cane, it was suggested that RSD-affected cane would not respond to treatment with a ripener as much as healthy cane. Tests conducted with Glyphosine confirmed this — treatment increased sugar yield per acre by an average of 4.37% in the case of healthy cane but reduced it by 6.41% in RSD-infected cane. Further tests indicated that response to chemical ripeners is a heritable trait, so that it should be possible to breed cane varieties for such response. In tests to evaluate new ripeners, sugar yield was consistently increased by the sodium salt of glyphosate which is to be marketed under the name of Polado. It increased sugar yield of CP 65-357 (planted on more than 60% of the Louisiana cane area) by 7.4% 24 days after treatment.

Irrigation of cane — which way to go? Anon. *Australian Canegrower,* 1981, **3,** (3), 59, 62. — The advantages of drip irrigation, its capital and running costs, water treatment and the properties of Bi-Wall tubing (manufactured by RIS Irrigation Systems Pty. Ltd.) are discussed.

Irrigation scheduling with a neutron probe. P. O. Cull. *Australian Canegrower,* 1981, **3,** (3), 79, 81-82. — For irrigation scheduling purposes, the soil moisture can be determined by lowering a source of fast neutrons and a detector tube down an aluminium tube into the soil; the fast neutrons pass down the tube and are considerably slowed down when they collide with hydrogen atoms. Since in most soils the only source of H atoms is water, any deceleration will be due to soil moisture. The detector, a boron trifluoride tube, is responsive only to weak slow neutrons, not high-energy fast neutrons. The holes for the insertion of the aluminium tubes measure 5 cm in diameter by 1.2 m deep and are made between plants within a row; the tubes can remain in the soil until the end of the growing season. Every 5-7 days the probe is lowered into the tube (located at, say, three selected locations in the field) and the moisture readings taken at several depths down to 0.9 m. The point at which irrigation should be carried out (the refill point) is established on the basis of the level of soil moisture depletion at which yield would fall without irrigation and the crop suffer from moisture stress. Estimation of the refill point will first depend on the results of experiments carried out on soils of the type closest to that in question, although the decision to irrigate will depend on the factors mentioned above and the farmer's own judgement.

Slow the flow with Gabion weirs. P. R. Downs. *Cane Growers' Quarterly Bull.,* 1981, **44,** 103-105. — If run-off water flows at a velocity sufficient to detach and remove soil particles it can erode the soil at the base and sides of farm drains. The flow velocity is governed by factors which should be considered during the designing and construction of drains, viz. drain size and shape, volume of water to be carried, slope of the land, soil type and vegetation on the drain surface. The flow rate in the drain can be dramatically reduced by means

of Gabion weirs, which are constructed from wire netting and rocks and can be made to fit any size and shape of drain. Details are given of the technique used to build these weirs by a Mackay cane grower who thus succeeded in solving an erosion problem with a major drain after numerous attempts to stabilize it had failed.

A model farm. E. G. Spry. *Cane Growers' Quarterly Bull.,* 1981, **44,** 106-107. – Photographs illustrate the benefits of good drainage on a cane farm; they were taken after 2137 mm of rain had fallen over a 12-day period. A section of the farm had once been swampland with creeks covered with para grass. Since reorganization of the farm, the owner has increased cane yield by 19% to 86 tonnes.ha^{-1} in years of record rainfall.

A farm drainage installation at Ingham. P. J. Nielsen. *Cane Growers' Quarterly Bull.,* 1981, **44,** 108-109. – On the cane farm in question, a drainage system for surface and sub-surface water has resulted in increased cane production. A flood lift pump has improved drainage on existing land and made available a further 8 ha of previously unsuitable land. Deeper drains have provided outlets for underground drainage pipes, which have eliminated seepage areas. The cost of the scheme will be recovered rapidly in the form of increased cane production and the additional area available for current industry expansion. Photographs illustrate the salient features of the system.

Five steps to efficient sub-surface drainage. A. I. Linedale. *Cane Growers' Quarterly Bull.,* 1981, **44,** 110-112. The five steps in achieving efficient sub-surface drainage are: identification of the problem, i.e. finding the origin of the water causing poor cane growth and difficulties in cultivation and/or harvesting, deciding on remedial measures, using the information gathered in the first two steps to plan the required drainage method, trenching (except where mole drains are used), and the actual operation of drain laying.

Installing mole drains. P. J. McGuire. *Cane Growers' Quarterly Bull.,* 1981, **44,** 112-114. – Advice is given on design and installation of sub-surface drainage systems, found to be an effective means of lowering the water table in clay sub-soils.

Calcium/magnesium nutrition – some questions and answers. A. A. Matthews. *Cane Growers' Quarterly Bull.,* 1981, **44,** 117-119. – The author answers questions frequently asked by cane farmers on calcium and magnesium fertilization.

Be careful at planting time – it pays. G. N. Turner. *Cane Growers' Quarterly Bull.,* 1981, **44,** 121-123. – Factors that should be given careful attention at planting time are discussed, including plant quality, planter operation, treatment for control of pests and diseases, and soil conditions.

Micro-element nutrition of sugar cane. II. Interactions in micro-element accumulation. J. E. Bowen. *Trop. Agric.* (Trinidad), 1981, **58,** 215-220. – Numerous synergistic and antagonistic interactions have been found between pairs of micro-nutrients in elongating leaf sheaths of field-grown cane 8-10 months old. Synergistic interactions were noted in the uptake of Ca and S, Ca and Zn, Ca and Cu, Ca and B, Mg and S, Mg and Zn, Mg and Mn, S and Zn, S and Cu, S and B, S and Mn, Zn and B, and Cu and B. Antagonistic interactions were found between Ca and Mn, Mg and Cu, Mg and B, and Zn and Cu. All of these interactions were statistically significant at the 5% confidence level, and many of them at the 1% level. SiO_2, not known to be an essential nutrient, significantly and positively influenced S and Mg accumulation, whereas the uptake of Mn, Cu and B fell significantly with increase in SiO_2 concentration in the immature sheath tissue.

Relative profitability of autumn- *vs.* spring-planted sugar cane grown alone or with intercrops and their competing cereal rotations. R. Tiwari and D. K. Singh. *Indian Sugar,* 1981, **30,** 685-688. – The financial return on various cane-plus-intercrop systems was investigated as well as that on cane grown alone and cereal crop rotations. The highest return was given by autumn-planted cane plus dhania or plus lentil, while the cereal crop rotations gave very low returns.

Composting of sugar cane trash using a mixed inoculum of fungus cultures and leguminous material by the open heap method. B. P. Rote, P. L. Narkhede and B. N. Sinde. *Indian Sugar,* 1981, **30,** 689-691. – Addition of fungal spore suspension plus leguminous material or N and P to cane trash spread on open ground for up to six months accelerated composting by comparison with untreated trash, as shown by the total N and organic C contents.

Response of sugar cane to phosphate at higher levels of nitrogen in different soils of the white sugar belt of Bihar. K. Thakur, Y. Rai, D. Singh and B. P. Sahi. *Indian Sugar,* 1981, **30,** 739-742. – Results of trials indicated that application of phosphate was necessary for cane to respond positively to higher levels of N, although phosphate application in the absence of N gave much lower yields than in its presence. Optimum doses of phosphate in conjunction with N are given for calcareous, non-calcareous and calcareous saline-alkali soils.

System of planting and soil compaction in sugar cane. J. Fernandes, V. L. F. Neto and R. Stolf. *Brasil Açuc.,* 1981, **97,** 160-171 *(Portuguese).* – The discordance between the traditional spacing of sugar cane furrows and the dimensions of wheeled transport vehicles is considered the principal reason for soil compaction in ratoon crops. Spacing of 1.8 m between furrows, against the traditional 1.4-1.5 m, allows the passage of such vehicles in the inter-rows. Trials were carried out wth wide-base furrows of 1.6 and 2.2 m spacing, planted with three rows of cane, by comparison with normal furrows, 1.5 m apart, planted with two rows of cane, over six crops. The effects were variable, depending on the variety, but the yield of cane was slightly reduced by the wider spacing over the whole period in only one case, and in some cases was considerably increased. With wider spacing, the furrow length per ha was reduced, which affected fertilizer usage; for the same quantity per ha the amount per m of furrow was increased. An alternative system particularly suitable for manual cane cutting is outlined where two 3-line, wide-base furrows are planted with 1.8 or 1.7 m spacing and then three furrows at closer (1.3 m) spacing. Transport vehicles would travel with their wheels in the wider inter-furrow spaces and so avoid compaction of the stubbles, while the system would permit easier application of herbicides, vinasse, etc.

SUGAR CANE MECHANIZATION

Extrapolation of the trash effect on pol losses in bagasse. A. I. Allam. *Sugar News* (Philippines), 1980, **56,** 50-55. See *I.S.J.,* 1981, **83,** 209.

Redimensioning of the cane transport fleet: economic and operational results. P. G. R. Freitas, J. M. Lorenzetti, J. T. Coleti and J. Jacomini. *Brasil Açuc.,* 1980, **96,** 109-116 *(Portuguese).* – A fleet of 45 "small" units was replaced by 33 "medium" transport units for carrying a total of 1,370,234 tonnes of cane over a distance of 19.4 km. This was found to have a number of advantages: the average amount of cane transported per unit per day rose by 10 tonnes, or 15.47%, the weight of cane carried per journey rose by 1.2 tonnes, or 11.6%, and the weight of cane carried per vehicle per season rose by 19.94% from 13,440 to 16,120 tonnes. The time taken for each trip was virtually the same, while fuel usage was reduced and the cost per tonne-km decreased from Cr.2.22 to Cr.1.21.

Sugar planter tackles weed problem. Anon. *S. African Sugar J.,* 1980, **64,** 581. – Illustrations are given of a patented machine which embodies a cultivator for inter-row weeding and two large tined wheels rotating at right-angles to the direction of the tractor for weeding in the cane rows. The photographs clearly show the effectiveness of the weeder in "combing out" weeds in between young cane; the machine can be used up to the start of canopy growth.

New cane transport system introduced to our sugar industry. Anon. *Australian Sugar J.,* 1980, **72,** 425-428. The Poole system of weight transfer for cane haulage is described with the aid of photographs. The two- or three-bin articulated cane trailer is linked to the towing tractor by a special quick hitch, using a gooseneck coupling. Transfer of weight from the trailer to both front and rear wheels of the tractor is possible through location of the attachment point in front of and below the centre of the rear axle of the tractor; this improves traction, stability and steering control, and allows tractors of relatively low hp to tow large payloads. Chopped cane is loaded directly by conveyor from the harvester into the wheeled bins positioned on the trailer. When the bins are full, they are towed to the tramway and unloaded from the trailer; empty bins are winched from the tramway rails onto the trailer.

Performance testing of MF 305 sugar cane harvester. L. H. Huang., C. C. Lo, D. W. Lin and S. A. Yin. *Taiwan Sugar,* 1980, **27,** 194-195. – Comparative trials are reported that were conducted on cane harvesting by three machines at two locations in Taiwan. The MF 305 proved generally better than the other two harvesters and left only an acceptable amount of cane in the field, while the amount of extraneous matter in the cane was the lowest, whether in burnt or green cane. The performance of the stone removal mechanism was, however, disappointing.

Evaluation of loads of mechanically harvested sugar cane. V. L. F. Neto, J. Fernandes and L. G. Mialhe. *Brasil Açuc.,* 1980, **96,** 149-154 *(Portuguese).* – Quantitative analyses were made of loads of cane harvested by three kinds of cane harvester from a crop of 3rd and 4th ratoon CB 41-76 cane which had been burnt before harvest. The details are tabulated and show that total impurities (earth, roots, tops and leaves) varied between 3.32 and 6.79% of the total.

Bulk planting at Fairymead. C. Morton. *Australian Canegrower,* 1980, **2,** (11), 68-70. – On the Fairymead cane estate of Bundaberg Sugar Co. one harvester operates on an 8-hour shift to provide cane billets for two planters operating 24 hours a day, one planting single rows and the other double rows. The planters are supplied with the billets from a special tippler, which also supplies "mercury water" from a tank; this sett-dipping solution is discharged in 3-4 min by a centrifugal pump started from the control console of the MF 188 tractor used as prime mover. The planters are provided with a means of facilitating reversing in awkward situations, particularly on soft ground. Levelling of the soil, prior to planting, is carried out by a land plane equipped with a scraper and a mechanism that permits 45° steering.

The "push-rake" arrives in Brazil. T. C. Ripoli and A. L. Segalla. *Brasil Açuc.,* 1981, **97,** 34-40 *(Portuguese).* As in other countries, the cane harvest in Brazil has become more and more mechanized, and a history of this development is provided. At Usina Mandacarú, however, no manual labour is available for cane cutting, and the push-rake system, as used in Peru, has been adopted. A description is given of the cultivation of cane, employing furrow irrigation, and of the harvest operations, loading and transport to the factory. Extraneous matter in cane harvested by the same method is quoted as 35% in Hawaii and 18% in Peru, but at Mandacarú is only 5-10%.

Sasaby: harvesting whole-stick green cane. Anon. *S. African Sugar J.,* 1981, **65,** 105. – Field trials with the single-row Sasaby green cane harvester designed at the Experiment Station of the South African Sugar Association[1] gave sufficiently encouraging results to justify further developments, but testing of the Sasaby II machine was limited by unusually wet weather. However, an improvement in conditions was expected to allow further trials to be carried out and necessary modifications made to the harvester.

A no-chain cane delivery system. D. H. Carter-Brown. *S. African Sugar J.,* 1981, **65,** 109, 111-112. – See *I.S.J.,* 1982, **84,** 44.

Assessment of the performance of sugar cane harvesters in the region of Campos, RJ. T. C. Ripoli and P. N. A. Berto. *Brasil Açuc.,* 1981, **97,** 92-103 *(Portuguese).* After a summary of the mechanical harvesting equipment in use in Brazil as at August 1980, and a survey of the literature on their performance, a series of trials of two variants (normal and super-reduction) of the Santal 115 machine is described. The conditions of the trials – cane variety, spacing, topography, etc. – are given in detail as are the results by assessment of the various indices proposed by Ripoli *et al.*[2] for such assessments.

[1] Pilcher & Boast: *I.S.J.,* 1982, **84,** 44.
[2] *Paper presented to Congresso Brasileira de Engenharia Agrícola,* 1977.

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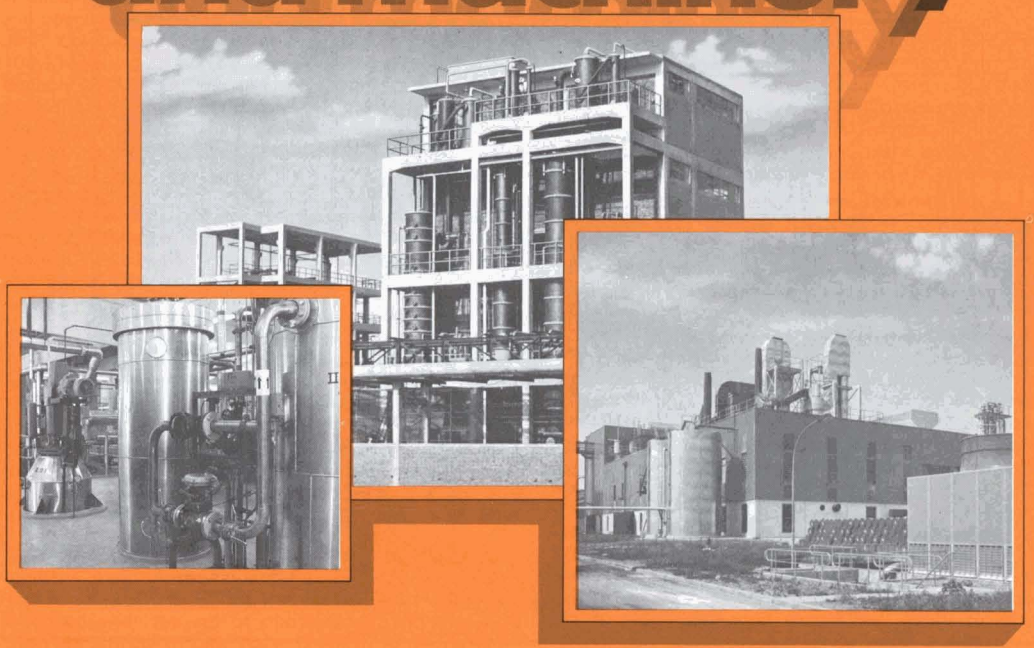

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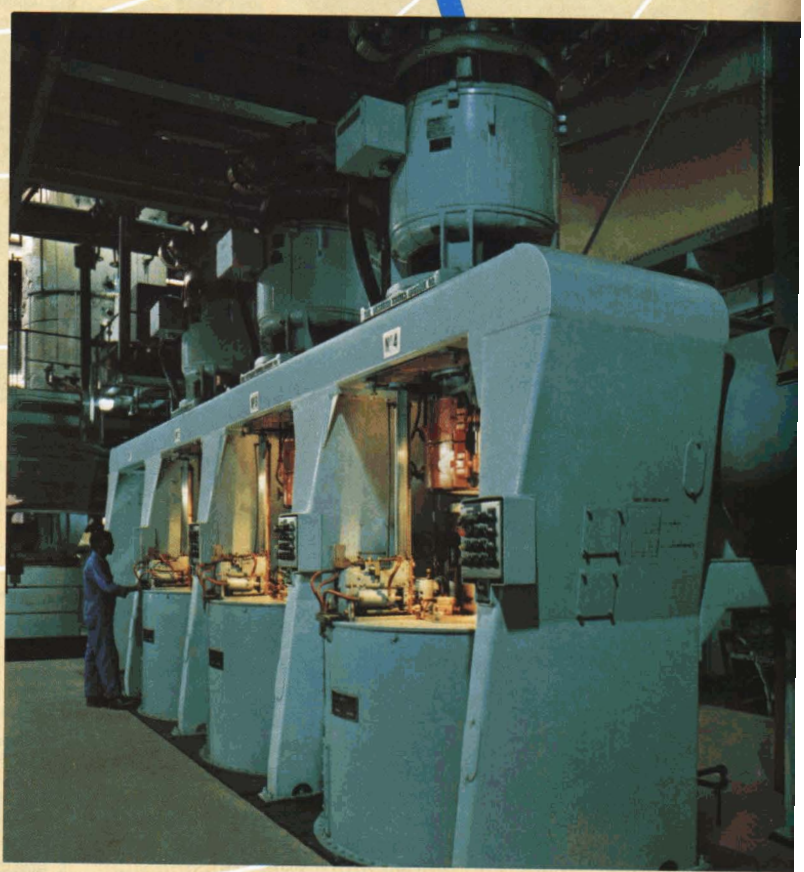

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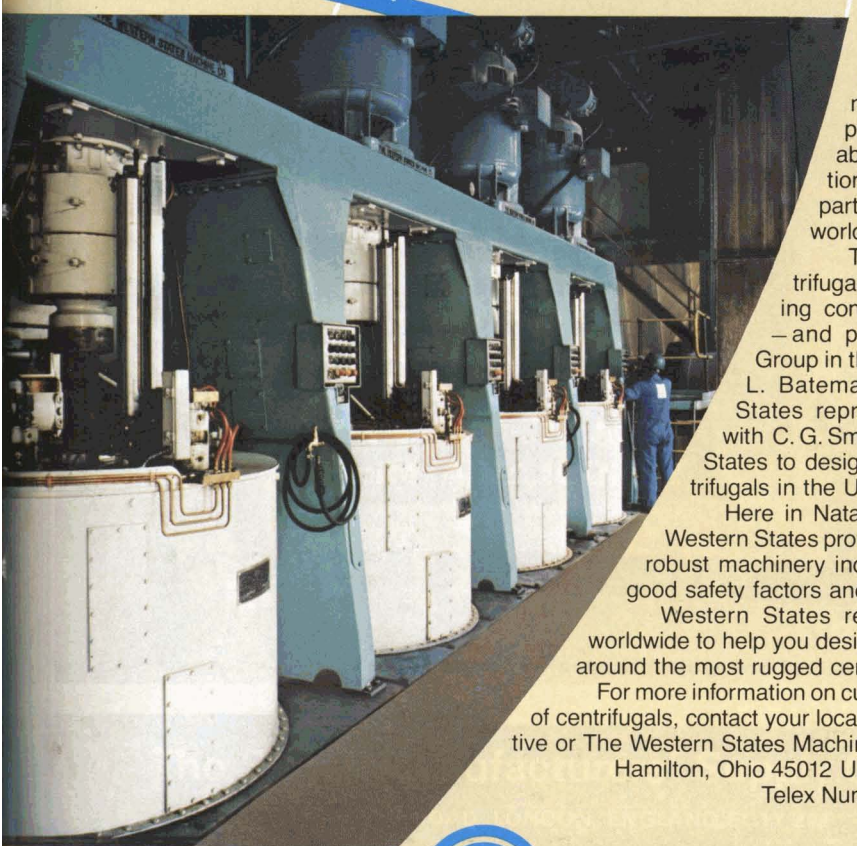

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CANE PESTS AND DISEASES

A note on the control of Pyrilla in sugar cane. A. S. Patil, D. G. Hapase and B. P. Gajare. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, Ag.93-Ag.97. — Of a number of treatments tested, the most effective in terms of *P. perpusilla* nymph reduction and cane yield increase by comparison with the control was removal of the bottom dry leaves and spraying with 0.05% Malathion in July, August and September.

Rust of sugar cane and its causal organism in Cuba. I. Alfonso and J. Sanjurjo. *Cienc. Agric.,* 1980, (5), 3-7 *(Spanish).* — The causal organism of the recent outbreak of rust on sugar cane in Cuba, mainly on plant cane of the variety B 4362, has been identified as *Puccinia melanocephala* Sydow. The best temperature for germination of the uredospores in distilled water was 21°C; low temperatures (13-14°C) contributed to the formation of the teleutospores. Results proved that the teleutospores of *P.melanocephala* can be obtained artificially.

Recommendation of new varieties of sugar cane with a view to substitution of the variety B 4362 in production areas. I. Abrantes R. *Cienc. Agric.,* 1980, (5), 163 *(Spanish).* — In view of the severe attack of rust on B 4362, a major variety used in Cuba, a total of 12 other varieties are recommended for substitution, smaller subgroups being proposed for individual provinces.

Two new host plants of *Elasmopalpus lignosellus* Zeller in Cuba. Z. Pérez A. and E. López. *Cienc. Agric.,* 1980, (6), 156 *(Spanish).* — This cane pest (a shoot borer) has been found on *Sorghum halepense* and *Echinochloa crusgalli* in the province of Havana, Cuba.

Diseases and pests of sugar cane in the Socialist Republic of Vietnam. J. R. Pérez, N. V. Khu, T. T. Van and S. Castro. *Cienc. Agric.,* 1980, (6), 156-158 *(Spanish).* A survey by Cuban specialists has identified five virus diseases, three bacterial diseases, 13 fungal diseases and nutrient deficiency diseases such as albino disease, as well as seven named pests and others. The losses caused are serious but, since the varieties used are susceptible, their replacement by resistant varieties is the principal measure to be adopted.

Detection of ratoon stunting disease in sugar cane ratoons in Cuba. J. R. Pérez, M. López and M. Castro. *Cienc. Agric.,* 1980, (7), 3-9 *(Spanish).* — Four methods for detection of the disease include (1) a pink colour in the fibrovascular vessels of stunted cane plants in fields where proper cultural practices have been carried out, (2) a salmon colouring in juvenile tissues of cane not treated with hot water and planted in a greenhouse, (3) development of a red colour in the fibrovascular vessels at the base of elephant grass *(Pennisetum purpureum* Schum var. Napier) inoculated with juice from diseased cane, and (4) the observation by means of an electron microscope of certain organisms in stunted cane which are not seen in healthy cane.

The fight against Eldana: searching the Ivory Coast. Anon. *S. African Sugar J.,* 1981, **65,** 7, 9. — *Eldana saccharina* is a very common pest of maize in West Africa, and the Experiment Station of the South African Sugar Association has sent a member of staff to the Ivory Coast in a search for parasites of the borer; several have already been identified. While a wasp of the Trichogrammatidae family is already being cultured, a larger wasp that is relatively long-lived is considered a more promising parasite, but will prove difficult to breed. Two flies found to parasitize Eldana larvae are also difficult to rear under artificial conditions. Even the parasites collected in the Ivory Coast maize fields may not behave in the same way when sugar cane is the host plant.

Biological-chemical control of sugar cane borers in Florida. E. R. Rice. *Sugar J.,* 1981, **43,** (9), 17-19. The borer, *Diatraea saccharalis,* is described as the most destructive insect pest of the above-ground portion of cane in Florida and in some years causes damage worth millions of dollars. A monitoring program instituted in an area of 75,806 acres owned by the United States Sugar Corporation showed that about half of the area contained no borers, while a small number were found in 8.2% of the area. Also recorded was the percentage parasitism by the two wasps, *Apanteles flavipes* and *Agathis stigmatera,* in each field. The number of fields to be sprayed with chemical was then decided. Where there was sufficient parasitism, no spraying was carried out; in some cases, spraying was carried out early and further borer control left to the parasites. In 12.9% of the total area spraying was carried out because fewer than half of the borers found were parasitized. It is concluded that the parasites were highly effective in controlling the borers and thereby greatly reduced the number of fields sprayed. Other predators, particularly ants, also helped to control the pest.

Trials on the rearing of two exotic coccinellid predators, *Chilocorus cacti* L. and *Sticholotis madagassa* W. on a semi-synthetic diet. T. A. V. S. Raghunath and B. H. K. Rao. *Maharashtra Sugar,* 1981, **6,** (4), 33, 35-36. Trials on various diets for the rearing of the title predators of the scale insect, *Melanaspis glomerata,* showed that best results were given by a honey-agar diet to which 10% powdered scale insect was added; this diet minimized consumption of scale insects during the development and pre-oviposition period of the beetles.

The "stylet nematode" *Tylenchorhynchus annulatus* (Cassidy, 1930) Golden 1971 (Nematodea:Tylenchorhynchidae) in sugar cane. T. A. Hasselrot G., M. A. Costilla and S. González O. *Rev. Ind. Agríc. Tucumán,* 1980, **57,** (1), 91-101 *(Spanish).* — *T. annulatus* is the most abundant nematode in Tucumán and is also found in Jujuy, Salta and Santa Fe provinces. Its morphology, distribution and population fluctuations are described, with an account of the damage it causes to the sugar cane crop.

Sugar cane diseases in Peru. M. Cueva C. *Bol. Técn. Divn. Técn. Inst. Central Invest. Azuc.,* 1979, **8,** 25-44 *(Spanish).* — The present level of knowledge concerning the five major diseases of sugar cane in Peru (ratoon stunting disease, mosaic, red rot, pineapple disease and red stripe) is surveyed, giving in each case an account of economic importance, symptoms, varietal susceptibility, causal agent, transmission and control.

Sugar cane nematodes in Peru. M. Cueva C. and E. Carbonell T. *Bol. Técn. Divn. Técn. Inst. Central Invest. Azuc.*, 1979, **8**, 59-68 *(Spanish).* — A survey is presented of the 19 genera of nematodes identified in cane fields in Peru, together with their economic importance and control.

Sugar cane rust disease in America — preventive measures. Anon. *La Ind. Azuc.*, 1980, **86**, 307-308 *(Spanish).* — In the past two years the Western Hemisphere has suffered from the rapid spread of smut disease, previously occurring only in South America, to the rest of the continent, and also the appearance of rust in 1978 in the Dominican Republic, whence it has travelled to 16 more countries, including the continental USA. It is considered a matter of time before the causal organism, the *Puccinia* fungus, reaches South America, but Argentina authorities are optimistic that it will not cause the same losses as elsewhere, since the industry in that country possesses a wide range of cane varieties, some of which are known to be resistant, and trials of Tuc and NA series varieties are undergoing tests in Florida for resistance. All importation of cane has been suspended for two years to ensure that the pathogen is not introduced by accident during this period of resistance testing.

Field recovery of an exotic parasitioid, *Paratheresia claripalpis* Wulp. (Tachinidae:Diptera) of the Gurdaspur borer, *Acigona steniella* (Hampson) (Pyralidae:Lepidoptera), a serious pest of sugar cane in Haryana, India. J. Prasad and A. D. Pawar. *Indian Sugar*, 1980, **30**, 405-407. — Gravid females of a larval parasite, *P. claripalpis*, imported from Peru for control of *A. steniella*, were released in cane fields at two sites in Haryana. The percentage parasitism was found, on three occasions, to be 8.9, 12.5 and 13.3 at one site, and 10.0, 8.0 and 11.1 at the other.

Management of sugar cane insect pests in Taiwan. Y. S. Pan. *Taiwan Sugar*, 1981, **28**, 22-26. — It is stated that of the 28 species of insect pests commonly found in Taiwan cane fields, seven are of major importance: the leafhopper *Matsumuratettix hiroglyphicus*, the grey borer *Argyroploce schistaceana*, the stalk borer *Proceras venosatus*, the cicada *Mogannia hebes*, the woolly aphid *Ceratovacuna lanigera*, the white grub *Alissonotum impressicolle* and the wireworm *Melanotus tamsuyensis*. Only the last three can be controlled by chemical means, while control of the other four depends on farming practices, the growing of resistant cane varieties and biological control. Details are given.

Study on the cultural characteristics of the causal agent of leaf scorch. Z. N. Wang. *Rpt. Taiwan Sugar Research Inst.*, 1980, (90), 9-21 *(Chinese).* — The causal organism of leaf scorch, *Stagonospora sacchari*, was isolated from leaf lesions and from pycnidia. Culture of the isolate on potato sucrose agar (PSA) resulted in white and slow-growing radial colonies initially, after which the colonies changed colour from white to greyish-black mixed with white, yellow and light pink. Most of the isolates produced pycnidia. A total of 650 single conidia isolated from 54-737 cane variety were separated into four cultural types: wilde, mycelial, conidial and intermediate. Inoculation tests showed that the conidial and wild types were highly pathogenic, the intermediate type moderately so, and the mycelial type only slightly pathogenic. Ten-day culture of the pathogen on PSA produced both *Stagonospora* and *Phoma* types of conidia in the same pycnidium, but the two types in colonies produced by single conidia were indistinguishable from each other, leaf scorch symptoms being obtained by inoculation of cane leaves with both types of conidia.

Field survey on the fluctuations of the numbers of sugar cane moth borer eggs and of those parasitized by *Trichogramma australicum* Girault. W. Y. Cheng, T. H. Hung and J. K. Hung. *Rpt. Taiwan Sugar Research Inst.*, 1980, (90), 23-43 *(Chinese).* — Field surveys conducted at 2-week intervals over 5 crop years showed that by far the greatest proportion of eggs found (80.1%) was represented by *Argyroploce schistaceana*, and of the parasitized eggs, 89.6% were those of *A. schistaceana*, although % parasitization was lower than with *Proceras venosatus*. The other borers investigated were *Chilotraea infuscatella* and *Scirpophaga nivella*. Factors responsible for the fluctuations in egg numbers are discussed.

Improved technique of transference of ectoparasite *Epipyrops melanoleuca* Fletcher for the biological control of the sugar cane leafhopper, *Pyrilla perpusilla* (Walker). M. P. Mishra, A. D. Pawar, R. Samujh and P. K. Maharaj. *Indian Sugar*, 1981, **30**, 491. — The chances of establishing the parasite in infested cane fields are increased by stapling cut leaves carrying 2-3 egg clusters and 5-7 live cocoons to the undersides of cane leaves (4-5 per plant in close proximity), thus allowing emerging males and females to come into contact and mate, and emerging caterpillars to find leafhopper nymphs and adults. The leaf pieces are best transported to the field in muslin placed in a portable ice box.

The fight against Eldana: ants, spiders and cockroaches are allies. Anon. *S. African Sugar J.*, 1981, **65**, 57-58. The use of cross-over electrophoresis as a serological technique to identify predators of *Eldana sacchari* is explained, and results of tests are reported which showed that, of a wide variety of arthropods found, ants and spiders constituted the largest groups. Two ant genera giving positive results in the tests, *Paratrechina* and *Pheidole*, are those most commonly associated with sugar cane. The highest positive results given by spiders were obtained with lycosid spiders, which are the commonest running spider family. Other predators included cockroaches and bugs.

Outbreak of yellow spot in Guyana. A. M. Whittle. *Sugarcane Pathologists' Newsletter*, 1980, (25), 1-3. Symptoms of a disease similar to those of yellow spot (caused by *Cercospora koepkei)* have been found on cane growing on two estates in Guyana; identification and final confirmation of the identity of the fungus were to follow. The most heavily affected variety, D 76/61, was expected to suffer significant yield loss, although it is being phased out because of its leaf scald susceptibility.

Observation of sugar cane rust in Negros Occidental, Philippines. F. T. Gargantiel and F. C. Barredo. *Sugarcane Pathologists' Newsletter*, 1980, (25), 4. — Brief mention is made of the occurrence of rust in the Philippines; the cane affected is the country's major commercial variety, Phil 56-226. Infection was as much as 90% in some fields visited and was severe during the summer months when the cane was subject to moisture stress.

CANE BREEDING AND VARIETIES

First harvest of six sugar cane varieties in the Cartavio C.A.P. C. Lapoint T. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1979, **7**, 103-113 *(Spanish)*. Cooperative trials at the Cartavio C.A.P. (Cooperativa Agraria de Producción) using varieties H 57-5174, H 44-3098, H 32-8560, H 37-1933, H 39-5803 and PCG 12-745, showed that the first three were superior both in terms of cane yield (247, 232 and 215 tonnes.ha^{-1} at 620 days) and sugar yield (34.2, 28.1 and 29.7 tonnes.ha^{-1}).

Assessment of the relative performance of different sugar cane varieties in Khatauli Sugar Mills gate area. J. P. Sharma and K. K. Kohli. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, Ag.23-Ag.30. — Varietal trials conducted in 1978-79 are reported. No significant difference in yield was found between the five varieties BO 70, Co 1148 (grown on more than 90% of the area in question and used as standard in the trials), Co 62399, CoJ 64 and CoS 687. CoJ 64 gave the highest c.c.s. per ha, followed by BO 70 and Co 1148. Hence, BO 70 and CoJ 64 are recommended for growing on a commercial scale so as to obtain higher sugar yields.

Studies of the leaf drooping index (DI) of certain sugar cane varieties in the T.B.P. area. E. Kondaiah. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, Ag.71-Ag.76. — An anatomical relationship was found between the leaf drooping index (ratio of length of drooped part to that of the non-drooped part of the top visible dewlap leaf) and the arrangement and extent of various tissues in the midrib and leaf blade, dimensions of the bulliform (motor) cells and tissue turgidity of 18 cane varieties.

The feasibility of growing Co 6907, an early maturing variety, in Andhra Pradesh. B. Subrahmanyam, K. B. S. Rao, A. Jagannadham and M. R. Reddy. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, Ag.77-Ag.85. — The possibility of growing Co 6907 in place of Co 997, which has proved highly susceptible to red rot, was investigated in trials. Results indicated that the variety could be grown as a practical substitute, and recommended planting and harvesting times are given for the various regions of the state.

Studies on the effect of flowering and delayed harvesting on sugar cane variety Co 740. A. V. Bendigiri, M. B. Jadhav, D. G. Hapase and S. S. Patil. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, Ag.131-Ag.141. Results of a replicated trial showed that flowering of Co 740 cane (the most popular variety in Maharashtra) was accompanied by an increase in yield and juice quality during December-February, after which there was a significant fall in cane and sugar yield, particularly from the second week in March (possibly a result of sugar inversion under the effect of high atmospheric temperature); sprouting of side buds may also have contributed to the inversion.

Comparative study between the leaf proline contents and the resistance to drought of some varieties of sugar cane *(Saccharum* **spp.).** O. Brinholi, O. G. Brasil and L. C. Dalben. *Brasil Açuc.,* 1980, **96**, 382-385 *(Portuguese)*. — Two varieties resistant to drought, two susceptible and two intermediate were grown in polyethylene bags in a greenhouse and irrigated at 10-day intervals from 110 to 180 days of age. The +3 leaves were sampled at 110, 148, 172 and 188 days and analysed for their proline contents. The results are shown in a diagram and confirm that resistance to drought is associated with a high proline content and susceptibility to drought with a low proline content.

Temperature-insensitive short-duration varieties in sugar cane farming. G. S. C. Rao, A. T. Yaragattikar and R. Narasimhan. *Maharashtra Sugar,* 1981, **6**, (4), 15, 17-19. — A significant genotype x season interaction has been found for cane yield and quality in a study involving three early-maturing varieties and two contrasting seasons of growth. Significance of these findings for extension of the crushing season in regions of low ambient temperatures is discussed.

Effect of the endogenous C/N ratio and gibberellin-like substance on floral initiation in sugar cane. Y. S. Chang and K. M. Huang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (90), 1-8. — The effects on floral initiation of the endogenous C:N ratio and GA_3 content in +1 leaf blades of F 146, F 160 and F 167 cane (respectively free, moderate and rarely flowering varieties) were investigated. The C:N ratio fluctuated in all three varieties during the floral initiation period under both natural field conditions and photo-induction, and no relationship was found between the ratio and formation of flower primordia. Exposure of F 160 and F 167 cane to a photoperiod of 12¼ hours per day over a 4-month period failed to induce flowering and their GA_3 content fluctuated, although it is not known whether this fluctuation had a direct effect on flowering or not. However, the GA_3 content in F 146 cane fell after floral initiation, and there was subsequent free flowering.

Effect of graded doses of nitrogen on growth, yield and quality of sugar cane varieties. B. S. Panwar, D. N. Rathore and R. K. Joon. *Indian Sugar,* 1980, **30**, 487-490. Investigations are reported in which an early and a late maturing variety were treated with increasing nitrogen dosage rates. Results showed that, although the responses to the varying rates were as to be expected (increase in yield but fall in sugar content and juice purity), there was no significant nitrogen x variety interaction.

Response of promising regional varieties to rates of nitrogenous fertilizer application. B. K. Singh, P. K. Bose, M. H. Ashraf and Y. Rai. *Maharashtra Sugar,* 1981, **6**, (5), 9, 11-12. — A field trial conducted during 1973-76 showed that, while the yields of all four varieties tested (BO 70, BO 75 and BO 76) increased with N application rate (0, 100, 150 and 200 kg.ha^{-1} N), there were significant differences between the yields of the varieties, although the pattern was not constant.

Principal exomorphological characters of variety Tuc 69-2. F. R. Piscitelli. *Rev. Ind. Agríc. Tucumán,* 1980, **57**, (1), 27-35 *(Spanish)*. — A detailed description is given, with drawings, of the external characteristics of the title variety, in accordance with the system proposed by Skinner[1].

[1] *Proc. 14th Congr. ISSCT,* 1971, 124-127.

SUGAR BEET AGRONOMY

Weed beet through the arable rotation. J. Gunn and J. Dunkerton. *British Sugar Beet Rev.,* 1981, **49,** (1), 8-10. — Observations as part of a continuing study are reported which showed that weed beets occur more frequently in sugar beet and potato crops, to a lesser extent in pea crops, but only to a small degree in cereal crops, and that they are more likely to become a problem in sugar beet when beet is grown in a 3- or 4-year rotation. Control by contact and translocated herbicides used in cereal crops is generally good, but less satisfactory when winter crops receive only a residual herbicide in the autumn or winter, which tends to allow survival of later germinating weed beet.

Now is the time to intensify eradications methods. R. Fletcher. *British Sugar Beet Rev.,* 1981, **49,** (1), 11-13. — While results of a weed beet survey suggest that the number of fields affected may not be increasing, it is stressed that it is advisable to intensify efforts to eradicate the weed rather than assume the problem will solve itself. Treatment recommendations are given.

Chemical control of ground keepers. C. Fletcher and W. Perowne. *British Sugar Beet Rev.,* 1981, **49,** (1), 13. Chemical control of bolted beet in cereal crops was assessed by spraying growing beet with nine herbicides used in such crops. Results indicated that six had no effect, while only Banlene Plus gave good control; MCPA and Blagal were fairly effective.

The weed wiper — an overall approach. N. Turner. *British Sugar Beet Rev.,* 1981, **49,** (1), 17, 20. — Means of applying non-selective herbicides to tall weeds have not been adopted on any significant scale by European farmers, but would be advantageous in the control of e.g. bolted beets. Details are given of the Weed Wiper rope wick applicator which deposits a minute quantity of herbicide such as Roundup to the weed as it passes across the top of the crop.

A guide to band spraying. K. Williams. *British Sugar Beet Rev.,* 1981, **49,** (1), 33-34. — Advice is given on chemical band spraying, covering pump pressure and output, speed, nozzle type, volume rate, nozzle height and end-of-season maintenance.

Drill preparation for the 1981 season. J. Bastow and W. Peck. *British Sugar Beet Rev.,* 1981, **49,** (1), 48-49. Advice is given on checking of drill components and on fitting the drill to the tractor.

Low-volume, high-pressure post-emergence application. I. T. Breay. *British Sugar Beet Rev.,* 1981, **49,** (1), 50-51. **II.** A. Kennedy. *ibid.,* 51-52.
I. Trials are reported in which high-pressure, low-volume, low-dose rate application of Betanal E post-emergence herbicide was compared with low-pressure, high-volume application at low and high dosage rates. The results are discussed.
II. Benefits of the high-pressure, low-volume spraying technique are discussed. It allows overall application to replace band spraying, so that timing of application is improved, and the costs of the chemical reduced to about one-third by comparison with band spraying. Droplet distribution is better, so that about three times as much herbicide is retained on the leaf surface by comparison with conventional spraying, while crop damage risks are no higher. However, only limited experience has been obtained with the technique, using Betanal E or Goltix herbicides. Timing is a very important factor for effective control using the system.

Results of some WRO (Weed Research Organization) experiments on the overall application of Betanal E and Goltix using repeated low doses, low volume and high pressures. M. May. *British Sugar Beet Rev.,* 1981, **49,** (1), 52-53, 66. — The method has been tested in a number of experiments, which have indicated a number of benefits, although the preliminary nature of the findings is stressed.

Fertilizing for a rotation. P. Draycott. *British Sugar Beet Rev.,* 1981, **49,** (1), 61-64. — Research which has been carried out at Broom's Barn Experimental Station since 1965 on the long-term aspects of fertilizer use for a rotation of sugar beet and cereals is outlined and the importance of using a nutrient balance sheet coupled with soil analysis to obtain high beet and cereal yields is stressed.

The physical properties of sugar beet roots. D. Ostrowska and H. Wzorek. *Gaz. Cukr.,* 1980, **88,** 218-221 *(Polish).* Physical properties of the sugar beet are discussed under three groups (geometric, mechanical and technological) and the need to reduce variation in those properties of importance in sugar manufacture is stressed.

Betanal E overall application to sugar beet at low volume. I. Jewry *et al. Agrospray* (FBC Ltd.), 1981, (4), 8-9. Low-dosage, low-volume, high-pressure overall spraying of Betanal E contact herbicide is discussed, and advice given on type and size of nozzle, droplet size and pressure.

Freezing and sugar beet deterioration — observations and experiences in 1980. K. Bürcky. *Zuckerind.,* 1981, **106,** 232-236 *(German).* — At the onset of the first frosts in the autumn of 1980, some 40% of the beets planted in West Germany were still unharvested, and in some regions suffered considerable damage. Observations on the beet during the frosty period and the subsequent period of warm weather are reported. Apart from the low temperatures (down to $-7^{\circ}C$), other factors such as soil moisture, plant population, leaf mass, wind speed, etc. were decisive as regards beet freezing. The changes in beet tissue caused by frost are similar to those observed with marked moisture stress, while frozen beets are particularly susceptible to injury, so that they should only be harvested if they are to be processed straight away, without any intermediate storage. The results of a model test are discussed, in which the effects on beet sugar content of temperature during a frost period and of storage duration and temperature after such a period were investigated.

Advice on sugar beet sowing. R. Vanstallen and A. Vigoureux. *Le Betteravier,* 1981, **15,** (151), 13-16 *(French).* — Advice is given on seedbed preparation, sowing, inter-seed spacing, calculation of the area sown and of the seed sown per ha, choice of drill, and use of micro-granulators.

BEET BREEDING AND VARIETIES

Varietal trials with sugar beet seed in 1979. L. Schmidt *et al. Listy Cukr.*, 1980, **96**, 25-33 *(Czech)*. – Trials are reported in which 20 varieties (16 of them imported) were grown at six small sites, while another trial was conducted with 24 varieties (seven of which were not included in the small-plot trials) on a larger scale. Highest root yield was obtained with Geem 65 (a West German variety), while a Danish variety, Ultramono, had the highest sugar content. Highest sugar yield per ha was given by Dobrovická A (grown on almost 97% of the beet area of Czechoslovakia), while Primahill (another West German variety) gave the highest white sugar recovery.

The technological and economic value of monogerm sugar beet varieties. J. Trzebinski. *Gaz. Cukr.*, 1980, **88**, 19-21 *(Polish)*. – From a 3-year trial with Polish mono- and multi-germ varieties, it is concluded that the former are of lower sugar content and yield less white sugar but are higher root yielders. Since, during a long campaign, the value of a given variety does not solely lie in its sugar yield, it is recommended to aim at increasing the sugar content of monogerm varieties which, although requiring special agronomic practices and use of special machinery, need less labour, which could be of importance in the future.

Correlation between iso-enzymatic polymorphism and technological parameters in sugar beet of different states of ploidy. P. Spettoli, A. Bottacin and G. Cacco. *Ind. Sacc. Ital.*, 1980, **73**, 13-17 *(Italian)*. – Specific activities and iso-enzyme multiplicities of five enzymes were examined in a diploid, a triploid and a tetraploid sugar beet variety. Subsequently, 60 roots each of a diploid and a tetraploid variety were analysed. The two varieties showed high enzyme polymorphism, and several sub-varieties with similar iso-enzyme profiles were identified within each ploidy status. Fresh weight and sugar content showed good correlation with glutamic dehydrogenase, acid phosphatase and esterase activities in all diploid and tetraploid sub-varieties; by contrast, comparison between roots of different enzyme multiplicity failed to show any correlation. The results showed that some enzyme activities can be related to a single character only within samples endowed with the same enzyme polymorphism.

Results of comparative trials of sugar beet varieties in Belgium from 1977 to 1979. N. Roussel, R. Vanstallen and W. Roelants. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1980, **48**, 5-56 *(French, Dutch)*. – Tabulated results of trials at six locations in 1979 (involving 37 varieties obtained from 15 commercial sources) are discussed, and the average results obtained for the 3-year period 1977-79 are reported.

Comparative trials on 12 varieties in 1979. L. Lukacs, F. Pocsy and J. Zana. *Cukoripar*, 1980, **33**, 121-124 *(Hungarian)*. – Beet varietal trials, in which Beta Monopoli N.1. was used as standard, are reported.

Trials of commercial varieties of sugar beet. D. Kimber and S. McCullagh. *British Sugar Beet Rev.*, 1980, **48**, (3), 33-35. – An account is given of trials at the National Institute of Agricultural Botany on their current recommended list of beet varieties, with details of plant populations, root yields, sugar yields, sugar contents, impurities, bolters and seedling emergence achieved in 1979 by comparison with figures for the two previous years.

The leaf system – yield-limiting factor in sugar beet agriculture? M. Dambroth and A. Bramm. *Die Zuckerrübe*, 1980, **29**, (5), 42-43 *(German)*. – The effect of beet leaf growth on root development and sugar content is discussed. While growth of a canopy prevents sunlight penetrating to the lower leaves, greenhouse trials showed that beets having an artificially restricted leaf system were smaller and contained less sugar than those having a natural leaf growth. The relationship between plant population, leaf growth and dry mass is examined; trials showed that increase in plant population density was accompanied by a fall in leaf area performance (g of dry mass per m^2 of leaf area), although plants having 6-8 leaves produced almost double the quantity of dry solids formed in untreated controls because of the increased competition for sunlight to which the controls were subjected. Plant population affected the relationship between the weight of the individual roots and the optimum number of leaves for that weight and sugar content; at lower population densities, the control plants were superior to those with reduced leaf systems, whereas at higher densities the reverse was true. As regards sugar content, the controls were always superior to the leaf-restricted beets, the sugar content in which rose, however, with increased population. The answer to the problem of excessive leaf growth lies with the breeder, it is stated; changes in agricultural practices would not provide a solution.

Results of sugar beet varietal trials. N. Roussel and W. Roelants. *Le Betteravier*, 1980, **14**, (148), 13-16 *(French)*. – Results of beet varietal trials at six locations in Belgium in 1980 are reported, and average results tabulated for the 3-year period 1978-80 (covering sugar and root yield, sugar content and gross return). Field emergence figures are also given for 1977-80.

Increases in sugar beet performances – what is to be expected from breeding? E. Kesten. *Die Zuckerrübe*, 1981, **30**, (1), 44-45 *(German)*. – Since 1950, beet sugar yields in West Germany have risen by an average of 70 $kg.ha^{-1}$ annually. This is attributed to a number of factors, including the growing of better varieties and new types of seed. Future improvements that can be expected as a result of breeding work are indicated, and modern breeding techniques described. It is stated that problems can arise where varietal modifications in one direction may adversely affect other parameters.

High-quality sugar beet seed. C. Hall. *British Sugar Beet Rev.*, 1981, **49**, (1), 71-72. – Developments in beet seed production, processing and testing in the UK are surveyed.

Sugar content and problems of sugar beet selection. V. A. Panin. *Sakhar. Prom.*, 1981, (4), 41-46 *(Russian)*. The beet varietal situation in the USSR, where both sugar contents and processing qualities have been falling in recent years, is discussed, and references are made to the results obtained in West European countries. The need for varieties of required standards is stressed.

CANE SUGAR MANUFACTURE

Extracting sugar from molasses. J. V. López-Oña. *Sugar J.,* 1981, **43,** (8), 7-9. — Massecuite curing by natural drainage (used for muscovado sugar manufacture) and by artificial drainage using centrifugals is described and the development of the centrifugal briefly surveyed.

Influence of higher imbibition on bagasse. R. Jawaharlal. *Coop. Sugar,* 1980, **12,** (3), 127-129; through *S.I.A.,* 1981, **43,** Abs. 81-349. — At an Indian factory, imbibition was increased to 180-200% on fibre and divided between the last two mills. This increased mill extraction and did not lead to slippage nor to an increase in moisture content of bagasse.

Biomass fuels dehydration with industrial waste heat. W. O. Young. *Sugar J.,* 1981, **43,** (9), 13-16. — Reasons for drying fuel are discussed and brief descriptions given, with the aid of diagrams, of a direct-fired rotary dryer with exhaust gas recycle and of a waste heat fuel dryer incorporating a positive air system; both schemes are applicable to bagasse handling. Also mentioned is a scheme based on a high-pressure boiler, in the furnace of which is burnt extra bagasse made available by steam economies; the additional steam is run through a condensing turbine to generate power for sale to the public utility. Additional heat for the system could be supplied by pre-drying the bagasse or recovered from the boiler waste gases.

Steps to minimize sugar losses. A. Jagannatham and M. R. Reddy. *Maharashtra Sugar,* 1981, **6,** (4), 9, 11-13. Causes of sugar losses in the field and in the factory are surveyed and means of reducing them indicated.

The "Central University" clarifier. P. M. Fabregat P. and A. P. Nikolaev. *Centro Azúcar,* 1980, **7,** (3), 3-21 *(Spanish).* — A clarifier designed under the sponsorship of the Central University of Las Villas comprises an insulated tower housing two cone trees, each consisting of a central pipe and 29 cones mounted on it with apertures under each cone for passage of clear juice. The top of the pipes feed clear juice into a horizontal pipe and so to an overflow box. At the bottom of the tower are two sets of four triangular plates which form pyramidal sumps into which mud collects and is transferred to a discharge pipe. The muddy juice feed is via a horizontal pipe into the space between the bottom of the cone trees and the sumps. Pilot- and industrial-scale models of the clarifier have been built and tested, the latter against Dorr clarifiers. The new clarifier can produce clear juice of satisfactory quality with a residence time of the order of 50 minutes, and costs appreciably less to build than other models.

Probability of influence of some agrotechnical factors on the composition of juices in the stages of the purification process. L. Gómez R., P. M. Fabregat P., A. P. Nikolaev, S. Cepero, J. Hernández and M. Marrero. *Centro Azúcar,* 1980, **7,** (3), 43-54 *(Spanish).* — Cane of three varieties was processed and analyses performed of mixed juice, limed juice, clarified juice, filtrate and filter cake, determining Brix, pol, apparent purity, reducing sugars, non-sugars, insolubles, sucrose and pH, and then relating these to a number of factors — variety, age, type of soil, maturity index, irrigation, method of harvesting, time of year, etc. The probability of significant influence of the various factors on the juice characteristics is presented in a series of tables.

Study on the advantages of vapour bleeding from a quadruple-effect and its influence on the heat balance of an industrial unit. R. de los Rios C. *Centro Azúcar,* 1980, **7,** (3), 55-62 *(Spanish).* — A heat balance is worked out for a quadruple-effect evaporator with and without bleeding of first effect vapour for juice heating. The savings are calculated in terms of fuel oil for those circumstances where all bagasse is used for paper making and the steam raising is by means of oil.

Determination of microbial losses in the tandem by spontaneous fermentation. M. T. Hernández N., M. E. Pérez R., R. Sánchez M. and R. Sánchez P. *Centro Azúcar,* 1980, **7,** (3), 63-87 *(Spanish).* — The pH and temperature of juices in a milling tandem are almost ideal for spontaneous fermentation, and a study of such fermentation is used to calculate the loss of sugar which could occur. It is considered that the losses are such that disinfectant should be applied in order to reduce them, even if the cost of the disinfectant were such as to balance the value of the sugar lost.

Optimum control of the sugar crystallization process. H. Ferrera F., M. Rodríguez B. and A. Casteleiro H. *Centro Azúcar,* 1980, **7,** (3), 89-95 *(Spanish).* — The control system developed for a batch pan boiling A-massecuite governs the syrup flow and steam temperature so as to keep the supersaturation approximately constant at a predetermined value. An optimization program was used, based on Montryagin's Maximum Principle, and the results obtained with a particular pan offer the possibility of developing more complex control algorithms and the use of other optimization criteria.

Automatic differential bridge for crystal content. F. Pantuso N. *Centro Azúcar,* 1980, **7,** (3), 119-126 *(Spanish).* — The use of a differential conductimetric bridge for determining the crystal content of massecuite in a vacuum pan is discussed and a commutator circuit described for an automatic bridge which permits adjustment of the latter to initial conditions at the start of each strike. Experimental results with a KCM2 instrument from the USSR are described.

The application of microprocessors as a control means in the sugar industry. F. Herrera F. *Centro Azúcar,* 1980, **7,** (3), 127-134 *(Spanish).* — A general description is given of microprocessors and suggestions made for their application to cane mills, juice purification, crystallization and centrifugals.

Total energy. V. J. Bailliet. *Sugar J.,* 1981, **43,** (10), 12-13. — Before 1950, most Louisiana sugar factories operated natural-draft boilers which generated steam of adequate pressure and in sufficient quantity to drive the factory equipment with only a minimal demand for supplementary fuel and outside electricity. Progressive replacement of steam engines with turbines as cane mill drives, coupled with power demands for equipment to reduce environmental pollution, led to a power imbalance, with increased purchase of electricity to drive

electric motors and increased burning of supplementary gas. The considerable rise in the prices of gas and electricity makes it desirable to minimize or possibly eliminate the dependence on outside energy, and the author describes means by which this could be accomplished.

Analysis of the use of basic funds in the "Ciudad Caracas" sugar enterprise. O. Santín C. *Centro Azúcar,* 1980, **7,** (3), 135-145 *(Spanish).* — An economic analysis is given of the capital investment involved in the title sugar factory and the changes between 1974 and 1976, with a note on the indices used to gauge capital utilization, and reserves.

Potash: potential profits or problems. M. A. Clarke. *Sugar J.,* 1981, **43,** (10), 18. — Reference is made to the problems encountered in Louisiana sugar factories in 1980 as a result of high levels of ash, particularly potassium. It is pointed out that, while potassium applied as fertilizer may induce increased cane sugar content, it will also increase molasses purity and processing difficulties and not give any extra sugar in the bag. The mechanism by which potassium reduces the size of sugar crystals as well as sugar recovery and increases molasses purity is explained, and mention is made of boiling tests in which 5-10% KCl was added to syrups, resulting in increased massecuite viscosity (especially at lower temperatures), low sugar crystal yields and very high purity run-offs. So much sugar was left in the mother liquor that a second crop of crystals (greater in weight than than the actual strike) formed as the mother liquor cooled. Graining was difficult and necessitated raising the Brix, and the seed sugar dissolved. With temperature rise, the solubility of the potassium-sucrose complex formed increased more sharply than that of sucrose alone. The salting-out effect of potassium resulted in large quantities of sludge in molasses diluted for analysis.

Profile of a wash pond. D. F. Day. *Sugar J.,* 1981, **43,** (10), 27-28. — More stringent regulations on environmental protection have forced sugar factories in Louisiana to recycle all of the cane wash table water, which has led to wash table corrosion because of the high BOD. An analysis was made of the sugar losses in cane washing at Cora Texas factory, and showed that the total monetary loss represented by the sugar and replacement of carrier chains was $453,700 in 1980. In the presence of oxygen, sugar degrades to CO_2 and water, while the presence of insufficient oxygen leads to formation of CO_2 and organic acids, providing a corrosive environment. Consequently, aerators were installed at the factory in question, but failed to reduce the BOD. Comparison with another factory using an identical aeration system, which has proved successful over a number of years, showed that the Cora Texas pond contained insufficient water to allow the necessary time for aeration, which is a cure for wash pond acidity only where the pond is large enough.

Considerations for efficient operation of sugar mills. F. Leech and J. Radovich. *Sugar y Azúcar,* 1981, **76,** (5), 33, 36. — While the square mill coupling is the most common method of connecting the low-speed gear reduction unit to a cane mill, the design of the coupling is such that high loads can be developed on the output shaft and output bearing on the speed reducer as a result of high top roller float. However, correct operating procedures will ensure that these loads are kept to a minimum. The effect of coupling arrangement on the loads is demonstrated by diagrams. Too high a top roller float could also have an adverse effect on the gears by loading the low-speed output shaft bearing (which has an inbuilt diametral clearance) in opposite directions and thus misaligning the gear mesh zone. Hence, to minimize the effect of the mill coupling, the top roller float should be controlled so that it is close to the physical offset of the roller to the output shaft on the low-speed reducer when the mill is running empty; if more than 10% extra cane is expected, roller settings and/or speed must be increased so as to maintain a correct top roller float, while the input horsepower must be controlled so as to keep the transmitted power within the design limits of the gear reducers.

The merits of excess bagasse as fuel for generating electricity. P. Perea. *Sugar y Azúcar,* 1981, **76,** (5), 42-43, 46. — A power generating system is described which can be installed to operate in conjunction with an existing factory system. In it, all the excess bagasse as well as some of the bagasse that is normally burnt, is used as fuel for steam generation in new high-pressure boilers. The steam passes to a turbo-generator equipped for automatic extraction and condensing. Since steam from the turbo-generator is of the same pressure as that from the existing high-pressure boilers, the two can be merged. The automatic extraction system allows the turbo-generator to operate continuously, regardless of the total quantity of steam required for factory operation at any given time. If the steam demand increases, the supply to the condenser is reduced and that to process increased, and vice versa. By this means, the plant can generate about 40% of its total installed electrical capacity even when no excess bagasse is being burnt. A cooling tower incorporated in the scheme can operate at 50, 75 or 100% of its capacity, its operating level being determined by the amount of steam going to the condenser and by atmospheric conditions. It has two compartments, each provided with a fan driven by a two-speed motor, while two centrifugal pumps for cooling water recirculation to the condenser can work individually or in parallel according to the load. Fuel oil may be burnt during the "dead" season or in emergency, provided the economics justify it. The system is calculated to generate about 788 kW of electricity per tonne of bagasse burnt, after subtracting the internal consumption of the boiler and turbo-generator auxiliaries.

Width of approach or depth of study? S. G. Kara-Murza. *Khim.i Zhizn',* 1979, (9), 14-18; through *S.I.A.,* 1981, **43,** Abs. 81-692. — Explosions of sugar dust and of large quantities of molasses have long been known, but raw sugar was thought to be safe until 1975, when a large heap of cane sugar (long stored because of the low value on the world market) suddenly blew off its top and gushed a dark semi-liquid, leaving a blackened sugar unfit for use. Cuban studies on darkening have indicated the cause and a simple method of prevention. The traditional process yields sugar whose surface film is acidic; in such conditions the Maillard reaction is autocatalytic and after a critical time will suddenly accelerate to catastrophe. If the film is made alkaline, the products of Amadori rearrangement are stable, while monosaccharide degradation will give buffering salts rather than free saccharinic acids. The change requires only a handful of NaOH per tonne of sugar, added between the evaporation and pan stations. The sugar obtained is initially darker but can be stored for a very long time before any colour increase occurs.

BEET SUGAR MANUFACTURE

Crack detection in centrifugal baskets. F. W. Meyer. *Zuckerind.*, 1981, **106**, 215-219 *(German)*. — After a fatal accident involving a centrifugal at a West German sugar factory, all machines were tested for basket material durability under the effect of operational stress and corrosion. Since it was found that repeated tests are necessary, the question arose as to whether methods other than the non-destructive tests used for sugar centrifugals could be applied. Details are given of the eddy current method, and its advantages and disadvantages are discussed. This method is based on the eddy current created in a conductive body to which an alternating magnetic field is applied. Where defective points occur, the eddy current must make a detour, and this is detected on a screen depicting the magnetic field. The data provided by this method are found to be much more accurate than those given by the ferromagnetic dust technique.

Effect of pile temperature on sucrose loss during sugar beet storage. P. V. Schmidt. *Lebensmittelind.*, 1981, **28**, 123-125 *(German)*. — The effect of pile temperature on sugar losses is discussed. For a temperature range of 3-10°C an empirical equation is presented; calculated values agreed with only one out of eight sets of experimental values, this being attributed to the fact that the equation and the values obtained by Vukov were based on measurements made on actual beet piles, whereas the other seven sets of values were obtained by laboratory analyses. The pre-storage of beets in clamps may have a marked adverse effect on losses in factory yard piles, even at low temperatures, e.g. in the case of beets of high reducing matter and conductivity ash contents. The changes in composition that take place during beet storage and their association with molasses losses and formation are discussed, and a number of equations based on data from the literature are developed for molasses sugar as a function of reducing matter and for sugar yield loss as a function of pile losses, reducing matter and storage temperature.

Effect of air temperature during the campaign on sucrose loss in stored beet. P. V. Schmidt and B. Senge. *Lebensmittelind.*, 1981, **28**, 125-129 *(German)*. — Investigations are reported in which the effects of ranges of air temperature from below −1° to above +20°C during October-December on stored beet were examined. The frequencies at which these ranges of temperatures occurred as measured on an hourly basis were established in sample 5-day periods. The dependence of pile temperature on the ambient temperature was also investigated, and hence the sugar losses determined as a function of air temperature and, indirectly, as a function of the time at which the beets were first piled and the length of the storage period. It is shown that the losses over a 60-day period in a pile first formed between October 11 and 15 were double those over a 40-day period where the beets, of comparable condition, were piled between November 1 and 5.

Methods of preventing rotting of frozen beet. L. Urbanowicz. *Gaz. Cukr.*, 1980, **88**, 249 *(Polish)*. Trials in which frozen beet were stored for 10 days at an ambient temperature of up to +6°C showed that spraying with 1% Sanspor (of UK origin) allowed the beets to remain hard and dry without any slime or fungus, while spraying with a Polish preparation, Kamin, at 1% concentration gave almost the same root condition with only very slight fungal growth on the crowns, whereas the untreated controls underwent marked degeneration, with a coating of slime and fungal growth. The sugar contents were highest after Sanspor treatment and lowest in the control, while the invert sugar contents were lowest after Sanspor treatment and highest in the control. Another Polish preparation, Sterniol, was not as effective as the two mentioned above — a 2% concentration gave only a slightly higher sugar content than in the control, while a 1% concentration still gave only a 1 unit higher content than without treatment; with both concentrations the invert sugar contents were higher than in the control.

Effect of the nitrogenous compounds in raw material on the stability of sugar juices. I. Oglaza, M. Zero and E. Walerianczyk. *Gaz. Cukr.*, 1980, **88**, 250-251 *(Polish)*. Over a number of years there has been a considerable fall in alkalinity of juices during evaporation, leading to processing difficulties and increased sugar losses; it has been attributed to increased degradation of amides during purification and evaporation. The content of nitrogenous compounds in beet is highly dependent on farming practices, even under identical soil and climatic conditions, and the concentration of α-amino-N and amide N in beet grown in an experimental plot was about half that for an entire region. Considerable variation occurs in the amide and ammonia N contents in cossettes and juices in the same factory during a campaign and from one year to the next, and between factories. The effect of process parameters on amide degradation is demonstrated by the differences between values obtained for thin and thick juice in the factory and in a laboratory. By comparison with conventional carbonatation, a scheme in which 1st carbonatation juice was heated for 20 minutes at 98°C before 2nd carbonatation gave a lower degraded amide content in thick juice and a smaller change in pH during evaporation, while liming 1st carbonatation juice with 0.2% CaO on juice and heating for 3-20 min before 2nd carbonatation gave an even lower content of degraded amide in thick juice and the same pH change as with heating 1st carbonatation juice alone.

Tests on use of new disinfectants in the sugar industry. K. Mossakowska. *Gaz. Cukr.*, 1980, **88**, 252 *(Polish)*. Bactericidal tests are briefly reported, in which seven disinfectants based on halogen compounds were added in concentrations up to 0.1% to beet wash water; the range of percentages of bacteria destroyed after 10 minutes was determined for each concentration. The results are tabulated.

Waste water treatment. J. P. Lescure and P. Bourlet. *Sucr. Franç.*, 1981, **122**, 141-143 *(French)*. — While anaerobic treatment of beet flume-wash water is highly efficient in eliminating dissolved organic material by destroying the chains of carbon atoms, the treated water is still unsuitable for discharge or recycling because of its hardness and nitrogen content. The water is very hard because of dissolution, by organic acids in it, of some of the Ca carbonate in the soils with which it

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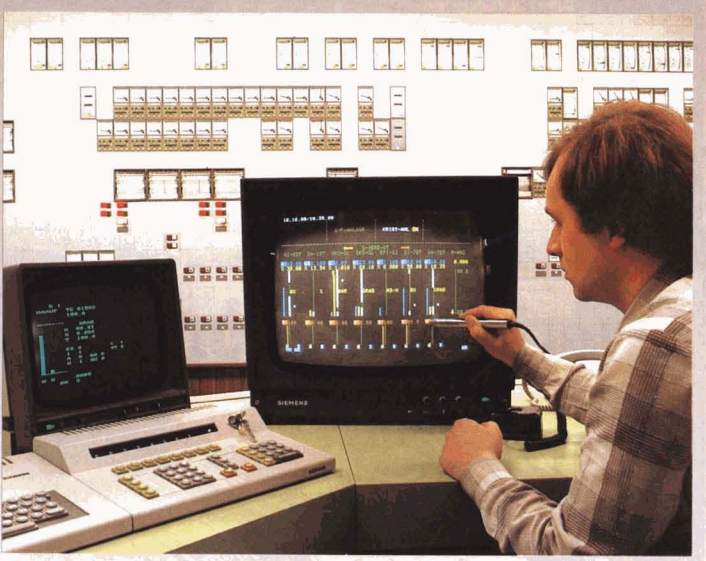

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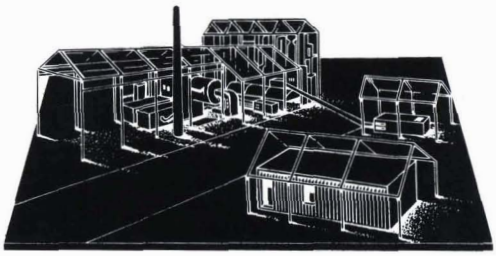

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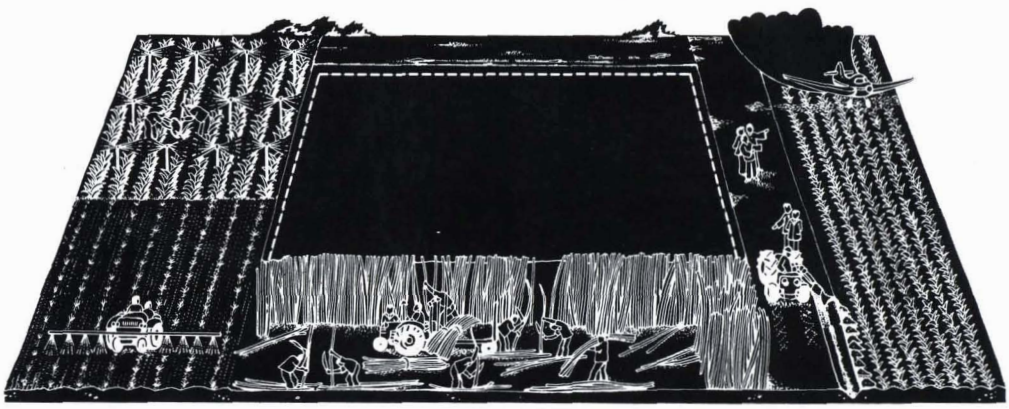

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is in contact. Anaerobic treament produces CO_2 which, in supersaturation, allows most of the Ca to be maintained in the form of soluble bicarbonate, only 10-15% of the Ca being retained in the mud as carbonate. When the water leaves the tank, it loses its supersaturated CO_2 and in so doing becomes a major source of incrustation. Tests have shown that the hardness diminishes naturally during storage, but that this stabilization is very slow and incomplete, so that such storage is of no value industrially. The release of dissolved CO_2 by mechanical or thermal means prevents recycling of the water; addition of lime is one answer to the problem, but requires high capital investment and consumes both energy and 700 g of CaO per tonne of beet. On the other hand, if the treated water is mixed with wash water, the hardness will improve foam dispersion and thus reduce the need for anti-foam agents. Anaerobic treatment produces ammonia by deamination of the amino-acids to volatile fatty acids. If the water is discharged onto the land, soil bacteria will oxidize the ammonia N and thus make it immediately utilizable by crops. However, if the water is discharged by surface means, the ammonia N is harmful and should be oxidized or completely eliminated. Oxidation produces mud, but only at a slow rate, so that a protracted time is necessary with a prolonged period of nitrification by aeration. Details are given of a biological oxidation system which embodies an ascending-stream reaction vessel. Studies have shown that treated water yields of 99% are obtainable following 9 minutes' contact at 22°C.

Tests and investigations of the performance of a PSW-100 (beet) pulp press installed at Opalenica sugar factory. K. Suliga. *Gaz. Cukr.*, 1980, **88**, 252 *(Polish)*. Brief mention is made of tests on the title press, which gave a dry solids content of 17.2-19.2% at a rating of 38.5-48 kW and a throughput equivalent to 552-1190 tonnes of beet per day.

A gravity-fluidized bed dryer for sugar (tests on an industrial prototype). Z. Gawrzynski, R. Glaser, A. Jezowska, J. Jurkiewicz, K. Mojzych and M. Styczynska. *Gaz. Cukr.*, 1980, **88**, 262-266 *(Polish)*. Details are given of a sugar dryer which incorporates a vertical chamber housing a series of rotating horizontal discs mounted on a central shaft and of increasing diameter from top to bottom of the chamber. At its lower end this chamber has an inclined, perforated screen through which warm air is blown. The sugar passes down over this screen as a fluidized bed and follows a path around the end of the screen to fall onto another screen (which is horizontal) and thence down a chute into a cooling chamber. At a throughput of about 10 tonnes.hr^{-1}, sugar moisture was reduced from an average of 0.4% to 0.025-0.045% at an air temperature through the screens of 79.5°C. The effect of air temperature variations on performance is discussed.

Application of electrodialysis to sugar factory products. The additives. J. C. Giorgi and R. Gontier. *Sucr. Franç.*, 1981, **122**, 145-147 *(French)*. — When a 40°Bx *B*-syrup was treated by electrodialysis, the rate at which K was extracted slowed and the amount extracted reached a maximum, even though the conductivity remained high and the residual K content was still appreciable. This was attributed to blockage of the membranes by anions of high molecular weight. Studies were therefore carried out to find suitable additives for reduction of molasses sugar. Addition of 40% HCl (% moles of K^+) failed to have the necessary effect; in fact, the residual ion content after demineralization was 4% higher than it would have been without HCl addition. Addition of $MgCl_2$ at 40% (Cl^- % moles of K^+) permitted a K extraction rate double that without the chlorides and thus produced an effect similar to the Quentin process; further studies are to be made on this basis.

Aided management of the three strikes in the pan station. G. Windal and A. Deleurence. *Sucr. Franç.*, 1981, **122**, 153-154 *(French)*. — Further investigations have proved the value of a computer program (using FARANDOLE) for the simultaneous control of three pans at Artenay sugar factory during the last two weeks of the 1980 campaign. However, analysis of the performance of the system over the entire 1981 campaign is considered important in order to confirm the results. Moreover, the system is to be extended to the continuous low-grade centrifugals.

Removal of soil introduced into the sugar factory with beets. S. Vermes. *Cukoripar*, 1981, **34**, 28-30 *(Hungarian)*. The problem of increasing dirt tare and the costs of handling the excess soil are discussed and mud dewatering equipment briefly described.

Increasing the efficiency of carbonatation by salt ion exchange. M. I. Daishev, T. P. Trifonova and P. P. Zagorodnii. *Izv. Vuzov, Pishch. Tekh.*, 1981, (1), 86-88 *(Russian)*. — The mechanism of non-sugars adsorption by $CaCO_3$ is explained, and the possibility of increasing the extent of adsorption examined. Two approaches are described: (1) exchange of some of the cations (primarily K^+ and Na^+) for Ca^{++} so as to provide the $CaCO_3$ nucleus with a greater charge and hence thicker layer of opposite-charge ions (non-sugar anions) as well as increasing the amount of $CaCO_3$ formed, and (2) exchange of at least some of the monovalent anions (primarily those of pyrrolidone carboxylic, lactic and acetic acids) for multivalent anions, e.g. SO_4^{--} so as to obtain a layer of opposite-charge ions that is better retained by the $CaCO_3$, resulting in a greater number of irreversibly adsorbed anions. Trials were carried out in which 60°Bx molasses was passed through cation exchange resin in Ca^{++} form and anion exchanger in SO_4^{--} form at a 1:1 v/v ratio and room temperature. This was followed by 10 minutes' liming at 80°C and a lime dosage in the range 2-20% CaO on weight of sugar, and then gassing with CO_2 to pH 8.5-9.0. In all cases, ion exchange improved the subsequent liming and gassing efficiency, slightly better results being obtained where passage through the anion exchanger came first; treatment with the anion exchanger on its own gave an increase in efficiency which at best was intermediate between the control and the most effective treatment, while treatment with the cation exchanger alone gave an overall efficiency which was halfway between that given by the control and treatment with the anion exchanger.

Filtration of standard feed with centrifugal disc pressure filters in the sugar industry. W. Schult and D. Schoppe. *Lebensmittelind.*, 1981, **28**, 209-214 *(German)*. — A vertical disc filter of East German manufacture is described which has undergone major modifications and tests at Delitsch sugar factory. The horizontal discs, mounted on a central shaft, are rotated to remove mud from the cloths. The filter is designed for polish filtration of standard liquor, wash liquor and melted *B*-sugar in white sugar manufacture.

LABORATORY STUDIES

Spectrophotometric studies on the complexes of metal ions with caramel. S. K. D. Agarwal and V. Gupta. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.9-G.14. — The evidence of complex formation by interaction of caramels, obtained by heating sucrose and glucose, with Cu^{++}, Cd^{++}, Ni^{++}, Co^{++} and Zn^{++} is discussed. The evidence is based on spectrophotometric measurements of absorption maxima in the presence and absence of caramel.

Identification of volatile constituents responsible for characteristic molasses aroma by unconventional gas chromatography. M. A. Godshall, E. J. Roberts and M. G. Legendre. *J. Agric. Food Chem.,* 1980, **28,** 856-858; through *Anal. Abs.,* 1981, **40,** Abs. 3F26. — The molasses sample (100 to 300 mg) is coated onto a glass rod, which is wrapped in glass wool and placed in a glass holder in the external inlet system[1] of a gas chromatograph. The volatiles are liberated by heating the inlet at 135-145°C and are swept by He (the carrier gas) to the head (cooled at 30°C) of the stainless steel GLC column, which is packed with Tenax-GC (35-60 mesh) coated with 6% of poly-MPE and temperature-programmed from 30° to 210°C at $4°C.min^{-1}$; flame ionization detection is used. Compounds are identified on the basis of retention time, peak enhancement, sensory evaluation and mass spectrometry. For gas chromatography-mass spectrometry, Tenax-GC coated with 6-7% of poly-MPE is used, and the chromatograph is interfaced via a silicone-membrane separator to a mass spectrometer operated at 70eV and with scanning from 21 to 350 atomic mass units in 2 seconds. Twenty-three compounds have been identified. Use of a Vigreux column for low-hold-up distillation of a 50% solution of molasses shows that seven of these compounds are responsible for the typical aroma. Dimethyl sulphide has been identified as a major contributor to this aroma.

Gas-chromatographic separation and identification of organic acids in beet molasses and date syrup. A. Amin. *Nahrung,* 1980, **24,** 697-711; through *Anal. Abs.,* 1981, **40,** Abs. 3F27. — Non-volatile N-free organic acids were isolated by ion exchange chromatography on Amberlite IR-120 and IRA-400 resin[2] and esterified with thionyl chloride-methanolic HCl[3]. The methyl esters were analysed by GLC on temperature-programmed columns (5 ft x 0.125 in) packed with 20% of DEGS on Chromosorb W and with 3% of SE-30 on Varaport 30. The acids (lactic, malonic, succinic, glutaric and 2-oxoglutaric) were identified, with use of model mixtures, by correlations between molecular weight, C number and boiling point.

A pressure method for measuring the filtration coefficient F_k. J. Grabka. *Gaz. Cukr.,* 1980, **88,** 205-206 *(Polish).* — A description is given of a micro-filter and its application to measurement of the filtration coefficient F_k at a pressure in the range 53-400 kPa. Results are tabulated for kaolin solutions of 2-3% solids content. Reproducibility of the results was improved by the presence of a tube extending below the filter and preventing the precipitated muds from being washed away.

Determination of Brix in cane juice using the automatic refractometer, the Abbé refractometer and the digital densimeter. J. A. Weber. *Brasil Açuc.,* 1980, **96,** 396-398 *(Portuguese).* — Comparative tests showed that the electronic densimeter was more precise (± 0.01°Bx) than the automatic refractometer (± 0.03°Bx) and the Abbé refractometer (± 0.05°Bx).

The mechanism of the action of added oxidizing agents in desorption of colouring matter from AV-17 polymeric anion exchangers. M. V. Rozhkova, V. I. Tyagunova and G. A. Chikin. *Sakhar. Prom.,* 1981, (3), 35-39 *(Russian).* — MR-500 and AV-16-2P highly basic anion exchange resins based on styrene and divinylbenzene were treated with varying concentrations of sodium hypochlorite after the resins had been saturated with colouring matter adsorbed from beet sugar factory products (MR-500) and refinery products (AV-17-2P). By comparison with 10% NaCl + 0.2% NaOH, 1% NaOCl after each of six cycles desorbed more colouring matter; hence, batchwise treatment with hypochlorite is recommended. The mechanism of regeneration with oxidizing agents is explained on the basis of further investigations involving treatment of caramels, melanoidins and products of invert sugar alkaline degradation with NaOCl.

Dextran problems in sugar refining: a critical laboratory evaluation. C. C. Chou and M. Wnukowski. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 1-25. A modified Nicholson & Horsley method for determination of dextran in raw sugar[4] has been tentatively adopted by ICUMSA as its official method[5]. The procedure used for dextran analysis is examined in detail, and results of intra- and inter-laboratory collaborative tests reported. Excellent correlation was found between the apparent rise in raw sugar pol and dextran concentration ($r = 0.98$), supporting the hypothesis of the effect of dextran on raw sugar pol, while the haze method appeared to give good approximation of raw sugar dextran content (within ± 3% in intra-laboratory tests and ± 10% in inter-laboratory studies); investigation of reproducibility showed that, with two exceptions, the results fell within expected experimental error. In most cases, the threshold dextran concentration in raw sugar, at which the refiner would incur extra expenses, was found to be 300 ppm. Investigation of refining processes (affination, filtration, phosphatation with and without surfactant, carbonatation, treatment with bone char and active carbon, and boiling) showed that most of them were ineffective in removing dextran. The problems caused by dextran are described.

Isolation and identification of constituents contributing to odour and flavour in syrups and brown sugars. M. A. Godshall and E. J. Roberts. *Proc. 1980, Tech. Session Cane Sugar Refining Research,* 26-49. — Six commercial brands of light brown sugar from refineries using bone char decolorization were analysed as well as (at certain refineries) char, sweetwater off char, equipment wash water and coating syrup. Gas chromatography

[1] See Legendre *et al.: J. Amer. Oil Chem. Soc.,* 1979, **56,** 552.
[2] See Schneider *et al.: I.S.J.,* 1973, **75,** 322.
[3] See Gee: *Anal. Abs.,* 1966, **13,** 5707.
[4] Keniry *et al.: I.S.J.,* 1969, **71,** 230-233.
[5] *Proc. 17th Session ICUMSA,* 1978, 418.

and thin layer chromatography were used to analyse the volatile components and ether extracts of the non-volatile constituents and to determine acetic acid as its phenacyl ester. Compounds found in just two of the sugars are listed, and the presence or absence of catechol as a major extractable phenolic compound is indicated. The association of the various constituents with flavour and odour of a specific nature (which is shown for a number of compounds used in foodstuffs) is discussed, and those compounds contributing to brown sugar flavour are listed together with their sources.

Colour in refinery products. E. J. Roberts and M. A. Godshall. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 50-59. – No. 1 liquor, 1st, 2nd, 3rd and 4th sugars and 1st, 2nd, 3rd and 4th syrups from three refineries were analysed for colouring matter; the syrups were extracted with chloroform and the dried extracts subjected to thin-layer and gas chromatography as well as mass spectrometry, while the refined sugar solutions were filtered, centrifuged and dialysed. Colour formation was quite variable in samples from two of the refineries, so that no conclusion could be drawn as to where most colour was formed. Fourteen non-sugars were identified in 4th syrups, and some of these were possible colour precursors. The greatest amount of apparent colour (21-51%) was removed from the 50°Bx sugar solutions by a filter of 8μ porosity; 46-93% of the particles had apparent molecular weights greater than 12,000. Centrifuging at 40,000 *g* removed 30-47% of the apparent colour.

A case study of compositional and quality changes in raw cane sugar in extended storage. J. A. Hupfer and E. J. Culp. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 60-83. – Samples were taken from raw sugar (stored in bulk at two warehouses, one in Texas and the other in Florida) at points near the surface of each pile and from deep within the piles, which contained 48,000 and 145,000 short tons of raw sugar, respectively. The samples near the surface were analysed for pol, moisture, invert sugar, colour and safety factor, as were composites of the core samples taken from deep within the piles; individual core samples were analysed only for pol, moisture and safety factor. The results are discussed in detail and showed that, generally, the sugar was unimpaired by 10 months' storage as regards the pol but had suffered a significant increase in colour; this increase was much greater in the core samples than in the samples taken from near the surface. However, pockets of sugar at depths of between 120 and 140 ft were not expected to remain stable during prolonged storage; the safety factors were considered too high and, in some cases, the pol had fallen appreciably.

A study of chemical additives for use in sugar refining. R. Riffer. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 84-102. – A number of reagents were studied in the laboratory for possible use in control of colour and turbidity and for treatment of waste. Hydrogen peroxide reacts quickly with colorants in liquors and syrups at typical refining temperatures, but sodium hypochlorite was found to be a more effective decolorizer, typically reducing the colour in clarified raw liquor by 60% (with 0.03% active chlorine) and by 80% (with 0.06% active chlorine), while 0.03% H_2O_2 removed a maximum of 24% colour from a liquor of $>$ 900 initial colour content. However, hypochlorite reduced the absolute value of the zeta-potential by about 50%, while carboxylic acids formed as a result of treatment with hypochlorite can catalyse new colour formation during boiling; moreover, decolorization of liquors with resin, bone char or cationic polymers was adversely affected by hypochlorite treatment. Addition of 500 ppm cationic surfactant to liquor undergoing phosphoric acid-lime defecation gave an additional 10-15% decolorization, thus providing an overall colour removal of 40-45%. The extra decolorization appeared to be independent of liquor colour, while the surfactant also reduced colour remaining after resin treatment of clarified liquor. Addition of 500 ppm alum during raw liquor defecation also gave an additional 10-15% colour removal, even when the pH was greater than the alumina isolectric point. Alum plus cationic surfactant caused flocculation at pH $>$ 7 of sludge normally resistant to settling, while alum plus anionic polyelectrolyte was effective at pH $<$ 7. Addition of 0.25% (wet weight) powdered ion exchange resin to clarified raw liquor followed by 9-10 minutes' agitation/contact at 70-80°C gave 32.3% decolorization by comparison with 23.8% decolorization with powdered carbon, while 40.9% decolorization of a dark fraction of No. 1 liquor was achieved by comparison with 29.2% using carbon; however, powdered resin is much more expensive than carbon. The colour of washed raw liquor, clarified raw liquor and remelt liquor was reduced by 37%, 31% and about 36%, respectively, by addition of 500 ppm hydrosulphite; higher levels of additive gave only small further improvement. However, much of the colour is slowly restored by air oxidation, while reducing agents containing sulphur are reported[1] to have an adverse effect on ion exchange resins, so that treatment should be late in the refining process. While the amount of phosphate normally used for raw liquor clarification is 0.02% on sugar solids, doubling the amount used in the laboratory studies gave a further 19% improvement in colour and a 14% improvement in turbidity. However, it was not possible to determine the effect of the increased addition under refinery conditions because of interference of the large volume of floc formed with handling of clarifier mud. Phosphatation of remelt liquor with 0.02% P_2O_5 gave 19% decolorization, while 0.04% and 0.10% addition gave 24% and 27% decolorization, respectively. Milk casein and egg albumin, among polyamides examined, bisulphite and urea all had little decolorizing effect. Other additives tested were citrate and EDTA complexing agents, ascorbate (for decolorization of iron complexes by reduction of iron) and sodium lauryl sulphate as anionic detergent. Fluoride and bisulphite had no inhibitory effect on dextran formation, while cetyl trimethylammonium bromide was highly effective, although it had limited success in removing dextran from liquor when added at 500 ppm followed by defecation. Other cationic additives and alum also had some effect, although considerable fluctuation occurred in performance with washed raw liquor, clarified raw liquor and light fractions of No. 1 liquor (up to 30-40% turbidity reduction). Oxidative cleavage of polysaccharides also substantially reduced turbidity.

Some speculations on sugar crystallization. A. VanHook. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 103-113. – The basic principles of crystallization kinetics are reviewed, and the possibility of optimizing crystallizer performance examined. The influence of temperature change is particularly significant at lower temperatures where the activation energy is high, and any improvement in performance will depend on careful consideration of the temperature coefficients of growth.

[1] Moody & Thomas: *Lab. Prac.*, 1972, **21**, 632.

BY-PRODUCTS

Pilot plant trials on the treatment of distillery waste using aerobic processes. C. B. Agnihotri and K. A. Prabhu. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.15-G.25. – Details are given of trials in which treatment of vinasse with activated sludge followed by biofiltration reduced the BOD by 80-85%.

Further studies on recovery and recycle of yeast for the production of alcohol. L. R. Juneja, M. Seshayya and A. K. Mitra. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.27-G.34. – Studies showed that the fermentation time could be dramatically reduced while maintaining or even increasing alcohol yield by increasing the yeast cell concentration. Repeat use of yeast up to 10 cycles did not affect fermentation efficiency. The adverse effect of incubation temperature rise from 35° to 41°C on alcohol yield was markedly reduced by decreasing the fermentation time.

Disposal of sugar factory and distillery effluents – problems and prospects. M. G. Joshi, H. R. Apte and –. Shyamsunder. *Proc. 44th Conv. Sugar Tech. Assoc. India,* 1980, G.35-G.43. – Because of difficulties in achieving the reduction in BOD of sugar factory and distillery effluents required by official bodies and because of the considerable land and dilution water requirements in lagooning, it is suggested that vinasse be concentrated in an evaporator and mixed with sugar factory filter cake, boiler ash and bagasse to yield, after adequate storage, a potassium-rich compost.

Effect of clarification of molasses on alcoholic fermentation. D. Saigal and L. Viswanathan. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.45-G.53. Molasses treatment to remove impurities that interfere with alcohol fermentation was investigated. The most effective means proved to be addition of 0.3% v/v sulphuric acid to the 40°Bx molasses, although all the methods tested increased fermentation efficiency by comparison with the control.

An inexpensive method of pre-treatment of molasses for the distillery industry. B. D. Kapoor and A. K. Misra. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.55-G.63. – Dilution of molasses to 45°Bx with water followed by sedimentation of suspended solids proved effective in increasing the total sugar:ash ratio while considerably reducing the calcium content and thereby reducing scale formation. The wash from the pre-treated molasses gave 1% more alcohol than did untreated molasses, while the resultant marked fall in the yeast sludge ash content made it suitable for recycling as well as for use in the food and fodder industries.

Yeast screening and fermentation studies on beet molasses. S. S. Dhamija, D. S. Dahiya and M. C. Bardiya. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.65-G.73. – Laboratory fermentation tests were conducted with 30 yeast strains. Three gave vigorous fermentation, although the alcohol yields after given fermentation times were always lower with beet than with cane molasses.

Role of new technology for augmenting cellulosic raw materials for pulp and paper. M. Singh and B. B. Paul. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.87-G.97. – Reasons for poor development in India of industries, such as pulp and paper manufacture, based on bagasse as raw material are discussed, and advice is offered on ways in which problems may be overcome and sugar manufacturers induced to provide bagasse. Particular mention is made of bagasse pre-drying to enhance its fuel value and thereby reduce consumption in the sugar factory. The economics of bagasse pulp production are examined.

Alcoholic fermentation of molasses using immobilized yeast. M. Seshayya, L. R. Juneja and A. K. Mitra. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.103-G.109. – Experiments were conduced on yeast immobilization by a simple process using a polymeric material as support. Use of the yeast for alcohol fermentation of molasses reduced the fermentation time considerably by comparison with conventional fermentation, while overall recovery was better. However, CO_2 accumulation in the bio-reactor reduced the working volume and cell activity, and further studies are needed to develop a suitable gas venting system.

Oxalic acid from deionized sugar cane juice. K. C. Gupta, S. K. Suri and S. Bose. *Proc. 44th Ann. Conv. Sugar Tech. Assoc. India,* 1980, G.119-G.125. – Addition of 250 ml nitric acid to 100 g deionized cane syrup of 70°Bx yielded 1.83 moles of oxalic acid per mole of hexose; purity of the acid was 99.5%. A maximum of 34.4% of the nitric acid was recovered.

The sulphate delignification of bagasse. I. The effect of sulphidity on the course of delignification and defibration. E. B. Gonzales, M. Kosik, J. Brabec and J. Farkas. *Cellulose Chem. Tech.,* 1979, **13,** (6), 763-767; through *S.I.A.,* 1981, **43,** Abs. 81-571. **II. The effect of sulphidity on physical properties of pulps.** *Idem ibid.,* 1980, **14,** (1), 75-79; through *S.I.A.,* 1981, **43,** Abs. 81-572.

I. Wet depithed bagasse was cooked at 140° or 160°C with an active alkali level of 8, 14 or 16% and sulphidity 0 or 25%. Results obtained are shown in graphs. In each case the yield of pulp decreased rapidly during the first 15 min, then remained nearly constant. The final yield depended mainly on the active alkali level and temperature; increasing the sulphidity was beneficial only at the lowest active alkali level. Under these conditions it also gave better defibration at the same yield.

II. Bagasse pulps were prepared using an active alkali level of 8, 11 or 14% and a sulphidity of 0 or 25%. Values of the elongation, breaking length, bursting strength and tear strength are shown in graphs. In general, all the properties were better at a sulphidity of 25%, and sulphidity had a greater effect at lower alkalinities.

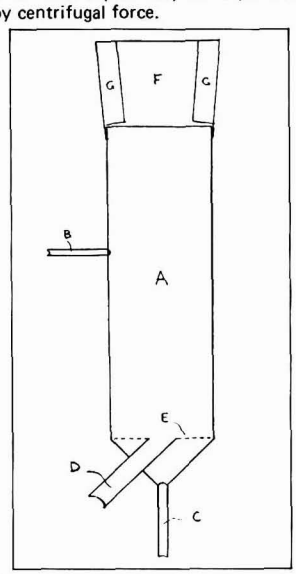
Preparation of furfural from bagasse pith. S. O. Heikal, N. A. El-Shinnawy and N. A. Fadl. *Cellulose Chem. Tech.,* 1980, **14,** (1), 81-85; through *S.I.A.,* 1981, **43,** Abs. 81-574. – The effects of temperature (100-170°C), liquor ratio (5:1, 7:1 or 10:1), H_2SO_4 concentration (0.5-10%) and hydrolysis time (0.5-2 hours) on yield of furfural were tested. Maximum yield, 56.97% on pentosans in pith, was obtained at 150°C using 3% acid, a liquor ratio of 10:1 and a reaction time of 1 hr.

PATENTS

UNITED KINGDOM

Elutriation column. R. G. Fuller and R. K. Strapp, of Hudson Heights, Quebec, Canada. **1,575,704.** January 7, 1976; September 24, 1980.

Sugar is extracted from a cane pulp such as the "Comfith" produced by the cane separation process[1] in a column A where B is an upper entry for the admission of solvent fluid (water), C is a lower exit for the discharge of extract, D is a means for introducing the host material (Comfith), E is a screen to prevent the host material from being discharged through exit C, F is a rotatable section of the column and G are projections extending from the inner wall of section F. This inner wall is perforated so that liquid may be separated from the Comfith by centrifugal force.



Comfith is fed into the column through duct D and its sugar content extracted by a counter-current flow of water admitted through entry B. The extract passes through screen E and into exit pipe C while the exhausted Comfith rises up to section F where it is engaged by projections G and spun, residual liquid being separated through the perforated inner wall. The dried Comfith is then discharged over the rim of section F.

Field beet cleaner. Soc. Nouvelle des Ets. A. Maguin, of La Fère, France. **1,581,060.** August 22, 1977; December 10, 1980.

Production of glucose. Projectierung Chemische Verfahrenstechnik GmbH, of Ratingen, Germany, **1,582,480.** July 18, 1977; January 7, 1981. – Cellulose-containing vegetable raw material (bagasse, wood, straw, etc.) is treated with saturated steam at 160° – 230°C for 2 – 240 minutes, when the raw material is disintegrated. It is then lixiviated with (water and then) an aqueous alkali solution [0.1 – 4% (0.2 – 1%) (0.3 – 0.6%) w/w NaOH] and the fibrinous residue (washed and/or neutralized and) subjected to acid or enzymatic hydrolysis to yield glucose in a high degree of purity.

Treatment of crystal suspensions. Fives-Cail Babcock, of Paris, France. **1,582,599.** December 13, 1977; January 14, 1981. – See US Patent 4,164,429[2].

Seeding a supersaturated sugar solution to effect crystallization. A/S De Danske Sukkerfabrikker, of Copenhagen, Denmark. **1,584,216.** May 23, 1977; February 11, 1981. To the supersaturated sugar solution in a pan is added finely-milled sugar suspended in an agent (polyethylene glycol, polypropylene glycol) (the suspension having been milled in a steel ball mill) which is wholly or partially soluble in water, and which does not dissolve sugar crystals and has a boiling point higher than the temperature of the sugar solution to be crystallized, the proportions of sugar and agent being such that the viscosity is sufficiently low to permit the suspension to spread in the sugar solution but sufficiently high to render the suspension stable for longer periods when subjected to a slow flowing movement.

Bagasse as animal fodder. BP Nutrition (UK) Ltd., of Witham, Essex, England. **1,583,751.** March 29, 1976; February 4, 1981. – Organic matter having a lignocellulose content and a varying moisture content, e.g. bagasse, is conveyed to a treatment zone with continuous monitoring of its weight and moisture content and acid or alkali (in aqueous solution) (e.g. NaOH) added in proportion to the dry matter content. The material is then pelleted and cooled. The treatment renders the material more digestible for ruminants.

Separation of sugars from mixtures. Imperial Chemical Industries Ltd., of London, England. **1,585,174.** June 16, 1976; February 25, 1981. – A mixture of sugars (HFCS) produced by conversion of an aldose (glucose) to a ketose (fructose) in the presence of an oxyanion (containing B or Ge) is separated by bringing the mixture into contact (at 20° – 60°C) with an ion exchange resin as defined by (A) or (B) below or a combination (C) of resins. The resin (A) is a cation exchange resin having divalent cationic counter ions (Ca^{++}) mixed with (a majority of) H^+ ions (or Na^+ ions); (B) is a cation exchange resin having monovalent cationic counter ions of which H^+ ions form a minor part (the remainder being Na^+ ions); and (C) comprises first a cation exchange resin having cationic counter ions of which most are H^+ ions, followed by a (quaternary ammonium) anion exchange resin having mono- or divalent anionic counter ions (acetate, formate or succinate ions).

Beet harvesters. J. W. Blench, of Huntingdon, Cambs., England. (A) **1,587,252.** May 30, 1977; April 1, 1981. (B) **1,590,183.** September 20, 1977; May 28, 1981.

[1] See *I.S.J.*, 1981, **83**, 327.
[2] *I.S.J.*, 1981, **83**, 254.

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

TRADE NOTICES

Loadcell weigh systems. Optibal Holdings Ltd., Radnor Park, Congleton, Cheshire.

Optibal Holdings Ltd., weighing equipment specialists, have introduced new electronic loadcell batch weigh systems and controls. The electronic controls are built in modular form and mounted in modern 19-inch rack assemblies. The weight display can be digital or analogue and includes a calibration check facility. Optibal Shear-beam ORB loadcells have been designed for silo weighing, batch and process weighing, hopper and conveyor weighing, etc. They can be employed as tension or compression units and embody strain gauges bonded to specially prepared web sections. A number of loadcells can be interconnected where required (through use of fully active half-bridge circuits connected at the terminal box).

Differential pressure and pressure transmitters. KDG Instruments Ltd., Fleming Way, Crawley, West Sussex RH10 2QE, England.

A new range of low-cost transmitters, the Series 6300, is now offered by KDG Instruments Ltd. Specifically designed to meet the requirement for relatively small, high-performance transmitters, the units are accurate to within ± 0.5%. The series covers a range of differential pressures between 0-15 mbar and 0-7 bar and gauge pressures between 0-8 mbar and 0-400 bar, thus meeting all industrial process control requirements. The standard output signal is 4-20 mA. The transmitters are constructed of corrosion-resistant materials.

Non-contact ultrasonic level sensing. Bestobell Mobrey Ltd., 190-196 Bath Rd., Slough, Berks. SL1 4DN, England.

A new 2-point level switch from Bestobell Mobrey utilizes the pulse-echo principle but also incorporates a micro-processor chip to enable the switch to "think" for itself. The MSP 801 is largely unaffected by agitation or turbulence, is simple to operate and provides high and low switching, automatic indication of empty or full tanks or high level fail-safe functions.

Reverse osmosis membrane. Paterson Candy International Ltd., Reverse Osmosis Division, Laverstoke Mill, Whitchurch, Hants. RG28 7NR, England.

Paterson Candy International have announced the development of a new non-cellulosic membrane (Type ZF 99) for use in process reverse osmosis. It has substantially improved pH, temperature and pressure resistance, gives better separation and is of increased capacity to permit use of reverse osmosis for a much wider range of applications, including concentration of sugar solutions, starch solutions, distillery effluents and molasses effluents. The new membrane can be used at a wide range of pH (3-11) up to a temperature of 80°C for low-cost concentration up to 30% total solids. It can be cleaned with caustic and acid cleaners at high temperatures.

Universal level switch. Gerrard Instruments Ltd., 724A High Rd., Finchley, London N12 9QD, England.

A universal level switch for liquids, slurries and granular solids operates on the principle of change of dielectric constant between the medium and air. It is insensitive to product build-up on the probe because of the damping effect, on a transmitted RF signal from the probe, of the liquids or solids surrounding it. Two wires connect the sensor to the switching unit containing a heavy-duty relay and a visual indication of the switching mode.

PUBLICATIONS RECEIVED

Cooling towers. Otto Estner GmbH, Postfach 11 01 97, D-4600 Dortmund 1, Germany.

Since 1912, Otto Estner GmbH have been engaged in the design and supply of complete water cooling systems. A recent brochure illustrates the various types of cooler supplied by the company, including towers erected at sugar factories, e.g. a K 311 natural-draft tower for hot-well water cooling, a FS 33 two-cell mechanical-draft tower for condensed water cooling, a FS 45 three-cell mechanical-draft tower for hot-well water cooling, and an FS 55 three-cell mechanical-draft tower (erected on a roof), also for hot-well water cooling.

Mechanical handling buyers' guide. Mechanical Handling Engineers' Association, 16 Dartmouth St., London SW1H 9BL, England.

A 20-page buyers' guide available from the MHEA lists leading designers and manufactures of conveyors and related equipment and systems for both bulk and unit load handling. Updated details are available of products (under more than 100 headings) and of the addresses of MHEA members as well as associate members (those supplying components and sub-assemblies to the mechanical handling industry).

Cane heat treatment. Eshowe Wagon Works (Pty.) Ltd., P.O. Box 74, 3815 Eshowe, South Africa.

In the Upfold heat treating plant, seed cane is immersed in hot water for the required time at the required temperature; the cane is loaded into the tank in a basket, one basket being fed and one removed at the other end every 15 min – each basket contains about 100 kg of cane, and is easily adaptable to fit mechanical planters.

Cane carts. Inter-American Transport Equipment Co., 3690 N.W.62 Street, Miami, FL 33147, USA.

The Series 1300 Vanguard chain net system for cane carts supplied by Inter-American Transport Equipment Co. provides for cane haulage in multiple units (one illustration shows eight carts being towed by a tractor). Features include patented indestructable wheels with a double-disc integral member to the hub and special dust-proof packing, a heavy-duty drawbar with special tow eye, a patented heavy-duty gooseneck, a fifth wheel of heavy-duty construction capable of rotating through 360°, and a chassis having cross-members and longitudinal beams integral to the gooseneck so as to form a solid unit. Another brochure illustrates the many types of cane handling equipment built by Inter-American, including loaders, tractors, grapples and various transport systems.

End dumpers. Edwards Engineering Corporation, 7400 Townsend Place, New Orleans, LA 70126, USA.

A leaflet from Edwards Engineering briefly describes their hydraulically operated end dumper for unloading of bulk materials, including sugar cane, from road trucks which are raised on the platform at an angle adjustable from 35 to 45°. The dumper has a manual override, while one or two platforms can be operated by one single power unit, so that one can be raised while the other is lowered, or both lowered simultaneously (an electric interlock prevents simultaneous raising of both platforms).

Dust control equipment. – Carter-Midac, the environmental engineering division of Carter Industrial Products Ltd., has been awarded a contract for the supply of dust control equipment for the new packaging plant at the Bury St. Edmunds factory of British Sugar Corporation Ltd. The order, worth more than £145,000, covers supply, delivery and erection of four reverse jet fabric filter plants.

Turbo-generator for Pakistan. – Peter Brotherhood PLC have received an order worth about £150,000 for the supply of a turbo-generator to a sugar factory in Pakistan. This is the third such order received by Peter Brotherhood from Pakistan during the past few months.

Japan sugar imports, 1981[1]

	1981	1980	1979
		tonnes, raw value	
Australia	595,299	768,639	717,930
Cuba	245,106	289,073	390,438
Fiji	52,990	25,059	10,497
Philippines	137,507	403,845	287,592
South Africa	365,710	469,775	446,642
Taiwan	97,624	154,109	126,845
Thailand	95,649	154,289	625,249
Other countries	1,663	180	255
	1,591,548	2,265,509	2,605,448

Mexico self-sufficiency delay[2]. — The Mexican National Sugar Industry Commission has now publicly acknowledged the country's inability to attain self-sufficiency, not to speak of exports, within four years. The official organization said that foreign purchases will continue in 1982, adding that, should there be a continuity in planning the modernization of mills and improvement of cane harvest, including the use of mechanical equipment, Mexico may achieve self-sufficiency in 1985/86. The Commission projects, however, attainment of self-sufficiency in 1987, if all goes well.

Yugoslavia 1981/82 beet crop[3]. — Figures published by the Federal Statistics Bureau show that Yugoslavia produced 6,140,000 tonnes of beet in 1981/82, about 927,000 tonnes more than in 1980/81.

Bangladesh sugar industry[4]. — Australians can claim credit, in part, for the fact that in 1981, for the first time since independence in 1971, Bangladesh was able to grow and crush enough cane and produce sugar to meet domestic demand, while in 1982, provided the weather is favourable, it is hoped to export. Since 1977, a $12 million aid program from Australia has refurbished two old sugar factories and provided the services of Australian experts and equipment with the aim of raising productivity in cane growing and crushing. The project has included a sugar research and training institute near Ishurdi and a program to spread information on better cane growing techniques to cane farmers through extension officers. The World Bank is planning to follow suit with similar schemes to help several more mill areas in the country. An important factor in the recent recovery, however, has been the success (through a higher support price) in shifting cane supplies to centrifugal sugar rather than gur manufacture. In 1980/81 over 76,000 hectares was harvested for mill use against less than 62,000 ha in 1979/80. As a result, sugar production jumped from 110,000 tonnes to 155,000 tonnes and imports fell from 60,000 tonnes to 11,000 tonnes.

Peru sugar industry reorganization[5]. — CECOAAP, the sugar cooperatives' joint marketing and financing agency set up in 1970, has been replaced by the Central Nacional de Cooperativas Agrarias Azucareras (Cenazúcar). Five of the twelve cooperatives have become members of the new organization, which will not receive official recognition until it represents the majority of the cooperatives. The other cooperatives are selling their product direct to the wholesalers, although four in the Department of Lambayeque have set up a regional marketing organization. Meanwhile, the Ministry of Economy and Finance is negotiating for the division of the debt of $89 million (equivalent) of CECOAAP among the cooperatives.

Fuel alcohol plant in Kenya[6]. — A power plant at Kisumu, sponsored by Kenya Chemical and Food Corp. Ltd., was to be commissioned in March and it is expected that petrol blended with alcohol will be available in the country from June 1982. The complex is to manufacture some 20 million litres of power alcohol from molasses and will also produce, for export or import substitution, citric acid, baker's yeast, vinegar, carbon dioxide, gypsum, ammonium sulphate fertilizer and methane gas. It should permit oil imports to be cut by 170,000 barrels per year.

Florida cane sugar crop reduction[7]. — A spokesman for the Florida Sugarcane League has said that the yield of sugar from cane was going down daily; following the freeze in mid-January, hot weather, coupled with the prolonged drought, is shortening the season and it is unlikely that the originally estimated production of 1.2 million tonnes will be reached, although he declined to estimate the extent of the crop losses.

Holland sugar imports and exports, 1981[8]

	1981	1980
	tonnes, tel quel	
Imports		
Belgium/Luxembourg	23,144	27,074
France	438	549
Germany, West	169	153
Mauritius	1,004	0
Surinam	0	648
UK	3,179	2,289
Other countries	872	744
	28,806	31,457
Exports		
Algeria	0	1,052
Bahrain	0	7,001
Bangladesh	6,500	0
Belgium/Luxembourg	4,837	8,234
Egypt	12,557	2,006
Germany, West	8,448	9,722
Ghana	1,800	2,500
Iran	40,418	26,335
Iraq	12,500	0
Israel	20,010	9,800
Lebanon	4,000	0
Libya	4,209	4,502
Nigeria	40,581	37,400
Saudi Arabia	6,083	0
Sudan	10,000	0
Tunisia	7,534	9,820
Turkey	3,984	0
UK	26,640	20,190
United Arab Emirates	3,200	1,020
USSR	60,308	42,115
Yemen, South	6,000	0
Yugoslavia	13,000	0
Other countries	2,109	1,000
	294,718	182,697

Indian sugar expansion plans[9]. — The state of Uttar Pradesh plans to produce 2,150,000 tonnes of sugar by the end of the Sixth Five-Year Plan and to that end will have 104 sugar factories in operation as against 84 in 1981. New factories are to be built and old ones expanded and modernized. A cooperative factory at Tilhar in Shahjahanpur District was to go into operation in the 1981/82 crushing season, and units at Gajrula in Moradabad District, Mahamoodabad in Sitapur District and Dhikauli in Sultanpur District will go into production in the 1982/83 season. The State Government has also started work on five sugar mills, to be set up at Ghosi (Azamgarh), Sitarganj (Nainital), Morna (Muzaffarnagar), Semikhera (Bareilly) and Nanpara (Bahraich). The Punjab may get licences for erection of three more sugar factories; there are at present eight in the state. Licences have been issued for construction of two sugar factories to be set up in Orissa, one at Nayagarh in Puri District and the other at Badamba in Cuttack District. The cost is expected to be Rs. 90,000,000 each and construction will take three years.

Finland campaign results, 1981/82[10]. — The four Finnish sugar factories sliced a total of 675,992 tonnes of beets to produce 65,470 tonnes of white sugar, 19,208 tonnes of raw sugar, and 26,753 tonnes of molasses.

New Rumanian sugar factories[11]. — In 1982 three small sugar factories will be put into production at Zimnicea, Calafat and Arad, and the construction of another 11 will be continued. Between 1982 and 1985 some 27 small plants, with a daily beet slicing capacity of 1000-2000 tonnes each, are to be established in the crop producing areas. By 1985 the sugar industry is to consist of 47 plants with a total daily capacity of 100,000 tonnes; this will make it possible to process domestic sugar beets in around 100 working days and also facilitate the processing of imported raw sugar.

[1] C. Czarnikow Ltd., *Sugar Review*, 1982, (1588), 46.
[2] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 111.
[3] *World Sugar J.*, 1982, **4**, (8), 39.
[4] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 113-114.
[5] *Bank of London & S. America Review*, 1982, **16**, 44.
[6] *Standard Chartered Rev.*, February 1982, 5.
[7] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 95.
[8] C. Czarnikow Ltd., *Sugar Review*, 1982, (1586), 38.
[9] *Indian Sugar*, 1981, **31**, 387-388.
[10] *Zuckerind.*, 1982, **107**, 169.
[11] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 110.

South Africa sugar exports, 1981[1]

	1981	1980
	—tonnes, raw value—	
Canada	216,672	175,310
Japan	453,210	476,577
Korea, South	66,245	0
United States	0	132,042
Zaire	0	557
	736,768	785,107

Pakistan mill tandem. – Our brevity concerning the new Jhok Shareef sugar factory in Pakistan, which appeared in our December 1981 issue[2], reported that the tandem of 5-roller mills was supplied by A. Goninan & Co. Ltd. of Queensland. In fact, the mills were supplied by Walkers Ltd. of Maryborough, Queensland, who also designed the complete factory.

Madagascar sugar project[3]. – France's Caisse Centrale de Cooperation Economique will lend 78 million francs ($13.3 million) towards the $86.2 million Analaiva sugar project in Madagascar. The money will be used for the project's first phase, which involves land preparation, setting up an irrigation system, purchase of equipment and construction of buildings. About 2200 hectares of land will be cultivated, to produce about 200,000 tonnes of cane a year. This will be the capacity of the $17.2 million sugar factory, now being built by China. The remaining $2.7 million needed for the first phase will come from the sale of sugar produced during the cultivation trials already carried out.

2nd International Colloquium on Sweetener Policy. – The US Sugar Users Group sponsored and conducted at Tarpon Springs, Florida, its second annual colloquium on world sweetener policy during February 7-10, 1982. Some 450 persons attended, including a much greater number from abroad than at the first meeting in 1981, especially from Europe and, to a lesser extent, Latin America. Speakers presented papers on alternative sweeteners and on nutrition, while a panel including Dr. H. Ahlfeld of F. O. Licht GmbH, Mr. K. Badenhop of B. W. Dyer & Co., Mr. M. de la Forest Divonne of C. E. F. S., Mr. R. Goodwin of C. Czarnikow Ltd. and Dr. A. Viton presented their views on world supply and demand for sweeteners with projections and notes on factors influencing the position up to 1985, and an assessment of capabilities and likely developments in different regions of the sugar world over the next few years. A forum was held in which a panel of experts including Ms. R. Prager of the US Trade Department, Mr. W. K. Miller, Executive Director of the I.S.O., Mr. W. K. Vaughn, a Congressional aide on trade matters, Mr. G. Perroud, Secretary-General of the CIBE and Dr. Viton, answered questions and gave their views on the International Sugar Agreement, its effectiveness, prospects of EEC accession, relationship with US legislation and the Reagan Caribbean Basin Plan, etc. Costs of production in the United States were discussed by a number of speakers who referred to the 1981/82 USDA survey which, depending on the basis used, found the cost of raw cane sugar to be 20.99-23.99 cents/lb and that for white beet sugar 22.31-25.31 cents/lb, compared with 13-16 cents/lb for HFCS. Costs in major production areas were discussed and stated to vary between 10 and 50 cents/lb, the majority being around 20 cents/lb. A senior economist of the World Bank described its organization and administration and referred to its increasing provision of loans for agricultural projects. Utilization of the futures market was discussed by a panel comprising brokers, a refiner, and exchange staff, while another panel presented views and information on the sugar purchase support program under the recently enacted Farm Bill.

Réunion sugar industry contraction. – The sugar factory of La Mare in Réunion closed at the end of 1981 and its supplying area will deliver cane to Bois-Rouge factory which is to be expanded to 250 t.c.h. The factory at Quartier Français will also be closed at the end of 1982 and its cane supply delivered to Beaufonds.

Booker McConnell PLC 1981 results. – The preliminary results of Booker McConnell for the year ended December 31, 1981 show a profit before tax of £15.3 million against £12.8 million in 1980. Encouraging increases were achieved in Food Distribution and Agriculture, and action has been taken to eliminate losses in a number of engineering businesses. The Plenty Group has shown a rapid turnaround to profit while Engineering as a whole has shown a reduced loss of £900,000 compared with a loss of £1.3 million in 1980. The Group expects to make a profit in Engineering in 1982 even though Fletcher and Stewart face another loss.

Brazil sugar exports, 1981[4]

	1981	1980	1979
		—tonnes, raw value—	
Algeria	212,215	129,695	0
Angola	0	0	13,235
Chile	8,120	48,376	22,068
China	12,883	0	41,788
EEC	0	0	56,152
Egypt	198,838	146,523	84,949
Ghana	0	0	10,826
Haiti	0	5,311	0
India	25,008	180,272	0
Indonesia	224,228	0	23,601
Iran	43,305	104,364	132,576
Iraq	117,220	181,484	121,809
Jamaica	8,120	0	0
Jordan	11,909	19,152	0
Malaysia	0	10,160	0
Mexico	50,342	67,212	0
Morocco	37,600	116,000	21,909
Nigeria	10,435	27,639	35,726
Pakistan	0	86,999	13,641
Portugal	25,200	49,050	36,000
Saudi Arabia	37,675	0	0
Senegal	0	0	41,475
Sri Lanka	0	61,176	0
Sudan	13,545	43,290	35,130
Syria	36,710	13,598	0
Tunisia	0	24,292	12,500
Turkey	12,937	24,117	0
USA	945,894	805,942	1,053,237
USSR	366,438	501,791	99,441
Venezuela	271,373	15,470	85,526
Other countries	54	0	0
	2,670,049	2,661,913	1,941,589

Indonesia sugar shortfall[5]. – Indonesia will have to import 600,000-700,000 tonnes of sugar in the year from April 1982 to make up for a shortfall in domestic production, according to government officials.

PERSONAL NOTES

We regret to report the death in October last of Mr. **David R. L. Steindl**, formerly Senior Pathologist of the Bureau of Sugar Experiment Stations. Born in 1912, he graduated from Sydney University in 1934 and joined the Bureau as an assistant pathologist the following year. Over the next forty years he made a considerable contribution to both the Australian and world sugar industries in the study and control of sugar cane diseases. Working with C. G. Hughes he contributed to the elimination of downy mildew and gumming disease in Australia and to the control of Fiji disease up to the 1950's, while another major achievement was the identification and control of ratoon stunting disease. He published many papers over the years and contributed to the standard text book "Sugar cane diseases of the world".

We regret to report the death of Mr. **William A. Powe**, former editor of *The Sugar Journal*. His career in the sugar industry had extended over more than 50 years, much of it spent in Cuba where he worked in a number of sugar factories, acted as a salesman and later representative for Oliver United Filters Inc., and created a very large business in that country which was confiscated when the Castro régime came to power. He had retained land interests in the USA, however, and operated these while maintaining his connexion with sugar through his association with *The Sugar Journal*, on whose behalf he visited a number of countries and participated in several ISSCT Congresses.

Mr. **Roy Deicke** has been appointed a Companion of the Order of St. Michael and St. George for his more than 26 years of service to the Australian sugar industry. After graduating from Queensland University he lectured in industrial chemistry and joined the Bureau of Sugar Experiment Stations in 1955. After five years as a senior mill technologist he joined Fairymead Sugar Co. as a research officer and was appointed General Manager in 1962. Following a merger of the two companies he became Managing Director of Bundaberg Sugar Co. Ltd. in 1976 which position he still holds. Mr. Deicke has served as Chairman of the Sugar Research Institute and has contributed to Congresses of the Australian and International Societies of Sugar Cane Technologists.

[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, S86.
[2] *I.S.J.*, 1981, **83**, 384.
[3] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 112.
[4] *I.S.O. Stat. Bull.*, 1982, **41**, (2), 6.
[5] *The Times*, April 1, 1982.

Beware of sand.

If you are involved with mechanical harvesting of sugar cane, then you face a problem that didn't exist with hand cutting. Soil and sand get into the process. Thorough washing won't always get the sand out. And all it takes is a little bit of sand to ruin expensive machinery. Or to overload equipment. And contaminate your juice.

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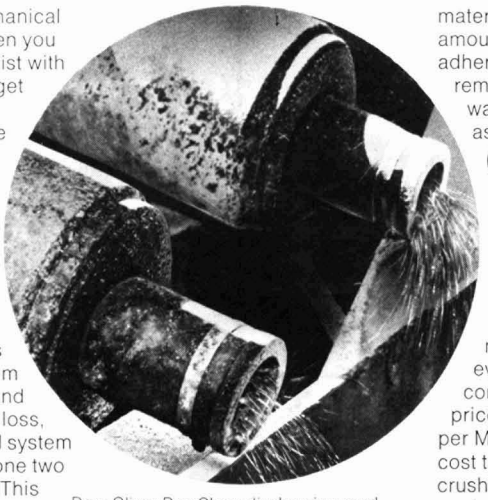
Ordinary desanding systems can't handle the sand problem adequately. For complete sand removal, with minimal sugar loss, you need the most advanced system on the market — the DorrClone two stage sand removal system. This economical system is designed to remove approximately 95% of coarse and fine material, up to about 300 mesh (50 microns). It handles any mill capacity.



Dorr-Oliver DorrClone discharging sand.

How the DorrClone cyclone works.

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For further information, write Larry Engel, Dorr-Oliver, International Headquarters, Stamford, Connecticut U.S.A. 06904.

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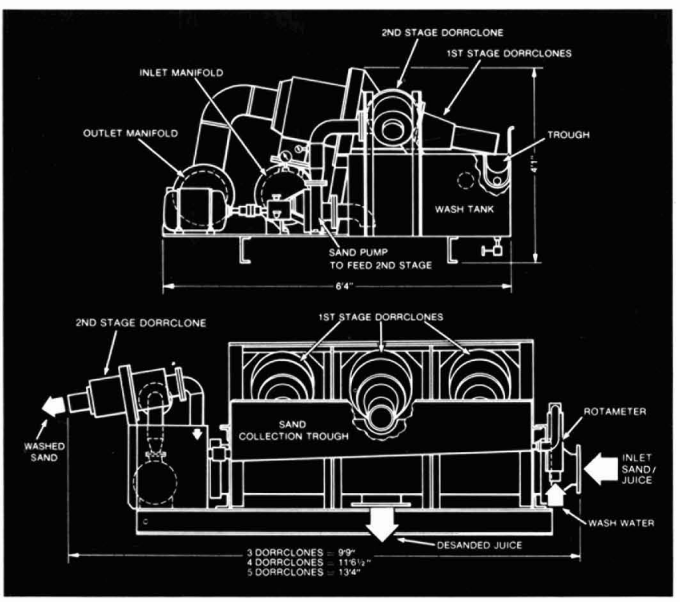

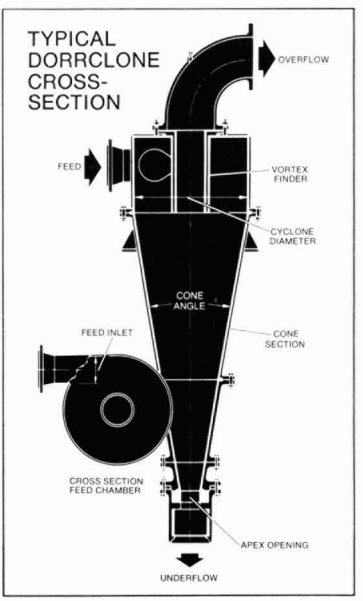

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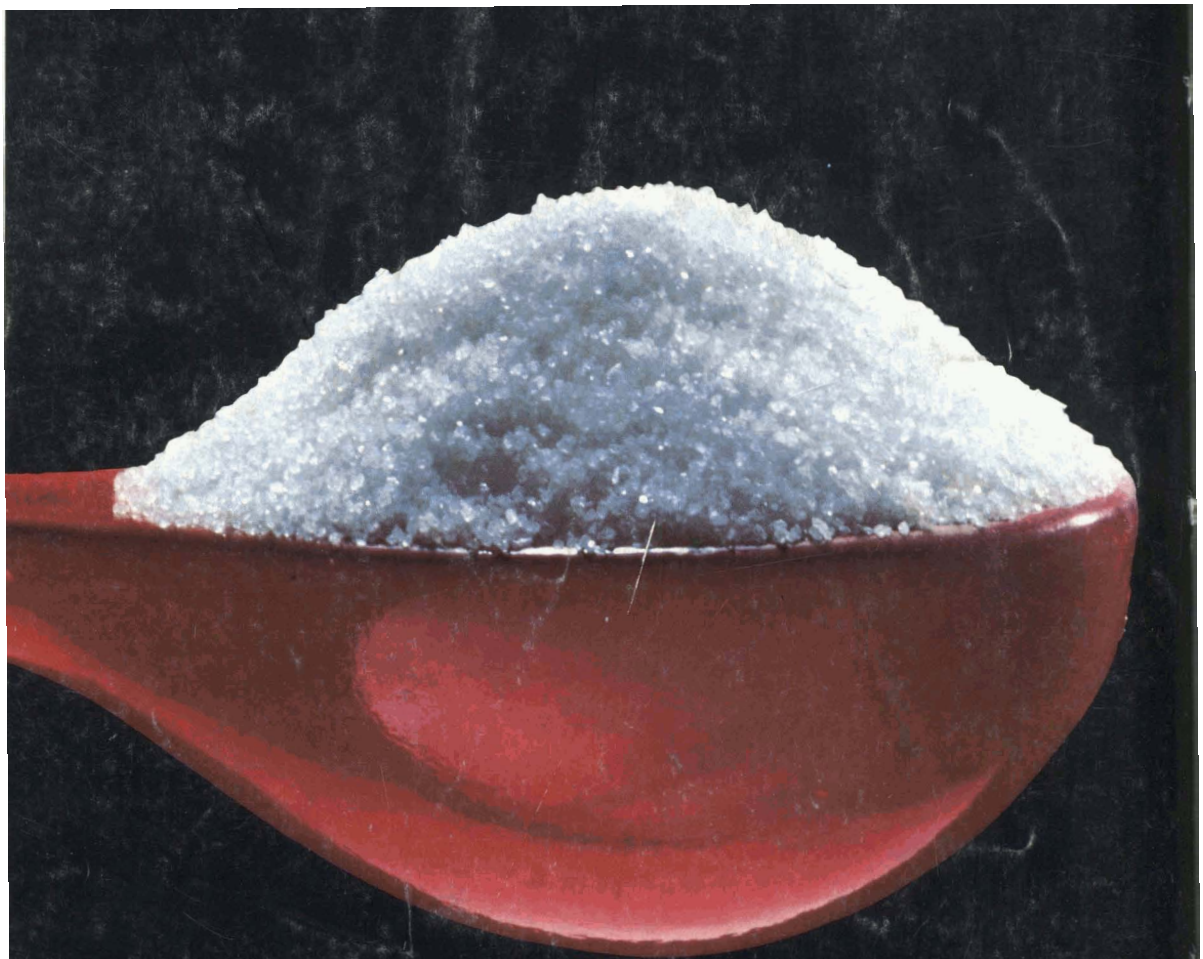

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