A FIELD TRIAL OF CERTAIN SUGAR CANE VARIETIES: SERIES B

By H. H. DODDS and P. FOWLIE.

PART I.

Mr. DODDS read the following paper on this subject:—

This experiment represents the second series of quantitative variety trials at the Natal Sugar Experiment Station.

The first series (Series A) of which the results have been published, [1] were planted in 1926 before any of the new varieties imported under the new scheme of introduction via the quarantine greenhouse were yet available in sufficient quantity for field experiments. Consequently only those varieties that had been long in the country are represented in Series A.

The present series was planted in October, 1928, and comprises those varieties of which it was considered desirable to have quantitative trials and of which sufficient material had already accumulated for this purpose.

These varieties were Co. 205 and 210 of the Coimbatore seedlings, several canes of the Uba type, including CH. 64/21, a cross between Uba and D. 74, produced at the Cuban Agricultural Experiment Station near Havana—Kavangire, an old-established cane that has often been confused with Uba in different parts of the world—Agaul, a cane imported from India by the Department of Agriculture some years ago, and Merthi, another Indian cane imported by us via the U.S. Bureau of Plant Industry at Washington; also Oshima, a cane of Japanese (Formosan) origin that had also come to us via Washington.

Another cane of the Uba type is Cuban Selection, an unidentified variety introduced unofficially into this country some years ago from Cuba.

P.O.J. 213 was included, which is also a thin type of cane and was produced at the Javan Experiment Station some years ago, and also Townsend's Selection, a variety of cane that had long been growing on the estate of A. Townsend at Umhlali and known by him as "China" cane.

There was also SC. 12/4, a thick cane from the West Indies; P.O.J. 2714 was also originally included, but it was found necessary eventually to use all the material of this variety for further replanting so that it did not come into the final results. P.O.J. 2714, however, is included with other varieties of this type in later series of trials (Series D. and E.).

The site selected for the experiment was a rather heavy clay loam on a gentle slope facing West, gradually merging into a level patch at the bottom. The soil was of fair depth and was apparently formed by the weathering of a doleritic hill cap very characteristic of this part of Natal. There was a stiff clay sub-soil and the field as a whole, especially the lower flat portion, presented difficulties in drainage.

A partial chemical analysis is as follows:—

	Per cent.
Hygroscopic moisture	6.64
Loss on ignition	12.01
Available potash (K_2O in 1% citric solution)	0.0112
Available phosphate (P_2O_5 in 1% citric solution)	0.0030
Total nitrogen	0.156
Total carbon	2.808
Carbon nitrogen ratio	18.0
pH	5.84
Lime requirement (tons $CaCO_3$ per acre)	4.87

The soil from the upper and lower portions of the field was sampled and analysed separately and showed very little difference.

The field like all the experiment station had been almost continually under cane for about 50 years. It was last harvested before becoming part of the experiment station in September, 1926, when it yielded 22 tons of cane per acre. It was allowed to fallow during 1927 and sown with buckwheat in September, 1927. Two further volunteer crops of buckwheat were obtained and ploughed in in turn up till April, 1928.

It was finally replanted with cane in October, 1928. Each of the 13 varieties, including Uba as a control, were planted in quadruplicate plots of 1/20th acre each, consisting of 4 lines, 5 feet apart and 109 feet long.

The cane in each case was planted in single line and fertilised with a mixture of 500 lbs. superphosphate, 60 lbs. potassium chloride and 120 lbs. of ammonium sulphate per acre.

Some of the SC. 12/4 failed to germinate, also a little of the P.O.J. 2714, and blanks were filled in. With both of these varieties, however, the cane available for planting was very young and immature. Each of the other varieties gave practically a perfect stand.

The P.O.J. 2714, Co. 210, Oshima, Townsend's Selection and P.O.J. 213 first appeared above ground in the order named, followed by Agaul, Uba, CH. 64/21, Cuban Selection, Merthi and Kavangire, which all sprouted at about the same time. SC. 12/4 and Co. 205 appeared some few days later.

1 Proc. S. African Sugar Tech. Ass. 1929, 141.

Periodical analyses of hand samples showed that the following varieties were all mature as early in the season as March, 1930:—SC. 12/4, P.O.J. 2714, P.O.J. 213, Cuban Selection, Oshima and Co. 210. Each of these showed a sugar content per cent. cane of 13 or over and a purity of not less than 86. The first-named, SC. 12/4, in fact showed a sugar content (Pol. per cent. cane) of 14.75, with a purity of 93.4 and Brix 21.12.

By May all varieties showed over 13 per cent. Pol. (sugar) in cane with a purity of 85.3. P.O.J. 2714 took the lead with a Pol. of 15.41 per cent. cane, purity 92.3 and Brix 21.6.

The ripening season for sugar cane, however, was exceptionally early in 1930 at Mount Edgecombe owing to the exceptionally low rainfall of the latter part of the summer after January.

The field was harvested in July, 1930, except for P.O.J. 2714, which was cut at irregular intervals for replanting and so does not appear in the final results.

The total rainfall received by the plant crop during its twenty months in the ground was 66.05 inches, of which only 9.36 inches fell during the last six months.

The final results of yields, etc., were as follows:

Variety.	Yield of cane in tons per acre.	Purity of juice.	Pol. (sucrose) per cent. cane.	Sucrose yield in tons per acre.	Ratio to standard (Uba eq. 100).	Standard deviation from mean of sucrose yield per acre.	Standard experimental error.	Reducing substance ratio.	Phosphate (mg. P_2O_5 per 100 ml. of juice).	Fibre.
Co. 205	55.70	90.3	15.89	8.86	118.0	0.690	0.395	2.74	14.0	14.36
Co. 210	57.61	90.0	14.85	8.56	114.0	0.547	0.274	2.82	17.5	13.82
Cuban Sln. ..	48.16	91.9	16.51	7.95	105.9	1.155	0.578	1.73	15.3	13.96
CH. 64/21	48.41	91.3	16.39	7.93	105.6	0.559	0.280	1.54	14.8	—
Uba	44.76	92.4	16.79	7.51	100.0	0.435	0.226	1.29	13.2	14.07
SC. 12/4	44.61	95.8	16.59	7.41	98.7	0.197	0.098	—	8.8	—
P.O.J. 213	46.55	93.8	15.58	7.25	96.5	0.437	0.218	—	11.9	—
Agaul	44.94	91.6	15.95	7.17	95.5	0.436	0.218	1.46	17.3	—
Kavangire	42.07	94.1	16.83	7.08	94.3	0.630	0.315	0.75	13.2	—
Oshima	41.30	91.7	16.33	6.74	89.7	1.045	0.522	0.76	15.0	12.97
Townsend's Sn	44.56	86.4	14.14	6.31	84.0	0.544	0.272	3.18	13.4	13.11
Merthi	38.04	90.1	14.03	5.33	71.0	0.502	0.251	0.83	17.5	14.28

Making due allowance for the considerable experimental error both of the soil and of the hand sampling of the cane, it is evident that under the conditions of this experiment Co. 205 and 210 are distinctly better, and the Cuban Selection and CH. 64/21 perhaps slightly better, than the Uba standard; and that the Kavangire, Oshima, Townsend's Selection and Merthi are distinctly inferior to the Uba in the plant cane crop at least.

The remainder may perhaps be regarded as more or less equal to Uba within the limits of experimental error and under the conditions of this experiment.

Co. 205 and 210 are both reedy canes bred at the Government Cane Breeding Station at Coimbatore in Southern India, specially for severe conditions of drought and extremes of temperature.

Co. 205 and 210 are not likely to be released from quarantine for commercial planting during the present campaign for the elimination of mosaic disease by the eradication of all susceptible varieties.

They evidently have possibilities, however, in competition with Uba in certain rather dry conditions such as these. According to present indications, some of the later Coimbatore varieties should prove superior to these, in which case Uba will not enjoy much longer its undivided monopoly, even in our drier soils.

Cuban Selection and CH. 64/21 are at least equal to Uba in this experiment and probably somewhat better, and in fact CH. 64/21 has already been released from quarantine to the industry as a possible alternative to Uba.

Both, however, are susceptible to the prevailing plant virus disease, streak disease, equally with Uba, and apparently immune for all practical purposes to mosaic disease.

Co. 205 and 210 have never acquired streak disease, but are both susceptible to mosaic.

The results from SC. 12/4 and P.O.J. 213 are somewhat disappointing in view of the very striking appearance of these canes. However, "handsome is as handsome does," and we must not lose sight of the fact that our aim should be not necessarily to produce the most beautiful plant specimens, but to grow the most sugar per acre at the lowest cost.

The results from Agaul, Kavangire, Oshima and Merthi confirmed our general impression that these varieties, all of which resemble Uba so closely in appearance, are hardly as productive as Uba. Townsend's Selection evidently is not suited to this class of soil although it made excellent growth in the early stages.

The ratoon crops at the present time (March, 1931) in general confirm the plant cane results. The Coimbatore varieties and the Cuban Selection, CH. 64/21 and Uba are ratooning strongly.

SC. 12/4 is ratooning very poorly, many of the stools having died out altogether in their uncongenial South African environment.

SUMMARY AND CONCLUSIONS.

A field trial of the following varieties is described: Co. 205, Co. 210, Cuban Selection, CH. 64/21, Uba, Agaul, Kavangire, Oshima, Merthi, Townsend's Selection, P.O.J. 213 and SC. 12/4. The soil was a clay loam of fair depth and good tilth but subject to drought. The two Coimbatore varieties gave the best results, Co. 205 giving 18 per cent. and Co. 210 14 per cent. more sugar per acre than the Uba standard. Cuban Selection and CH. 64/21 also compared very favourably with the Uba, but the other varieties were inferior to Uba, under the conditions of the experiment.

Natal Sugar Experiment Station,
South African Sugar Association,
Mount Edgecombe.

March, 1931.

SERIES A.

PART II.—FIRST RATOON CROP.

This paper describes the results of further work in the first series of comparative field trials with a range of sugar cane varieties undertaken at the Experiment Station (Series A.).

The results of the plant cane cutting were described at the 1929 Annual Conference of the South African Sugar Technologists' Association when it was shown that of the five varieties under trial P.O.J. 213 gave the best results both of cane and sugar per acre followed by Uba, D.1135, Badila and 1900 Seedling in the order named.

After the cane had been cut during July and September, 1928, the field was cultivated in the usual way, the trash being gathered into alternate middles and the middles thereby exposed cultivated once with a light plough and subsequently at frequent intervals by a mule-drawn cultivator.

A fertiliser mixture of 250 lbs. per acre of superphosphate and 100 lbs. of ammonium sulphate was applied and worked into the soil by the cultivation described.

A little hand weeding in the lines was of course necessary.

The ratoon crop received 67.04ins. of rain in all at well distributed intervals, so was not subject to drought to the same extent as the plant crop which received only 58.5ins. of which 19ins. fell in one month.

The ratoons were harvested in June, 1930, and the results showed that Uba now occupied the first place with P.O.J. 213 second followed by D.1135, 1900 Seedling and Badila in order of sucrose yield per acre.

The soil is a clay loam, distinctly acid (pH 5.5), and very deficient in moisture holding capacity and in the ordinary plant foods. There is a very stiff and impervious clay subsoil so that the soil has very poor drainage qualities.

We have now a comparative trial (Series C.) of Uba with certain of the Coimbatore varieties noted for their tolerance of severe conditions, in this kind of soil, due to harvest this coming season.

The following are the results of yields and analyses over the two crops:—

PLANT CANE CROP—HARVESTED 1928.

Variety.	1900 Seedling.	Badila.	P.O.J. 213.	D. 1135.	Uba.
Number of plots	4	4	4	4	5
Yield—Tons cane per acre	17.20	15.33	25.44	22.99	23.32
Tons sucrose per acre	2.75	2.70	4.02	3.26	3.37
Standard deviation from mean	0.29	0.24	0.29	0.08	0.22
Standard experimental error	0.14	0.12	0.14	0.04	0.10
Sucrose per cent. cane	16.0	17.6	15.8	14.2	15.1
Fibre per cent. cane	11.3	12.0	14.0	14.2	13.8
Juice:—					
Brix	21.8	23.6	22.0	20.4	21.8
Sucrose	19.68	22.32	20.23	17.77	18.99
Purity	90.3	94.6	92.0	87.2	87.1
Reducing substance ratio	3.2	0.6	1.33	4.1	3.2
Hydrogen ion concentration (pH)	5.32	5.28	5.11	5.17	5.31
Phosphate (P_2O_5) per cent.	0.026	0.041	0.028	0.032	0.041
Potash (K_2O) per cent.	0.081	0.053	0.093	0.107	0.128

Cane juice expressed by a small laboratory hand mill.

FIRST RATOON CROP—HARVESTED 1930.

Variety.	1900 Seedling.	Badila.	P.O.J. 213.	D. 1135.	Uba.
Number of plots	4	4	4	5	4
Yield in tons of cane per acre	20.67	15.87	29.89	29.04	32.31
Tons pol. (sucrose) per acre	3.16	2.51	4.32	4.15	4.90
Standard deviation from mean	0.497	0.553	0.490	0.482	0.683
Standard experimental error	0.248	0.276	0.245	0.241	0.306
Pol. (sucrose) per cent. cane	15.31	15.81	14.44	14.28	15.13
Fibre per cent. cane	11.00	12.31	13.42	12.35	14.21
Juice:—					
Brix	21.0	21.4	19.8	19.2	21.2
Pol.	19.3	19.9	18.3	17.3	19.2
Purity	91.7	93.2	92.3	90.3	90.7
Reducing substance ratio	1.20	—	0.60	1.71	—
Hydrogen ion concentration (pH)	5.31	5.34	5.30	5.24	6.22
Phosphate (P_2O_5) per cent. of juice	0.028	0.022	0.029	0.018	0.024

YIELD IN TONS POL. (SUCROSE) PER ACRE OVER THE TWO CROPS.

Variety.	Plant cane crop.	First ratoon crop.	Total.
P.O.J. 213	4.02	4.32	8.34
Uba	3.37	4.90	8.27
D. 1135	3.26	4.15	7.41
1900 Seedling	2.75	3.16	5.91
Badila	2.70	2.51	5.21

Taking both crops into account there is no appreciable difference in yield between P.O.J. 213 and Uba having regard to the experimental error, but both are superior to D.1135 which in turn has yielded much more heavily than 1900 Seedling or Badila.

The latter again show their characteristically high sugar content of juice and cane and exhibit also a low fibre content but are evidently quite unsuitable to these poor and dry soil conditions. D.1135 is more hardy, but is inferior to the Uba and P.O.J. 213 under the conditions of this experiment.

All of the varieties in this series other than Uba possess the grave disadvantage under our conditions of susceptibility to mosaic disease. The P.O.J 213 as described in our earlier report comes from a strain that appears to have acquired a considerable degree of resistance to mosaic infection for some reason, and has still remained free from mosaic disease at the experiment station although there have been one or two cases in susceptible varieties in adjoining fields.

However, there is no guarantee that this acquired apparent resistance is permanent, and in any case this strain of P.O.J. 213 can be infected with mosaic disease by intensive inoculation in an insect chamber containing some hundreds of specimens of insect carrier, aphis maidis together with diseased sugar canes.

None of these varieties then appear to have any advantage over Uba except that P.O.J 213 up to the present has proved very highly resistant to streak disease; it might prove therefore a useful alternative to Uba under similar conditions to these as a means of controlling streak disease in locations where secondary infection is rampant, provided, of course that the mosaic campaign has been brought to a successful issue in such a locality.

SUMMARY AND CONCLUSIONS.

A comparison of the first ratoon crop of a field trial of Uba, P.O.J. 213, D.1135, Badila and 1900 Seedling in a poor clay loam with stiff clay subsoil and with deficient moisture supply, shows that Uba gave the best returns under the conditions of the experiment, and nearly compensated for the better yields shown by P.O.J. 213 on the plant cane crop.

Both of these varieties (Uba and P.O.J 213) proved considerably superior to D.1135 and much superior to 1900 Seedling and Badila both in the plant cane and the ratoon crops under these severe conditions.

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Mr. DODDS added that he should have mentioned the work of Mr. Beater, of the Experiment Station Staff, in connection with the large number of analyses involved, which he carried out almost single-handed last season.

Mr. DODDS: Within the last few days there have been two rather interesting developments in our field work. We have received at the Station from the quarantine greenhouse cuttings of POJ.2952, a new cane which is claimed to be a marked advance on POJ.2878 in Java, where I believe they are now replacing 2878 by this further improvement. We were fortunate in getting a little of that about a year ago, just before the absolute embargo was placed by the Java people on the export of any more of their new seedlings. We have also had rumours of 2961, which is said to be better again, but we can get very little information about that, still less specimens. The other event is that we have received from Louisiana during the present week specimens of CP.807, that is one of the new varieties bred by the United States Cane Breeding Station in Florida, and since our conditions resemble theirs in certain important respects we have great hopes from CP.807 under our conditions also. According to our usual procedure, of course, it will have to remain at least twelve months in the quarantine greenhouse, and perhaps longer, before we can try it in field work.

CHAIRMAN: As you know, this variety work constitutes one of the main features at present of the Experiment Station. It is not, of course, the only work, but it is one of the bigger things, and one which probably attracts most attention. It is dealing with a problem which at any moment may be a serious one, and one which should have been dealt with years ago. Although Mr. Dodds says these papers do not deal with our most interesting varieties, still it is a progress report on some of the other variety work that is being done, and gives us some interesting figures as to comparison of Uba with some of these others that have been tried out, and on the balance Uba does not show up so badly.

Mr. JEX: It is very interesting to hear of the later developments, but apparently we still must place great reliance on our old friend Uba. But what has been done in connection with the elimination of streak disease? Is that campaign being carried on? Streak disease, from my own experience, is a very deadly enemy affecting the growth of the cane and affecting the germination of cane when planted out.

Mr. DODDS: I may say that the problem of streak disease, which is one of the two important cane diseases of the country, is never lost sight of for a moment. Each one of the new varieties is carefully observed for its susceptibility to streak disease, both by ourselves under field conditions and by Mr. McClean at the Natal Herbarium. You will notice I have made a reference to this in the paper.

If I may take up a little more of your time I would like to mention a matter I intended to refer to when I was giving you the outlines of our fertiliser experiments. You will remember that yesterday I stated that we had not yet had any direct positive evidence of the effect of potash or any fertiliser in increasing the sucrose content of the cane apart from increasing the yield and affecting the maturity of the cane. But by the kindness of Mr. Lintner of the S.A. Potash Syndicate, I have had handed to me two very interesting papers. One is by Dr. Wagner, the well-known agricultural authority in France, who shows an increase in sucrose content of beet by the application of very heavy dressings of potash. The increase in the sucrose content of beet amounted from 0.5 to over 1% from the application of as much as 2,000 kgms. of potash. The other deals with sugar cane and is from Guadeloupe in the West Indies, and records some experiments in which the sucrose content of cane was increased apparently from 13.4 to 15.6% by the application of very heavy dressings of potash, far more than we are in the habit of applying in this country, to the soil. So it may be that we can get this effect by applying dressings greater than we have been in the habit of doing, and it will be very interesting to carry out a few experiments on those lines.

CHAIRMAN: That is very interesting, and I hope that experiments will be carried out and prove useful in the way stated.