FURTHER DEVELOPMENTS OF SUGARCANE VARIETIES IN SOUTH AFRICA

By H. H. DODDS.

The last general report on sugarcane varieties grown experimentally and commercially in this country was presented to this Association by the writer three years ago.[1]

Since then certain trends of change in varieties and their effect on the industry have continued.

Thus the varieties Co.281 and Co.301 continue to form an increasing part of the crop, while the older established varieties, Uba, Co.290 and P.O.J.2725 and 2878, continue to decline in proportion.

Herewith is a table of percentages over recent years :—

	Per cent. of total crop.					
	1943/44.	1942/43.	1941/42.	1940/41.	1939/40.	1938/39
Uba...	6.50	11.1	16.6	23.2	30.2	32.2
Co.281	64.40	52.4	42.4	37.5	28.3	21.0
Co.290	11.28	19.1	26.5	28.2	30.0	35.0
Co.301	14.06	10.6	5.9	3.3	2.4	0.3
P.O.J.2725 and 2878	3.76	6.8	8.6	7.8	9.1	11.3

Co.281 has proved very suitable to South African conditions, especially in heavy soils, and has qualities of hardiness which makes it adaptable to the less extreme vagaries of our local climate, though, as many of us discovered during last season of exceptional rains, it does not always resist prolonged waterlogging in heavy soils as long as might be desired. Hitherto it has been very resistant to the major diseases of sugarcane in this country.

Nevertheless, it is undesirable that any one variety should monopolize too much of the area under cane; hence the necessity of developing other canes to supplement or surpass Co.281 over the wide range of soils to which it is suited.

Co.301 is another rapidly expanding cane, as the extent of its usefulness in this country in light and medium soils and its many good qualities come to be more fully appreciated.

Co.290 has now been on the down grade for some years. It proved very susceptible to red rot in certain areas, and is not very adaptable to some of the exigencies that may arise in harvesting the crop; but if it can be harvested always at the right time and cultivated in the right type of soil and conditions it will continue to give good results, as witnessed by the eighth ratoons of this variety still growing very well at the Experiment Station.[15] But even if there should be no future for Co.290 now in this country, it has certainly served the industry well in the past and tided us over a difficult period when Uba had to be supplemented at comparatively short notice.

The two P.O.J. canes, 2725 and 2878, continue to decrease in area, even in the alluvial coastal deltas, being replaced largely by the general varieties Co.281 and Co.301 that cannot be considered particularly well adapted to such conditions.

There would appear to be a place here for an improved variety of the thick or noble type to which the P.O.J. numbers mentioned belong, but not the two Co. varieties, although there are some excellent Coimbatore canes of the noble type. Perhaps we shall find one that suits our particular requirements.

The effect on yields of cane per acre of the progressive replacement of Uba by other varieties may be seen in the following table :—

	Uba cane.		Other Varieties.			Total crop.	
Year.	Proportion of total crop	Tonnage per acre.	Proportion.	Tonnage per acre.	Ratio of yield of other varieties to Uba.	Tonnage per acre.	Rainfall in inches.
1926/31 inclusive ...	100.00	20.35	—	—	—	20.35	—
1932...	99.96	19.29	0.04	27.80	144.1	19.29	48.20
1933...	99.72	20.20	0.28	29.50	146.0	20.24	31.12
1934...	96.68	20.63	3.32	29.55	143.2	20.84	44.60
1935...	88.80	19.49	11.20	26.78	137.4	20.10	46.12
1936...	63.77	19.04	36.23	26.83	140.9	21.27	50.10
1937...	51.90	20.38	48.10	28.91	141.9	23.75	39.48
1938...	28.04	20.40	71.96	31.57	154.8	27.37	40.38
1939...	25.08	23.34	74.92	33.53	143.7	30.22	47.63
1940...	19.28	20.95	80.72	27.55	131.5	27.55	43.37
1941...	13.12	15.22	86.88	24.06	158.1	22.36	26.18
Mean 1932/40 inclusive	64.93	20.41	35.07	29.11	142.6	23.40	43.44

These figures are taken from the Special Agricultural Census of Sugarcane grown by European planters only (approximately 91 per cent. of the total crop), published annually by the Union Government Office of Census and Statistics.[2] Unfortunately, returns for seasons subsequent to 1941.42 are not yet available.

Although new varieties began to be released in 1930 for commercial growing, it was not until the 1934/35 crop season that they were harvested in sufficient quantities to affect appreciably the total crop yield per acre. Since then there has been steady progress in yields of cane per acre concurrently with the increasing proportions of the new varieties.

The tonnage of Uba cane per acre remains remarkably constant at about 20 tons per acre, not varying more than one ton per acre from this figure except in seasons of unusually favourable rainfall such as 1939, or unusually unfavourable, such as 1941.

Similarly, the other varieties keep fairly close to a mean yield of about 29 tons of cane per acre, and the progress shown above is therefore largely due to the gradual replacement of Uba by the improved varieties. In the same way, a fairly constant ratio of sucrose content of the new varieties to that of Uba can be traced from the analytical records of the Sugar Industry Central Board, representing a typical proportion of about 60 per cent. of the total crop.

Average Sucrose Content of all Cane tested by Central Board for Seasons 1936/1943 inclusive.

Year.	All varieties.	Uba.	Other varieties.	Ratio of other varieties to Uba.
1936	13.15	12.76	13.84	108.46
1937	13.84	13.35	14.40	107.87
1938	13.79	12.92	14.14	109.44
1939	13.38	12.73	13.63	107.07
1940	13.13	12.39	13.34	107.67
1941	14.12	13.63	14.21	104.26
1942	13.49	13.01	13.55	104.15
1943	13.20	12.47	13.25	106.25
Means	13.51	12.91	13.80	106.85

We have sufficient data to compare both the average yield of cane per acre and the sucrose content per cent. cane of Uba and the new varieties for the seasons 1936 to 1941 inclusive. I propose omitting the 1941 figures, however, because of the unprecedented drought of that year, which caused Uba cane yields to be shown in a particularly unfavourable light.

	All varieties.	Uba only.	All other varieties than Uba.	Ratio of other varieties to Uba.
Average yield of cane in tons per acre, 1936/40 inclusive, grown by Europeans...	26.03	20.82	29.68	142.55
Average sucrose content per cent. cane according to Central Board, 1936/40 inclusive	13.46	12.83	13.87	108.11
Average yield of sucrose in tons per acre, 1936/40 inclusive, calculated from above data	3.50	2.67	4.12	154.1

It is evident, therefore, that in normal seasons the new varieties are capable of yielding rather more than half as much more sucrose per acre than Uba.

It is realised that the Uba crop in recent years has consisted almost entirely of old ratoons, nearly all the plant cane having consisted of the new varieties.

However, there is no sign of the yield per acre of Uba cane having fallen off, and it may be supposed that the Uba was maintained for further cropping mainly in those fields where it was ratooning well.

As regards relative sucrose content, it may be remarked that mixed consignments of cane received at the mill containing Uba are recorded as Uba, which would tend towards its advantage in sucrose content. This will possibly account, partially at least, for the progressively smaller superiority in sucrose content of the new varieties over Uba.

Another differential factor is the tendency towards harvesting the new varieties at least at shorter periods of growth than was customary when the crop was all Uba. Thus the proportion of the total area under cane that was reaped in a given season increased from only 42.3 per cent. in 1927, when the crop was entirely Uba, up to 52.1 per cent. in 1940, when it was only 19 per cent. Uba.

NEW VARIETY RELEASE.

The only new variety to be released since Co.301 in 1935 to the industry for commercial planting is Co.331, which was issued in the latter part of 1941.

Co.331 is a cross between Co.213 and Co.214, both of which were thoroughly tried here and found wanting. Co.213 was a vigorous growing cane under favourable conditions and resistant to most of the prevailing diseases, but was not sufficiently resistant to drought and other unfavourable soil conditions. Co.214, on the contrary, was particularly resistant to drought as well as to cane disease and was capable of developing a high sucrose content, but was a poor cane yielder.

Thus over a cycle of plant cane and five ratoon crops completed at the Experiment Station in 1941 in a stiff clay soil the following are the comparisons with Uba and Co.281 in terms of tons of sucrose per acre per crop[3]:—

	Tons sucrose per acre.	Per cent. of Uba.
Co.281	5.38	148.6
Uba	3.62	100.0
Co.213	3.51	97.0
Co.214	2.25	62.2

Co.331 has figured in two variety trials at the Experiment Station, and two on the estate of the Tongaat Sugar Co., 10 cuttings in all. [4] [5] [6] [7] [8] [9] [10] [11] [12] [13]

In the two plant cane and three ratoon experiments in the clay soils of the Experiment Station, Co.331 led in yield of cane per acre in one of the plant cane crops and in all three ratoon crops, but because of its relatively low sucrose content could not establish a significant superiority over Co.281, and in one case was significantly inferior.

In the first ratoon crop harvested at 24 months in section G4 in August, 1943, the average yield per acre of the Co.331 was 83.28 tons of 12.77 per cent. sucrose, or 10.63 tons of sucrose per acre, the Co.281 controls yielding 72.64 tons of cane per acre of 14.56 per cent. sucrose, or 10.58 tons of sucrose per acre.

The experiments at Tongaat were in light sandy soils, either wind-blown beach sand at Mwawine, or Table Mountain Sandstone at Isiputu.

In the latter case Co.331 led significantly in yield of cane per acre over Co.281 and the other four varieties under trial at each of three cuttings, but the lead was not significant in terms of sucrose per acre because of the relatively low sucrose content of the Co.331.

In the Mwawine experiments the variety Co.432 led in both plant cane and first ratoon crops in yield of cane and of sucrose per acre, the only experimental site in which this variety proved a success. Co.331 came second, proving significantly better at both cuttings in yield of cane and of sucrose to Co.281 and three other varieties under trial in this experiment.

It thus appears evident that Co.331 may be expected to give improved yields of sucrose per acre over other released varieties only in very light soils, where its superiority in yield of cane is sufficient to overcome its relatively low sucrose content.

Another factor that needs to be borne in mind is the somewhat lower recoverability of sugar in the factory from a variety such as Co.331 having a high ratio of fibre to sugar, thus tending towards a lower extraction, and a lower purity of juice tending towards a lower boiling-house recovery in comparison with other cane varieties, other things being equal.

Nevertheless, I believe that there is a useful place for a vigorous grower and ratooner such as Co.331 in our sugar industry.

Further experiments with this variety are, of course, in progress.

Co.331 is a variety that has become widely planted in India in recent years, in contrast to Co.281 and Co.301, which have never become widely established in India.

OTHER PROMISING NEW VARIETIES.

There are few really promising new imported varieties now under trial. Co.453, a cross between Black Cheribon and Co.285, proved a very vigorous grower but is only moderately resistant to red rot.

Co.464 is the most promising Coimbatore variety at present on trial and is doing well in a wide range of soils, but we have not had it very long. It is a cross between Co.361 and Co.285 and shows good resistance to red rot.

C.P.29/291, a cross between Co.281 and U.S.1694, is the most promising variety we have yet had from the U.S. Cane Breeding Station at Canal Point, Florida, but we are not yet in a position to say much about it.

B.3337 is a promising variety recently received from Barbados.

Another variety of some promise for limited application is M.P.R.28, a hybrid of the favourite Puerto Rico cross P.O.J. 2725 × S.C.12/4. It closely resembles its P.O.J.2725 parent, but is even higher in sucrose content and does not exhibit the tendency of P.O.J.2725 to premature flowering. For some years it successfully replaced P.O.J.2725 as a standard variety in Cuba, and might do the same here, where the area under P.O.J. 2725 and 2878 is rapidly diminishing, even on the Umfolozi flats.

NEW SEEDLING CANES.

By far the most promising developments now in view are the seedling canes germinated and raised in this country from imported fertile fuzz of the following crosses:—

P.O.J.2725 × Co.281

P.O.J.2725 × Co.301

Co.421 × Co.312

from Coimbatore, and from batches of fuzz of very complex descent from Mauritius and Hawaii.

Up to the present the most promising seedlings have resulted from the Co.421 × Co.312 cross.

Co.421, like all Coimbatore varieties numbered between 400 and 500, is a thick cane variety, and proved insufficiently resistant to drought when tested here. Co.312 is a thin type of cane and also did not prove in any way outstanding when tested here.

Co.421 is a cross between P.O.J.2878 and B.3412 (a Barbados variety derived from the famous Louisiana cane D.74), and Co.312 is a cross between Co.213 and Co.244.

The following diagrams show the descent of the N.Co. seedlings of the above-mentioned three crosses from the original natural varieties.

A few of the P.O.J.2725 × Co.281 or Co.301 crosses passed primary and secondary trials sufficiently well to be considered worthy of field trials against Co.281 or Co.301. Some of them have proved apparently equal or even slightly superior to Co.281 in soils eminently suited to the latter, but none have yet proved significantly superior to Co.281 or Co.301. Further experiments in different types of soil are in progress both at the Experiment Station and at Tongaat Sugar Co., and at Verulam (Central Factory, Ltd.).

Seedlings of the Co.421 × Co.312 cross have been tested recently at the Experiment Station against Co.281 in heavy clay soils where the latter variety has hitherto been supreme.

The numbers N.Co. 310, 349, 352, 291, 339 and 330 proved significantly better (20 to 40 per cent. more in terms of sucrose per acre) than the Co.281 in the plant cane plots.[14]

They ranged in yield of cane from 51 to 97 tons of cane per acre at 24 months, with sucrose contents from 12.78 to 16.78 per cent. and sucrose yields per acre from 7.44 to 14.16. The Co.281 was from 59.35 tons of cane per acre of 15.61 per cent. sucrose, corresponding to 9.27 tons of sucrose per acre to 72.09 tons of cane per acre of 15.12 per cent. sucrose, corresponding to 10.90 tons of sucrose per acre, according to the soil. These tests were made last season when conditions happened to be particularly favourable for heavy cane yields.

Planting material of these hybrids, of which the original seed did not arrive here until May, 1938, is still scanty, but demonstration plots have been planted under various soil and other conditions at Powerscourt (Illovo Sugar Estates), Cornubia Estate (Natal Estates, Ltd.), Mount Edgecombe), Chakas Kraal (T. Roberts), and Eshowe (estate of the late C. R. Butcher).

While gaining information about their reaction to these different environments, it is hoped to build up stocks of cane for planting out further replicated experiments of these seedlings next season.

Certain things still have to be further studied about them before any of them can be selected for release; for example, their resistance to red rot and other diseases, their capabilities for different soils and conditions, and their ratooning powers.

There is no doubt, however, that some of the seedlings will fulfil excellently the exacting and varied requirements of a commercial cane for this country.

In the meantime, further supplies of seeds from the same crosses that have already proved successful have been received from Coimbatore within the past few weeks. Germination was fairly successful, notwithstanding the long period the fuzz had been in transit, and several thousand new seedlings have sprouted, each one, of course, being an entirely new individual with a different blend of characteristics from any other cane variety.

We have had several batches of seed from Mauritius within recent years. The first batch or two failed to give us anything of commercial value, and one or two other lots of seed did not germinate.

Experiment Station,
South African Sugar Association,
Mount Edgecombe.
April, 1944.

Within recent years, however, we have had some very promising material from Mauritius under study, both at Mount Edgecombe and at Umfolozi (U.L.O.A.), from which some valuable varieties may develop.

The batch of fuzz of fourteen different crosses from Hawaii received in 1940 yielded over 7,000 seedlings to come to maturity. It is still a little early to say much about these, except that many of them did remarkably well in preliminary tests, and have been replanted to build up sufficient material for small plot trials.

The development of seedling canes is a long and tedious task, but we may consider that we are now well on the way to developing and establishing excellent new varieties by this means.

ACKNOWLEDGMENTS.

We are much indebted to the Imperial Cane Breeding Station at Coimbatore and to the Indian Government Sugarcane Expert, also to the Sugar Research Station of Mauritius, and the Experiment Station fo the Hawaiian Sugar Planters' Association, for supplies of seed. For the supply of specimens of already established sugarcane varieties, the U.S. Bureau of Plant Industry, Washington, D.C., and the British West Indian Sugarcane Breeding Station at Barbados continue to earn our grateful thanks.

Thanks are also due to the many planters and estates who have co-operated in our work on new varieties and seedlings by offering suitable land and taking care of our variety experiments; also to the Division of Botany and Plant Pathology of the Department of Agriculture, and Dr. V. A. Wager, officer in charge of the Durban Botanical Station of the Division, for taking charge of our quarantine reception glasshouse in Durban for imported specimens of sugarcane.

SUMMARY.

The changes are traced in the proportion of different sugarcane varieties grown commercially in this country over recent years, and causes leading to these changes are discussed.

The yields of cane per acre over recent seasons are recorded in relation to the progressively diminishing proportion of the Uba variety. These, taken in conjunction with cane analyses done by the Sugar Industry Central Board, show that the new varieties yield approximately a little over 50 per cent. more sugar per acre than Uba.

The origin of the recently released variety Co.331 and its performance in field experiments, are described.

The gradual establishment of new canes from imported seed fuzz of varied origin and comparative experiments with them are described, and the descent of such seedlings from original natural varieties shown diagrammatically.

References.

[1] Dodds, H. H. (1941): Notes on the Present Sugarcane Variety Position South Africa. 1941. Proc. S.A. Sugar Tech. Assoc., **15**, 78.

[2] "Special Annual Censuses of Sugarcane Plantations" (1926-1941 inclusive) Office of Census and Statistics, Pretoria.

[3] (1941): Experiment Station Notes. S.A. Sugar Jour., **25**, 389.

[4] (1940): Experiment Station Notes. *Ibid.*, **24**, 35.

[5] (1941): Experiment Station Notes. *Ibid.*, **25**, 445.

[6] (1943): Experiment Station Notes. *Ibid.*, **27**, 315.

[7] (1941): Experiment Station Notes. *Ibid.*, **25**, 447.

[8] (1943): Experiment Station Notes. *Ibid.*, **27**, 401.

[9] (1940): Experiment Station Notes. *Ibid.*, **24**, 617.

[10] (1941): Experiment Station Notes. *Ibid.*, **25**, 615.

[11] (1943): Experiment Station Notes. *Ibid.*, **27**, 489.

[12] (1941): Experiment Station Notes. *Ibid.*, **25**, 559.

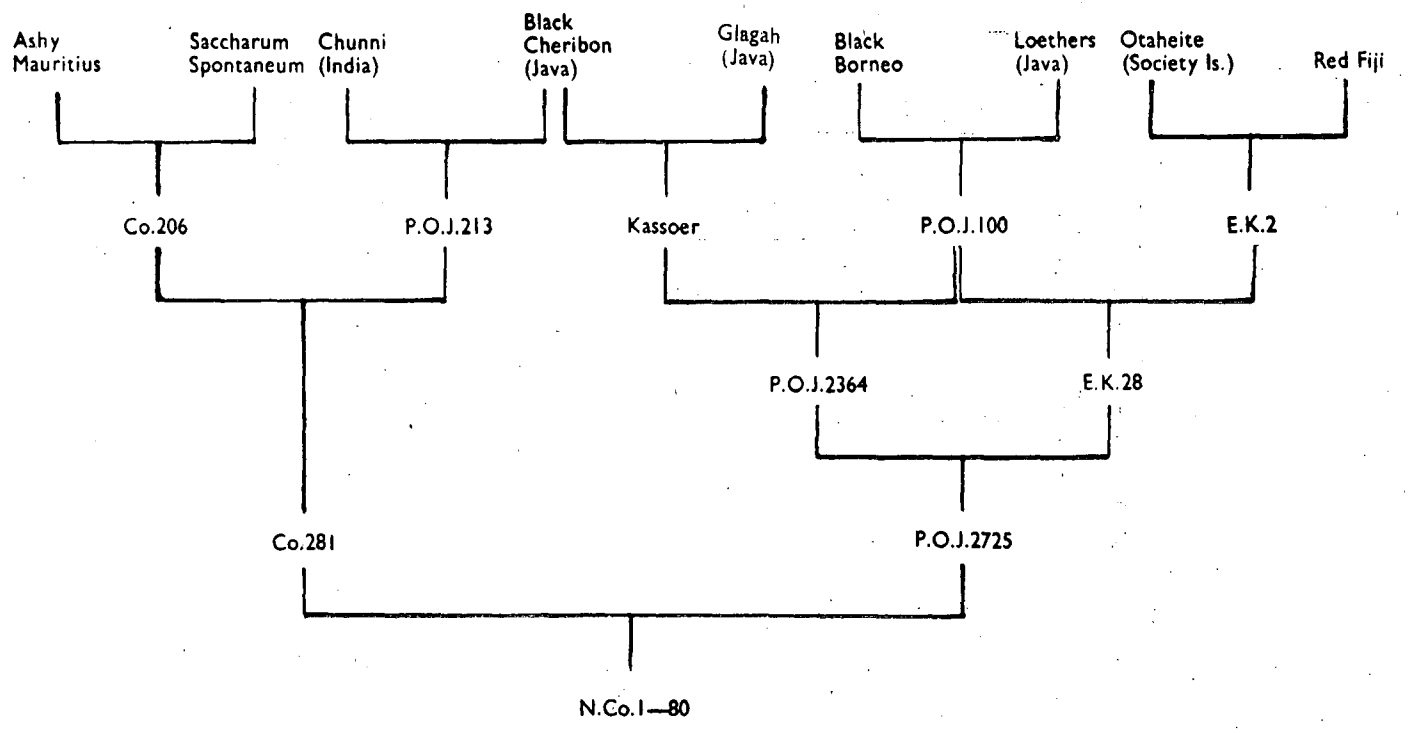
[13] (1943): Experiment Station Notes. *Ibid.*, **27**, 403.

[14] (1944): Experiment Station Notes. *Ibid.*, **28**, 117.

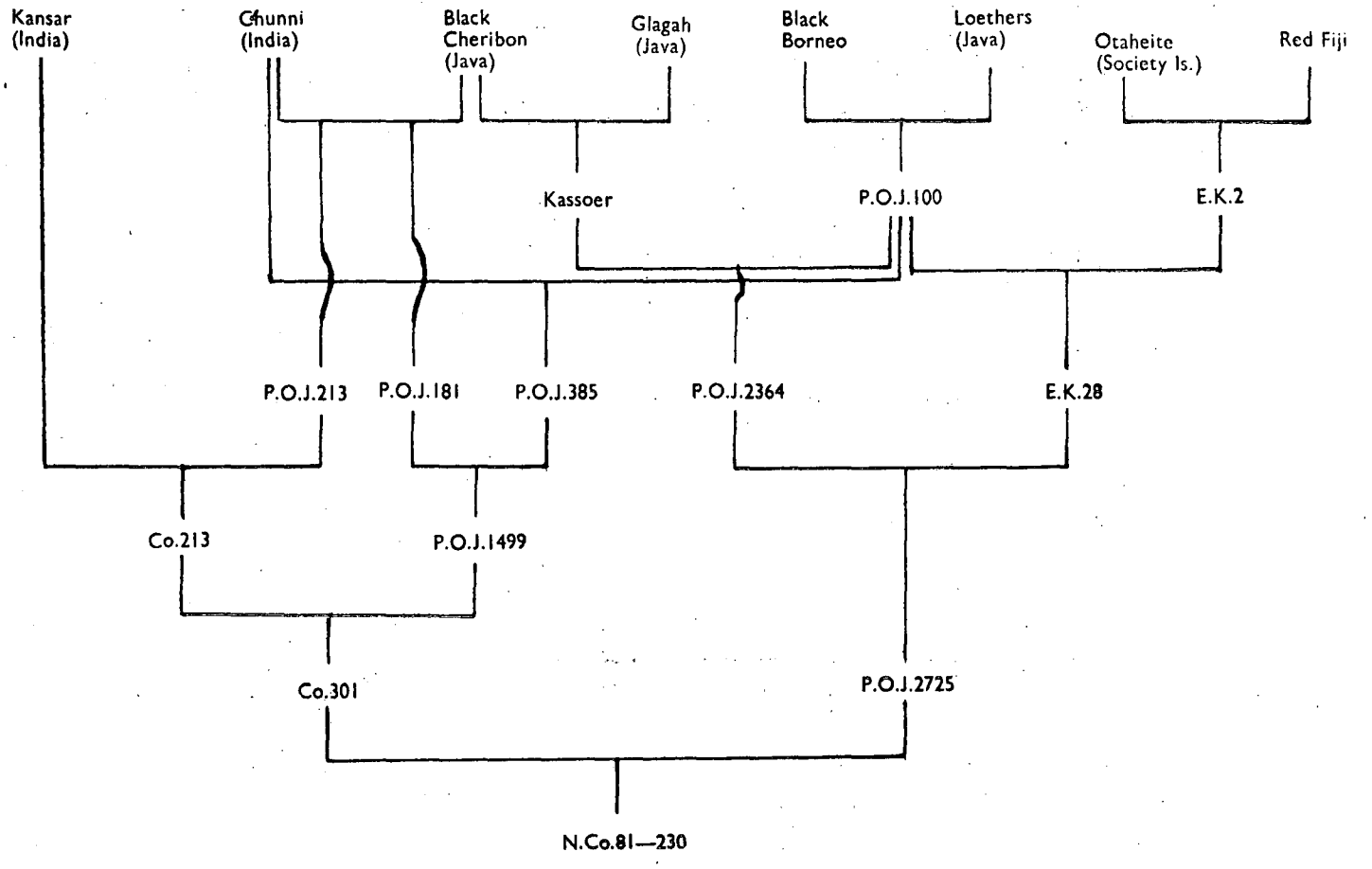
[15] (1942): Experiment Station Notes. *Ibid.*, **26**, 625

The diagrams mentioned are included in the Proceedings of the S.A. Sugar Technologists' Association, 1944.

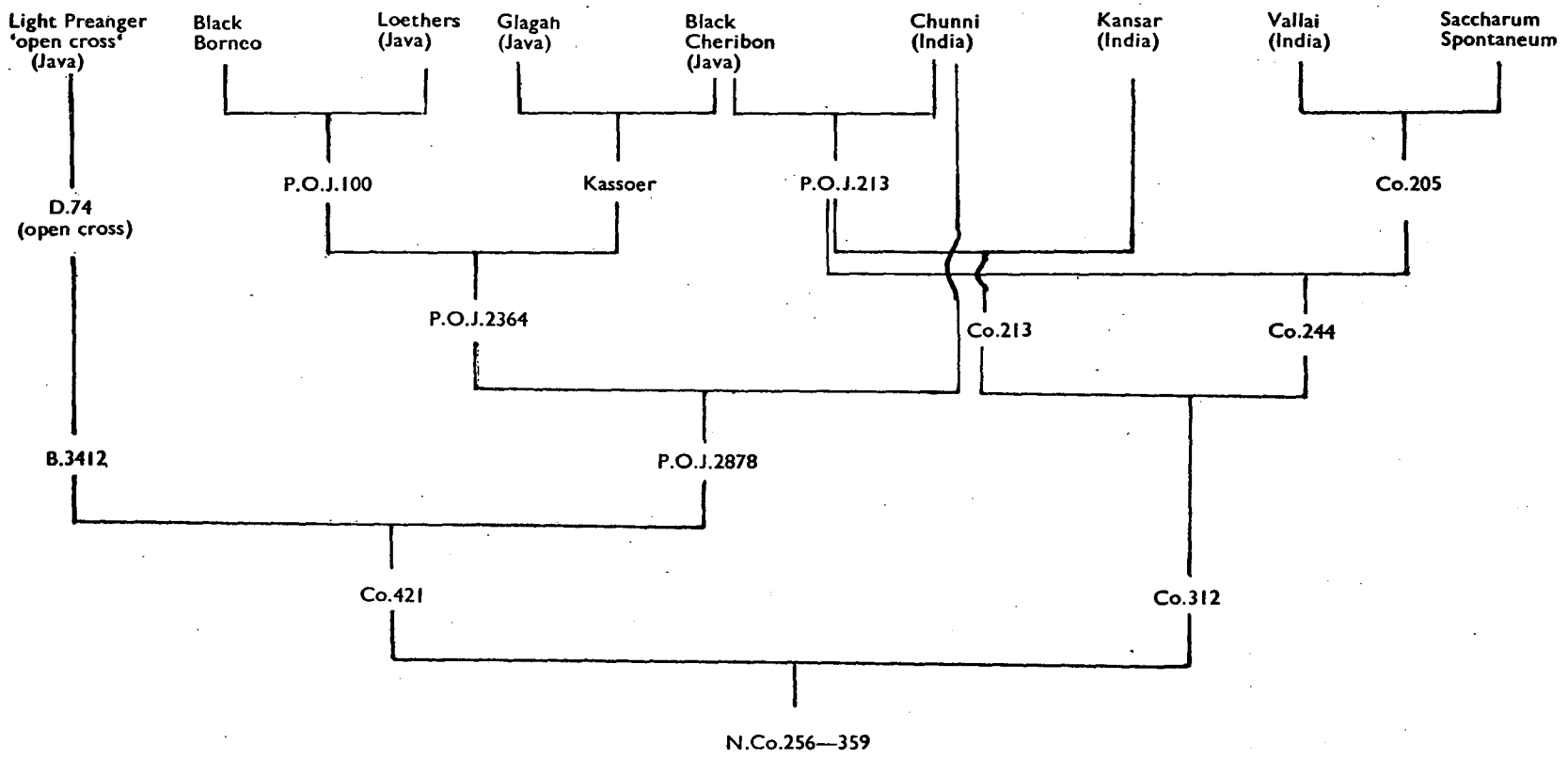
ORIGIN AND DESCENT OF THE P.O.J. 2725 × Co.281 SEEDLINGS



ORIGIN AND DESCENT OF THE P.O.J. 2725 × Co.301 SEEDLINGS



ORIGIN AND DESCENT OF THE Co.421 × Co.312 SEEDLINGS



The PRESIDENT said that although the development and establishment of new varieties was a long and tedious task, we were fortunate in that so much progress had already been made.

Mr. DYMOND said, while agreeing to the necessity of varieties being submitted to disease-resistant tests, and while realizing that the release of a new variety was necessarily a long and tedious task, he still felt that it might be possible to try out those promising varieties on a large scale sooner. The last cane released, Co.331, was a poor one in all respects except yielding powers, when compared with some of the very promising N.Co. seedlings which the Experiment Station had not yet seen fit to release.

He thought it was rather unfair to compare the varieties on their average sucrose percentages for the whole year. This put certain varieties at a disadvantage. Uba, for example, which was now going out of production, was mostly cut at the beginning of the season, when sucroses were naturally low. Co.301 was also unfairly treated, as this variety was cut at the end of the season.

Dr. McMARTIN replied to Mr. Dymond, stating that when sugarcane seed was sown, as was done when raising these new varieties, it was two years before a plant was obtained—and then only one plant, as each seed provided a new individual; this when cut would only plant a line of cane which had to grow for another two years, and then again another two had to elapse before there was even a small quantity of material available. Thus six years had elapsed and only a limited quantity of cane had been grown from selected seedlings.

Mr. RAULT found himself in agreement with nearly everything mentioned in the paper, but he could not agree that the new cane varieties have led to a higher average sucrose per cent. cane. It was most puzzling to him that, in spite of most varying weather conditions—extreme droughts and heavy rainfalls of the past nine years—there were no definite indications that the sucrose per cent. cane had gone up, as one would expect from the popularity of the new varieties and their supposed better sucrose content. The average sucrose content of the varieties milled at Natal Estates for the last season, and the average sucrose per acre, were as follows:—

	Sucrose per cent. cane.	Sucrose per acre.
Uba...	12.9	4.8
Co.290	12.4	4.7
Co.281	13.3	6.2
Co.381	12.78	5.97
P.O.J.	13.3	5.2

Co.301 was still being watched and studied very carefully. It was not greatly favoured in the mill, but the field staff and growers liked it. The results were not only from Natal Estates, where about 50 per cent. of the cane was under irrigation, but also included consignments of cane from planters. Nearly all the cane was two years old and fully matured when harvested. It should be pointed out that irrigation did not have such a pronounced depressing effect on sucrose as was often imagined. Irrigation was only practised eleven days at Natal Estates this year. Tests done last year and in 1941 showed that there was very little difference between the sucrose contents of cane from irrigation and unirrigated lands. Irrigation therefore only played a minor role in lowering the sucrose per cent. cane. There seemed to be other factors which were not properly understood yet.

Mr. DODDS said he found the figures submitted by Mr. Rault of great interest to him, especially so since the Natal Estates' crop comprised 10 per cent. of the whole crop. He, nevertheless, preferred the figures from the Central Board, in that the results were obtained from thirteen factories evenly distributed over the whole area and comprising 60 per cent. of the whole crop. The average sucrose content of the cane tested by the Central Board was, year after year, very close to that of the whole industry.

It was, of course, very desirable to have canes giving not only a good yield of cane per acre, but also a good sucrose percentage. That was what we were aiming for. In the past it was perhaps too much to expect where the best canes from other countries were imported. These canes were developed for other countries, and as such were not ideally suited to our conditions. The speaker was, however, more optimistic about the future, where we were now developing our own varieties to suit our local conditions. Mr. Dodds said he was as anxious as Mr. Dymond to see new varieties released as soon as possible, but he reminded him that the seeds of the varieties that we now consider promising were only imported in 1938, and that consequently we would still have to wait patiently for some time to ensure the most suitable selection.

It was quite possible that Uba, because it was cut early in the season before its maximum sucrose had developed, suffered in comparison with the other varieties. This was, however, probably compensated for by the fact that Uba was now cut mostly as ratoons and that ratoons frequently had a higher sucrose content than plant cane. Carefully controlled field experiments also bore out the statement that the new varieties produced 50 per cent. more sugar per acre than Uba. It should be pointed out once more that Uba was neither an early nor a late ripening cane and should be cut, more so than any other variety now grown, during the peak months of August and September.

In reply to Dr. Rossouw, Mr. Dodds said that the yields of tons of cane per acre were obtained from the Government statistics. These figures were obtained by the Government from the planters, and their accuracy depended on the farmer. Many of them, of course, did not even know the area of the fields, yet when these returns were scrutinized year after year they were found to be sufficiently uniform to give a certain amount of confidence in their accuracy, even though individual returns might not always be so accurate.

The PRESIDENT said that a paper such as this illustrated the value of the Experiment Station to the sugar industry in doing work of this nature. He could not see that the Department of Agriculture could justify the starting of the Pongola scheme without the full co-operation of the Experiment Station.