VARIETAL MILLING RESULTS IN NATAL, 1941.

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CONTENTS

1. Method employed.
2. Co.281 and Co.290.
   (*a*) Sucrose per cent. Cane.
   (*b*) Sucrose per cent. Bagasse.
   (*c*) Moisture per cent. Bagasse.
   (*d*) Extraction Values.
   (*e*) Noël Deerr Reduced Extraction.
   (*f*) Steam.
3. Uba, P.O.J. and Co.301.
   (*a*) Uba.
   (*b*) P.O.J. and Co.301.
4. Summary and Conclusions.
5. Appendix A.
6. Appendix B.
7. Appendix C.

1.—METHOD EMPLOYED.

In order to determine the practical effect of varietal fibre on sucrose extraction in Natal, an examination of available records, relating to the 1941 season, was carried out.

The method employed consisted of picking out from the Central Board's daily records of cane testing, those cases when a single variety of cane had been crushed, for periods comparable with the hourly sucrose and moisture in bagasse figures recorded by the mill laboratories.

At ten factories, this procedure was found to be practicable. Two others ran a special series of tests and are included in the general average.

The number of comparable tests of Co.281 and Co.290 at these 12 factories was 939 and 670 respectively.

With regard to Uba, only 7 factories had adequate numbers of tests, 398 in all. Of these, 344 cases occurred at 4 factories.

With P.O.J. varieties, there were only 57 cases, 50 of which occurred at 3 factories.

Co.301 yielded 64 tests, of which 45 were found at a single centre.

The general simple average of figures from the 12 factories is as follows:—

		Central Board's Laboratory.		Factory Laboratory	
Variety of Cane.	No. of Tests.	Approx. Sucrose % Cane.*	Purity Crusher Juice.	Sucrose per cent. Bagasse.	Moisture per cent. Bagasse.
Co.281	939	14.21	89.21	2.91	50.54
Co.290	670	13.66	88.03	3.27	52.05
Uba	402	13.44	86.84	3.09	51.54
P.O.J.	57	14.44	89.10	3.17	50.91
Co.301	64	13.91	88.57	2.94	51.35

For detailed list of data see Appendix A.

2.—Co.281 AND Co.290.

The number of cases and the general trend of results constitute an outstanding example of the effect of the varietal quality of fibre on sucrose extraction. Thus:—

Name of Factory.	Number Tests.		Sucrose per cent. Cane.		Sucrose per cent. Bagasse.		Moisture per cent. Bagasse.	
	Co.281	Co.290	Co.281	Co.290	Co.281	Co.290	Co.281	Co.290
Darnall	93	26	13.55	12.52	3.21	3.67	53.43	53.53
Doornkop ...	212	154	15.29	14.60	3.26	3.41	47.20	48.43
Z.S.M. & P. ...	79	34	14.48	13.53	2.82	3.24	51.50	52.66
Felixton	127	97	13.74	12.80	2.56	2.85	51.25	52.46
Illovo	55	79	14.12	13.52	3.73	3.79	51.71	50.68
Natal Estates...	25	25	13.78	13.13	2.07	2.36	50.34	53.06
Amatikulu ...	51	18	13.37	13.91	2.44	2.87	54.20	55.90
Chakas Kraal...	75	70	15.04	13.98	3.36	3.73	50.67	51.95
Verulam	9	2	13.79	13.31	2.38	2.80	47.60	53.15
Gledhow	104	107	14.29	13.82	3.50	3.63	51.13	52.15
Renishaw ...	88	49	13.97	13.81	3.12	3.72	49.96	51.87
Esperanza ...	21	9	15.13	15.02	2.50	3.20	47.53	48.70
	939	670	14.21	13.66	2.91	3.27	50.54	52.05

Sucrose per cent. Cane.—With the exception of Amatikulu, the approximate sucrose in cane is generally appreciably higher in Co.281 than in Co.290. The general average difference is 0.55 per cent.

The reason, or reasons, why the sucrose in Co.290 is 0.54 per cent. *higher* than Co.281 at Amatikulu, 0.11 per cent. *lower* at Esperanza, and 1.16 per cent. *lower* at Chakas Kraal, is probably due to regional peculiarities. This is, however, outside the objects of this enquiry.

Sucrose per cent. Bagasse.—At every mill the sucrose in bagasse is lower in that from Co.281 (despite its higher sucrose in cane) than in Co.290.

These differences are:—

Mills	1	2	3	4	5	6
Lower sucrose in Co.281 bagasse	0.46	0.15	0.42	0.25	0.06	0.29
Mills	7	8	9	10	11	12
Lower sucrose in Co.281 bagasse	0.43	0.37	0.42	0.13	0.60	0.70

The general average difference is 0.36 per cent., with a maximum difference of 0.70 per cent. at Esperanza, and a minimum of 0.06 per cent. at Illovo.

The quantities of these two canes crushed at these two centres were not remarkably different:—

	Esperanza.	Illovo.
Co.281 per cent.	43.25	33.97
Co.290 per cent.	36.28	52.67

The causes for this great difference in the extraction value must therefore lie in the quality of the canes, or in some unknown milling condition. (*See* moisture in bagasse.)

Moisture per cent. Bagasse.—With the exception of Illovo, the moisture in bagasse is higher in Co.290 than in Co.281, the average difference being 1.51 per cent. Individual differences are:—

Mills	1	2	3	4	5	6
Higher moisture in bagasse from Co.290	0.10	1.23	1.16	1.21	−1.03	2.72
Mills	7	8	9	10	11	12
Higher moisture in bagasse from Co.290	1.70	1.28	5.55	1.02	1.91	1.17

It is interesting to note that the two factories with the highest extraction show the greatest difference in moisture, while the two lowest extraction mills give the lowest, and a reverse difference. Thus:—

		Difference in Moisture.	Average crop Extraction.
Natal Estates, Verulam Central	Highest extraction	2.72	94.52
		5.55	93.50
Darnall ... ..., Illovo	Lowest extraction	0.10	91.06
		−1.03	91.19

Extraction Values.—From the data available, the sucrose extraction of these two canes, Co.281 and Co.290, can be calculated for any assumed fibre content. The actual fibre content of the individual varieties as supplied to the factories is an *unknown*; and therefore constitutes a difficult problem in any attempt to calculate the milling value of canes from the results of this investigation.

The Experiment Station found the relative differences in fibre in canes grown on experimental plots to be:—

	Co.281.	Co.290.	Uba.	P.O.J.	Co.301
Fibre per cent. cane	15.28	14.09	15.60	13.35	14.30

These figures were no doubt representative of the particular conditions under which the canes were grown, but may not represent the yearly cane supply to the mills, which is affected by climatic and regional conditions, physical cleanliness, age,

* Note.—The approximate sucrose figures are those found by the method of differential Java Ratios. Simple averages have been used throughout.

time between cutting and milling, and the changing nature of individual varieties.

The formula used in calculating the following extraction values of Co.281 and Co.290 will be found in Appendix B of this paper.

At a basic common fibre content of 15 per cent., the extraction of these two canes at the 12 mills is as follows :—

Variety.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Average drop, Crusher to last Mill Juice.	Fibre % Bagasse.	Bagasse % Cane.	Extraction.
Co.281	14.21	2.91	50.54	9.52	45.81	32.74	93.31
Co.290	13.66	3.27	52.05	9.52	43.79	34.25	91.80

Calculated on this basis, the difference in extraction between a 14 per cent. and a 16 per cent. fibre in Co.281 would be 0.92 per cent. Assuming, then, that the relative difference in extraction between the two varieties of 1.51 per cent. at 15 per cent. fibre would arithmetically differ at different fibre contents, the question arises, at what level of fibre would Co.290 give the same extraction as Co.281 ?

The answer is :—

Variety.	Fibre Content.	Calculated Extraction.	Fibre Content.	Calculated Extraction.
Co.281	15.0	93.3	18.3	91.8
Co.290	11.7		15.0	

Note.—The calculated extraction at 15 per cent. fibre for each mill will be found in Appendix A.

Noël Deerr Reduced Extraction.—In the first place the extraction data at the mills demonstrates that a unit of fibre in Co.281 does not take away the same amount of primary juice as does a unit of fibre in Co.290.

Having established the actual difference in extraction values between these two canes, the formula is applicable on the assumption that canes of 12 per cent. fibre will behave arithmetically, and entrain the same relative proportion of sucrose.

Thus :—

Variety.	Fibre Content.	Calculated Extraction at 12 per cent.	Noël Deerr reduced Extraction.
Co.281	15	94.65	94.83
Co.290	15	93.41	93.66
Difference		1.24	1.17

If, however, only the extraction of Co.281 is known and applied to Co.290, the error in the calculated reduced extraction of Co.290 would be 1.17 per cent. too high.

Steam.—From a number of tests conducted at Darnall, the steaming conditions of Co.290 bagasse is markedly inferior to both Uba and Co.281. After 30 minutes milling the steam pressure invariably fell from 100 lbs. to 75 lbs.

UBA, P.O.J. AND Co.301 COMPARISONS.

Uba.—There are 7 factories at which a fair number of comparative tests with Co.281 and Co.290 were found. All these Uba cases, however, represent old ratoons and in some instances canes up to four and five years old.

Renishaw would appear to be the fairest comparison, as apart from having 37 per cent. of Uba, this cane is still remarkably free from streak disease in this area.

The comparative data is as follows :—

Name of Factory.	Number of cases.			Percentage of total crop.			Sucrose % Cane.			Sucrose % Bagasse.			Moisture % Bagasse.			Calculated Extraction at 15% Fibre.		
	Co.281	Co.290	Uba.	Co.281	Co.290	Uba.	Co.281	Co.290	Uba.	Co.281	Co.290	Uba.	Co.281	Co.290	Uba.	Co.281	Co.290	Uba.
Darnall ...	93	26	19	46.32	21.90	24.15	13.55	12.52	12.34	3.21	3.67	3.22	53.43	53.53	53.71	91.66	89.46	90.68
Doornkop ...	212	154	149	35.83	28.53	30.42	15.29	14.60	13.90	3.26	3.41	3.20	47.20	48.43	47.64	93.46	92.60	92.88
Illovo	55	79	17	33.97	52.67	8.91	14.12	13.52	13.71	3.73	3.79	3.62	51.71	50.68	50.64	90.93	90.53	91.10
Natal Estates	25	25	18	32.00	39.20	19.80	13.78	13.13	13.11	2.07	2.36	2.15	50.34	53.06	52.10	95.21	93.91	94.58
Chakas Kraal	75	70	47	38.98	34.21	17.93	15.04	13.98	13.76	3.36	3.73	3.48	50.67	51.95	51.54	92.62	90.77	91.42
Gledhow ...	104	107	59	40.56	32.01	14.72	14.29	13.82	13.11	3.50	3.63	3.58	51.13	52.15	51.96	91.74	90.82	90.54
Renishaw ...	88	49	89	38.87	21.42	37.04	13.97	13.81	13.48	3.12	3.72	3.20	49.96	51.87	50.83	92.77	90.73	92.14
Average	652	510	398	38.08	32.85	21.85	14.29	13.63	13.34	3.18	3.47	3.21	50.63	51.67	51.20	92.40	91.13	91.70

It is interesting to note that on a basis of 15 per cent. fibre, Uba ranks first in extraction at one mill, second at five mills, and third at one. In the average of the seven factories it ranks second.

On the assumption that the figures at the Experiment Station are representative of the cane supply, the calculated extractions would then be as follows :—

	Fibre per cent. Cane.	Calculated Extraction.
Co.281	15.28	92.30
Co.290	14.09	91.71
Uba	15.60	91.38

There is no reason to suppose, however, that normal clean Uba, as grown in past years, would not have ranked higher than these calculations indicate.

P.O.J. and Co.301.—Gledhow is the only mill at which the five varieties are represented. The results at a basic fibre of 15 per cent. are :—

Variety.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Calculated Extraction at 15% Fibre
P.O.J.	11	13.29	3.03	52.75	92.10
Co.281	104	14.29	3.50	51.13	91.74
Co.301	45	13.93	3.64	52.06	90.95
Co.290	107	13.82	3.63	52.15	90.82
Uba	59	13.11	3.58	51.96	90.54

The results of all tests are :—

Variety.	No. of mills.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Calculated Extraction at 15% Fibre
Co.281 ...	12	939	14.21	2.91	50.54	93.31
Co.301 ...	8	64	13.91	2.94	51.35	92.95
P.O.J. ...	7	57	14.44	3.17	50.91	92.73
Uba ...	10	402	13.44	3.09	51.54	92.26
Co.290 ...	12	670	13.66	3.27	52.05	91.80

SUMMARY AND CONCLUSIONS.

1. This investigation illustrates the fact that certain milling qualities of variety canes can be determined seasonally from data which can be made available at each factory.

2. The outstanding difference in milling qualities is that shown by the variety Co.290, which is markedly inferior in extraction value and in steam-raising qualities.

3. The principal result of this enquiry is the positive proof that the *quality of fibre* in two specific varieties, Co.281 and Co.290, is a highly significant factor in the milling of sugar canes.

This factor has, up to now, been ignored in text-books and papers dealing with the effect of fibre on extraction.

Interesting exceptions due to regional effects are : Uba cane grown on alluvial plots (Illovo), and Co.290 grown at high elevations (Illovo, Doornkop).

4. The results obtained from Uba consignments have been recorded, but it must not be overlooked that the quality of present-day Uba is not normal, and that its sucrose content is determined by the differential Java Ratio method.

5. With regard to the P.O.J., Co.301 and Uba results, they are erratic and no absolute conclusions can be drawn as in the case of Co.281 and Co.290.

6. The use of this method for evaluating the milling values of variety canes is impossible without an accurate knowledge of the *unknown individual fibre percentages*. Should, however, an average table be worked out from a large number of experiments, any evaluation must bear the guarantee that individual consignments will contain the standard percentage of fibre—an obvious impossibility.

APPENDIX "A."

VARIETAL CANE MILLING RESULTS, 1941.

Co. 281.

Name of Factory.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Purity Crusher Juice.	Purity Last Mill.	Purity Drop.	Fibre % Bagasse.	Bagasse % Cane.	Extraction at 15% Fibre.
Darnall	93	13.55	3.21	53.43	87.45	77.10	10.35	42.41	35.37	91.66
Doornkop...	212	15.29	3.26	47.20	91.86	82.76	9.10	48.84	30.70	93.46
Z.S.M. & P. Ltd. ...	79	14.48	2.82	51.50	88.76	78.16	10.60	44.89	33.41	93.51
Felixton	127	13.74	2.56	51.25	88.29	77.49	10.80	45.45	33.00	93.89
Illovo	55	14.12	3.73	51.71	88.74	78.31	10.43	43.53	34.46	90.93
Natal Estates	25	13.78	2.07	50.34	88.70	81.69	7.01	47.13	31.83	95.21
Amatikulu	51	13.37	2.44	54.20	87.87	78.07	9.80	42.68	35.14	93.57
Chakas Kraal	75	15.04	3.36	50.67	90.34	81.22	9.12	45.21	33.18	92.62
Verulam	9	13.79	2.38	47.60	87.63	78.63	9.00	49.37	30.38	94.78
Gledhow	104	14.29	3.50	51.13	89.37	79.89	9.50	44.49	33.72	91.74
Renishaw...	88	13.97	3.12	49.96	90.39	81.39	9.00	46.21	32.46	92.77
Esperanza	21	15.13	2.50	47.53	91.08	81.58	9.50	49.41	30.36	94.65
Average	939	14.21	2.91	50.54	89.21	79.69	9.52	45.81	32.74	93.31

P.O.J.

Z.S.M. & P. Ltd. ...	23	15.56	3.01	53.24	89.67	79.07	10.60	42.95	34.92	93.25
Felixton	16	13.58	2.47	51.97	86.89	76.09	10.80	44.78	33.50	93.89
Illovo	1	12.55	3.70	48.00	85.70	75.27	10.43	47.08	31.86	90.60
Chakas Kraal	1	16.32	3.90	51.00	91.00	81.88	9.12	44.24	33.90	91.91
Verulam	4	15.18	2.80	49.40	92.70	83.70	9.00	46.26	32.42	94.00
Gledhow	11	13.29	3.03	52.75	86.50	77.00	9.50	43.31	34.63	92.10
Renishaw...	1	14.60	3.30	50.00	90.70	81.70	9.00	45.96	32.64	92.60
Average	57	14.44	3.17	50.91	89.10	79.24	9.86	45.09	33.27	92.73

Co. 301.

Darnall	1	11.99	2.90	54.70	85.70	77.10	10.35	41.54	36.11	91.24
Z.S.M. & P. Ltd. ...	3	14.03	2.90	52.60	88.19	77.59	10.60	43.66	34.36	92.87
Felixton	7	14.04	2.75	52.50	88.57	77.77	10.80	43.96	34.12	93.30
Chakas Kraal	3	14.39	3.17	50.67	87.93	78.81	9.12	45.31	33.10	92.70
Verulam	2	13.15	2.25	49.40	88.15	79.15	9.00	47.74	31.42	94.60
Gledhow	45	13.93	3.64	52.06	88.55	79.05	9.50	43.34	34.61	90.95
Renishaw	2	13.99	3.20	50.50	89.75	80.75	9.00	45.54	32.94	92.49
Esperanza...	1	15.76	2.70	48.40	92.20	82.70	9.50	48.34	31.03	94.67
Average	64	13.91	2.94	51.35	88.57	79.12	9.45	44.93	33.38	92.95

Co. 290.

Darnall	26	12.52	3.67	53.53	86.13	75.78	10.35	41.63	36.03	89.46
Doornkop...	154	14.60	3.41	48.43	89.93	80.83	9.10	47.35	31.62	92.60
Z.S.M. & P. Ltd. ...	34	13.53	3.24	52.66	86.89	76.29	10.60	43.09	34.81	91.65
Felixton	97	12.80	2.85	52.46	85.58	74.78	10.80	43.73	34.30	92.34
Illovo	79	13.52	3.79	50.68	86.97	76.54	10.43	44.37	33.80	90.53
Natal Estates	25	13.13	2.36	53.06	86.70	79.69	7.01	43.98	34.11	93.91
Amatikulu	18	13.91	2.87	55.90	88.74	78.94	9.80	40.46	37.07	92.38
Chakas Kraal	70	13.98	3.73	51.95	88.29	79.19	9.12	43.34	34.61	90.77
Verulam	2	13.31	2.80	53.15	89.75	80.75	9.00	43.38	34.58	92.26
Gledhow	107	13.82	3.63	52.15	87.88	78.38	9.50	43.22	34.71	90.82
Renishaw	49	13.81	3.72	51.87	89.63	80.63	9.00	43.52	34.47	90.73
Esperanza...	9	15.02	3.20	48.70	89.82	80.32	9.50	47.32	31.70	93.48
Average	670	13.66	3.27	52.05	88.03	78.51	9.52	43.79	34.25	91.80

Uba.

Darnall	19	12.34	3.22	53.71	84.94	74.59	10.35	41.97	35.74	90.68
Doornkop...	149	13.90	3.20	47.64	88.72	79.62	9.10	48.34	31.03	92.88
Felixton	1	16.05	3.40	53.00	89.85	79.05	10.80	42.70	35.13	92.59
Illovo	17	13.71	3.62	50.64	86.30	75.87	10.43	44.59	33.64	91.10
Natal Estates	18	13.11	2.15	52.10	85.20	78.19	7.01	45.15	33.22	94.58
Amatikulu	1	10.45	2.25	55.00	81.63	71.83	9.80	41.87	35.82	92.25
Chakas Kraal	47	13.76	3.48	51.54	88.09	78.97	9.12	44.05	34.05	91.42
Gledhow	59	13.11	3.58	51.96	86.03	76.53	9.50	43.36	34.59	90.54
Renishaw	89	13.48	3.20	50.83	87.38	78.38	9.00	45.09	33.27	92.14
Esperanza...	2	14.52	2.80	49.00	90.30	80.80	9.50	48.54	30.90	94.08
Average	402	13.44	3.09	51.54	86.84	77.38	9.46	44.47	33.73	92.26

APPENDIX "B."

$$\text{Fibre \% Bagasse} = 100 - \text{Moisture \% Bagasse} - \frac{\text{Sucrose \% Bagasse} \times 100}{\text{Purity of Last Mill Juice}}$$

$$\text{Bagasse \% Cane} = \frac{\text{Fibre \% Cane}}{\text{Fibre \% Bagasse}}$$

$$\text{Sucrose lost in Bagasse \% Cane} = \frac{\text{Bagasse \% Cane} \times \text{Sucrose \% Bagasse}}{100}$$

$$\text{Extraction} = \frac{\text{Sucrose \% Cane} - \text{Sucrose lost in Bagasse \% Cane}}{\text{Sucrose \% Cane.}}$$

APPENDIX "C."

OPTIMUM MONTH'S VARIETAL MILLING RESULTS FROM SEVEN FACTORIES DURING 1941.

Factories—Darnall, Felixton, Amatikulu, Empangeni, Gledhow, Renishaw, Chakas Kraal.

Variety Co.281.

Month.	No. of Factories.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Crusher Purity.
June	7	86	13.55	2.94	51.52	88.30
July	7	128	14.11	3.00	51.71	89.26
August ...	7	118	14.86	3.11	51.42	89.85
September...	7	95	14.88	3.10	51.35	89.45
October ...	6	100	13.92	3.02	51.40	88.77
		527	14.30	3.03	51.48	89.13

Variety Co.290.

Month.	No. of Factories.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Crusher Purity.
June	7	82	13.13	3.45	52.10	87.10
July	7	93	13.88	3.43	52.91	88.40
August ...	6	64	14.14	3.41	52.49	88.63
September...	7	56	14.12	3.35	52.49	87.71
October ...	5	45	13.68	3.48	52.57	87.75
		340	13.79	3.42	52.51	87.92

Variety Uba.

Month.	No. of Factories.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Crusher Purity.
June	4	62	12.33	3.25	52.38	85.73
July	4	59	13.24	3.43	51.81	86.77
August ...	4	43	14.15	3.38	51.48	85.85
September...	4	35	15.25	3.53	51.96	89.06
October ...	3	8	13.21	3.16	51.75	88.18
		207	13.63	3.35	51.88	87.12

Variety P.O.J.

Month.	No. of Factories.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Crusher Purity.
June	4	11	13.69	2.88	51.99	87.89
July	3	9	14.68	2.93	52.57	88.58
August ...	2	14	14.68	2.71	53.31	88.45
September...	4	10	15.43	3.29	52.05	88.85
October ...	2	4	13.94	2.56	51.38	87.22
		48	14.48	2.87	52.26	88.20

Variety Co.301.

Month.	No. of Factories.	No. of Tests.	Sucrose % Cane.	Sucrose % Bagasse.	Moisture % Bagasse.	Crusher Purity.
June	1	1	13.82	3.05	51.50	88.10
July	4	20	14.09	2.95	51.90	89.17
August ...	3	16	14.39	3.50	50.89	89.61
September...	3	6	14.97	3.33	51.00	86.45
October ...	1	13	12.16	3.21	52.00	86.93
		56	13.89	3.21	51.46	88.05

The following comment, which really forms a paper by itself, was sent in by Mr. R. M. BECHARD, *but was only received after the Conference.*

JUICE RETENTION VALUE OF VARIETIES OF CANE.

As handled at Amatikulu during seasons 1940 and 1941.

Period Covered.

The work was started in 1940. All hourly samples of bagasse used that year in the determination of sucrose and moisture between 21st May, and 21st December, and all those used in 1941 between 10th May, and 23rd November, were examined and classified as to their origin.

Method of Classification.

After making the necessary allowance for overlap in the samples, which normally consist of bagasse produced from three to four consignments of cane, the samples were classified as follows:—

All samples produced by a single variety, the general average of which is given for 1940 in Table I and for 1941 in Table VI.

All samples containing not less than 25 per cent. of one consignment of one variety together with another single variety, the results of these are given in Tables II. and VII.

All other combinations, these were not made use of.

Number of Samples and Nature of Average.

In 1940, 4,283 samples were examined ; there were 744 samples of bagasse from single varieties, also 2,400 samples of straight mixtures of two single varieties, while 1,139 samples of more complex origin.

During 1941 the total number of samples was 3,961 ; of these 879 were of single varieties, 2,195 mixtures of two varieties, and 887 of more complex origin.

On the assumption that each sample, consisting as it does of one hour's crushing, is of equivalent weights, the averages given in Tables I., II., VI. and VII. are strictly weighted averages.

The results for 1940 and for 1941 are given separately as the methods used in the first year are identical to those in the second.

Table I.—Summary of Bagasse from Single Variety, 1940.

Variety.	No. of samples.	Sucrose per cent. bagasse.	S.E. of mean.	Moisture per cent. bagasse.	S.E. of mean.
Co.281 ...	404	2.598	0.0002	52.957	0.0028
Uba ...	40	2.540	0.0012	53.863	0.0253
Co.301 ...	13	2.546	0.0029	53.538	0.0528
P.O.J. ...	2	2.850	—	55.000	—
Co.290 ...	285	2.940	0.0004	53.972	0.0035

It is evident from this and from an examination of the distribution of samples that only the results obtained in the case of the varieties Co.281 and Co.290 can be made use of, as these are the only averages yielding significant differences of mean.

A gauge to the analysis of the other varieties can be obtained however, from the results of bagasse produced by mixtures of varieties.

Table II.—Bagasse Analysis from Two Varieties, 1940.

Varieties.	No. of samples.	Sucrose per cent. bagasse.	S.E. of mean.	Moisture per cent. bagasse.	S.E. of mean.
Co.281 and Co. 290	1,243	2.749	0.0001	53.465	0.0009
Uba and Co.281	352	2.553	0.0002	53.376	0.0030
Uba and Co.290	303	2.757	0.0004	53.893	0.0034
Uba and Co.301	32	2.590	0.0180	53.750	0.0250
Uba and P.O.J.	20	2.600	0.0222	54.025	0.0410
Co.301 and Co.281	184	2.587	0.0003	53.198	0.0058
Co.301 and Co.290	143	2.751	0.0012	53.734	0.0070
Co.301 and P.O.J.	5	2.660	0.0150	54.100	0.1350
P.O.J. and Co.281	66	2.727	0.0012	53.887	0.0246
P.O.J. and Co.290	52	2.836	0.0013	54.106	0.0210

It is again evident that the best and most reliable results are those obtained when the two main varieties Co.281 and Co.290 form one of the constituents of the mixture.

From this data it is desirable, if found possible, to extract the analyses of bagasse from varieties other than Co.281 and Co.290.

We will discuss this possibility.

Frequency of Occurrence.

Consider the results obtained from varieties Co.281 and Co.290, taken both singly and in their mixture with one another. We have good evidence, both from the table of time distribution and from the analysis of variance of samples, that the figures obtained do represent the analysis value of the bagasse from these varieties.

By means of the law of mixture, we can easily obtain the relative proportion in which the bagasse produced by each of these varieties was mixed in the 1,243 samples of bagasse obtained when these two were mixed. Let the proportion be Y/X, in which Y is the proportion of Co.281 bagasse and X that of Co.290.

Again, let Y_1 be the unknown proportion of bagasse from Co.281 when this variety was mixed with another; for instance Uba. Let X_1 be the corresponding value for variety Co.290.

In order to be able to get the values for the variety Uba, it will be sufficient to know the ratio of Y_1 to X_1, quite irrespective of the intrinsic values of Y_1 and of X_1.

If in a large number of occurrences, when there is no bias in the way in which varieties Co.281 and Co.290 are presented at the mill door for crushing, the ratio in which the bagasse from these varieties occur are in a determinable ratio of Y to X.

There is every reason to believe that in an equally unbiassed series over a large number of occurrences these varieties will be presented for crushing together with other varieties in frequencies which will maintain the same ratio throughout; in other words, that the ratio of Y_1 to X_1 will be substantially the same as the ratio of Y to X.

With this single assumption, which appears to be a highly reasonable one, we may proceed to obtain values of average analyses derived from varieties other than Co.281 and Co.290 when these varieties were constituents of mixtures having in the average a significant different value from the straight result obtained from a single variety.

Calculation.

Thus if we required the value S of a variety, for instance Uba, given:—

2.530 the value of the mixture of this variety with Co.281,

2.757 the value of the mixture of this variety with Co.290,

2.598 the value of Co.281 by itself,

2.940 the value of Co.290 by itself.

Y and X, unknown proportion of Co.281 and of Co.290 in the mixtures from Uba and these varieties, when the ratio of Y to X is known.

We get
$$S(1-Y) = 2.553 - 2.598Y \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$
$$S(1-X) = 2.757 - 2.940X \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

From which
$$\frac{Y}{X} \cdot \frac{2.598-S}{2.940-S} = \frac{2.553-S}{2.757-S} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The ratio Y to X is eliminated and (3) resolves into a quadratic where the substitutable root of S is the value of sucrose for the samples of the variety required.

Proceeding in this manner we get the following values (those for Co.281 and Co.290 having been obtained in the direct way.)

Table III.—Sucrose and Moisture of Bagasse from All Varieties.

Variety.	Sucrose per cent. bagasse.	Moisture per cent. bagasse.
Co.281	2.598	52.957
Uba	2.402	53.940
Co.301	2.580	53.398
P.O.J.	2.778	54.164
Co.290	2.940	53.972

It is not possible to translate these values into extraction values, as in order to do this certain totally unwarranted assumptions would be necessary.

From this and other data at our disposal we can, however arrive at the quantity of juice lost per unit of fibre in each of the varieties.

This value, which is identical with the coefficient (v) of Noël Deerr, will, by differentiation, represent the practical *retention value* of each to the different types of fibre.

Other Data Used.

We have at our disposal for the same period the weighted average sucrose content of each of the varieties as determined by the differential Java Ratio method.

By eliminating this differentiation, it is possible to arrive at the weighted average sucrose content of the primary juice derived from each of the varieties.

We also have the average purity of the first expressed juice from each variety, by making the unimportant assumption that the purity of residual juice will bear a constant ratio to that of the first expressed; we deduce the solid concentration of each type of bagasse, from which in the usual manner the fibre content of the bagasse can be obtained (1).

From the primary juice composition of each variety and the sucrose content of the bagasse produced, we also arrive at the primary juice content of the bagasse (2).

The ratio of these two quantities (2) and (1) represents the juice lost per unit of fibre (v), and the relative values of these the *retention value of the fibre of each variety*.

We obtain the following values:—

Table IV.

Varieties.	Co.281.	Uba.	Co.301.	P.O.J.	Co.290.
Sucrose per cent. bagasse	2.598	2.402	2.580	2.778	2.940
Moisture per cent. bagasse... ...	52.957	53.940	53.398	54.164	53.972
Sucrose of primary juice	16.529	14.851	15.741	16.333	15.999
Purity of last expressed juice ...	79.61	77.13	78.44	79.75	78.34
Dissolved solids per cent. bagasse	3.263	3.114	3.289	3.484	3.758
Fibre per cent. bagasse	43.780	42.946	43.313	42.353	42.270
Primary juice in bagasse	15.718	16.164	16.391	17.008	18.847
Unit loss (v)...	0.35902	0.37662	0.37843	0.40158	0.44587

If Co.281 is taken as standard (100) the different varieties will have the following relative *retention values*.

Table V.—Relative Retention Value of Varieties for 1940.

Variety.	Retention value.
Co.281	100.00
Uba	104.90
Co.301	105.41
P.O.J.	111.85
Co.290	124.19

Results for 1941 :—

Table VI.—Summary of Bagasse Analyses from Single Varieties, Season 1941.

Variety.	No. of samples.	Sucrose per cent. bagasse.	S.E. of mean.	Moisture per cent. bagasse.	S.E. of mean.
Co.281	615	2.600	0.0001	53.186	0.0035
Co.301	40	2.605	0.0043	54.112	0.0460
Uba	10	2.430	0.0130	54.550	0.1722
P.O.J.	1	2.400	—	54.000	—
Co.290	213	3.033	0.0005	55.298	0.0112

It is again evident that only varieties Co.281 and Co.290 show differences in analysis which are significant; there being insufficient data from the other varieties.

We proceed as for 1940, and use those figures obtained from analysis of mixtures of two varieties which are significant. P.O.J. is now so scanty that no reliable figures are available.

Table VII.—Analysis of Mixtures of Two Varieties.

Varieties.	No. of samples.	Sucrose per cent. bagasse.	S.E. of mean.	Moisture per cent. bagasse.	S.E. of mean.
Co.281 & Co.290	1125	2.790	0.0001	54.160	0.0019
Uba and Co.281	363	2.551	0.0002	53.760	0.0064
Uba and Co.290	119	2.854	0.0009	54.802	0.0148
Co.301 & Co.281	286	2.625	0.0002	53.423	0.0081
Co.301 & Co.290	156	2.855	0.0005	54.481	0.0149

Again proceeding as in 1940, by eliminating the new ratio of Co.281 to Co.290, we obtain values for single varieties. P.O.J. is now not represented.

Table VIII.—Sucrose and Moisture Per Cent. Bagasse.

Variety.	Sucrose per cent. bagasse.	Moisture per cent. bagasse.
Co.281	2.600	53.186
Uba	2.481	54.342
Co.301	2.661	53.463
Co.290	3.033	55.298

Using weighted average sucrose of varieties and purity obtained, we get the complete set of values :—

Table IX.

Varieties.	Co.281.	Uba.	Co.301.	Co.290.
Sucrose per cent. bagasse	2.600	2.481	2.661	3.033
Moisture per cent. bagasse	53.186	54.342	53.463	55.298
Sucrose of primary juice	16.967	15.895	17.127	16.761
Purity of last expressed juice	81.04	78.15	81.06	80.84
Dissolved solids per cent. bagasse	3.21	3.17	3.28	3.75
Fibre per cent. bagasse	43.604	42.490	43.257	40.952
Primary juice in bagasse	15.324	15.609	15.537	18.096
Unit loss (v)	0.35143	0.36736	0.35918	0.44188

Keeping Co.281 as standard variety we get the following practical retention values for 1941, which confirm those of the previous season.

Table X.—Relative Retention Value of Varieties for 1941.

Variety.	Retention value.
Co.281	100.00
Uba	104.53
Co.301	102.21
Co.290	125.74

SUMMARY.

The samples of bagasse analysed at Amatikulu during the years 1940 and 1941 were classified as to their origin. During both seasons marked differences were observed in the juice-holding capacity of the different varieties of fibre. These differences were exceedingly important in the case of varieties Co.281 and Co.290; Co.290 retaining from 24 to 25 per cent. more juice for each unit of fibre than Co.281. Other varieties were intermediate between these two extremes.

Mr. MOBERLY said the method followed by Mr. Dymond in obtaining these results was a very useful one. He thought the work should be extended and the actual extraction should be determined.

Mr. Moberly said the author was not correct in stating that the quality of fibre had been ignored by textbooks and papers dealing with the effect of fibre on extraction. Maxwell and Geerligs clearly recognized the effect of quality of fibre on extraction, while Noël Deerr showed that pithy fibre and internode fibre gave different extractions. In a paper printed in 1938, Mr. Rault acknowledged the effect of quality of fibre on extraction, while Dr. Hedley in 1936 gave some figures on the mechanical quality of fibre. The fact that quality of fibre was an important factor in extraction was well recognized, but it was difficult to measure it quantitatively.

Mr. DYMOND, in reply to a further question by Mr. Moberly, said that care had been taken to avoid any after effect of a previous consignment of cane. There was quite an adequate overlap in all cases.

He was well aware that many authors had recognized the importance of fibre quality, and their observations were based on actual experience. He thought, however, that it was the first time that a large series of figures showed the effect of fibre quality.

The VICE-PRESIDENT said that he had often noticed the marked difference in the readiness with which certain varieties would take a stain when a section was examined under a microscope. There was usually a difference in the intensity of the stain as well, and this was obviously due to differences in the chemical composition of the fibres in the various varieties.

Prof. STEIN referred to Appendix C and said that in an experiment of that nature the timing was important. The distribution of the samples should be more or less similar. As it was, the percentage samples taken from Co.290 during the unfavourable month of June was higher than that for Co.281. The differences between the two varieties were, however, so big as to cover this oversight.

One further point was that in the table of distribution, Appendix C, only part of the data used in Appendix A was given. For Co.290, for example, the distribution of only 340 samples out of a total of 670 was given.

Apart from that this number did not seem representative of the whole, the sucrose per cent. bagasse varied from 3.35 to 3.48, whereas the average in Appendix A was as low as 3.27. Rather than to take a simple average on these figures it would have been better to take the figures mill by mill and month by month.

Prof. Stein also critised the method of taking a standard fibre of 15 per cent. It would have been better if the actual fibre and actual corresponding extraction could have been obtained.

Mr. DUCHENNE pointed out that this paper threw some light on the difference in moisture per cent. bagasse between Co.281 and Co.290 and thus their sucrose retention values. It was described as the result of inherent differences in fibre. This physical quality might be attributed to their ratios of rind to pith fibre, which must be higher in Co.281. He pointed out that factory No. 3 crushed the highest proportion of Co.281 and had the lowest moisture per cent. bagasse.

Mr. Duchenne gave the following figures for Umfolozi mill, season 1941 :—

Variety.	Per cent. crushed.	Planters' sucrose per cent. cane.	Purity of crusher juice.	Expected overall recovery.
P.O.J.2725	60	13.90	87.1	81.38
Co.281	28	13.85	87.3	81.57
Co.290	6	12.67	85.9	79.80
Co.301	4	13.39	88.8	82.93
Uba	2	12.95	84.6	77.87
Season	100	13.78	87.1	81.38