PRESENT DEVELOPMENTS IN THE SEARCH FOR NEW SUGARCANE VARIETIES

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Varietal Position at Present.

Since the almost entire elimination of the variety Uba from commercial cultivation and its replacement by the more newly introduced varieties from other countries, some factors have been introduced into the varietal problem for our cane growing areas which did not arise in the period which is now at a close. In the period of cultivation of a single variety, the crops that could be anticipated in different regions were dependent upon the manner in which that one variety reacted towards the environmental and biologic factors of the area; if the cane grew poorly, or was a failure, there was no means of rectifying the matter from the varietal standpoint.

With the introduction of other varieties, however, it soon became apparent that where a choice was available some were better suited to certain areas than others, and further, that in some fields where Uba had been a total or partial failure one of the newer types could produce a crop, perhaps not large, but at least of sufficient size to alter an opinion already formed that sugarcane would not grow under these conditions. The position at present is that of a large number of varieties tested eleven are available to growers (including the new N:Co.310), but those mainly grown are the varieties from Java—P.O.J. 2725 and 2878 and the three from India—Co's.281, 301 and 331, while N:Co.310 appears to be rapidly on the increase. The Java varieties are largely confined to alluvial flats and the Indian varieties to the other areas, with a tendency for Co.281 to be planted more on heavy soils and shale, with Co.301 and Co.331 occupying the sandy areas, although of late there is a tendency to extend these varieties into heavier soils also. The Indian varieties form by far the largest proportion of the total crop.

Varieties and their Environment.

The adaptability of varieties towards some situations and their inability to produce a remunerative crop in others is obviously related to some plant characters, apart from those of resistance towards the pests and diseases peculiar to the area.

This latter property of a variety—its degree of resistance towards the major enemies likely to interfere with its cropping capacity—always received considerable emphasis in considering the suitability of the variety for commercial cultivation. This must always be so, because of the high loss which may be experienced due to pests and diseases; and resulting from this much investigation is directed into evaluating the factors which go to produce disease resistance.

Other characters, not always so apparent, however, play an important part in determining the value of a variety; for example the nature, extent, and distribution of the root system may be influential in deciding whether a variety will succeed in certain soil types. Thus the P.O.J. varieties grown here with their large bulk of surface feeding roots require good growing conditions and are a failure on poorer conditions, in which the Co. varieties thrive, due partly to their larger mass of deeply penetrating roots.

Again, one other factor which is probably not without some influence is the character of the leaves—particularly whether or not they form a close canopy. Thus it may be that one of the reasons why Co.281 grows poorly on sandy soils is the lack of cover caused by its very erect habit, whereas Co.301 with its mass of drooping leaves provides shade and ensures less rapid drying out of the soil than with an open growing variety. Partly related also to the type of canopy is the formation of surface roots; when the rows of cane have closed in and shaded the ground, there is less chance of desiccation of these roots, which develop then in greater abundance; further, during rains, drips from a drooping leaved variety direct some of the moisture away from the cane row itself to the interline, whereas in the open, erect leaved varieties, the leaves act as channels for directing the rain down the stems to the cane row itself, and induce the roots to go deeper from the base of the stem rather than to spread out.

A further benefit which may possibly be attributed to a dense canopy-forming variety is that of the maintenance of the soil in a better condition, particularly in regards to its organic matter content; there is evidence that under conditions of shade organic matter disappears less rapidly than under open conditions. On the other hand, if conditions are such that the decomposition of organic matter is naturally too slow, then the open canopy might possibly be an advantage.

The relation between the type of leaf and weed control is of course well recognised, the open type of cane being considerably more expensive to grow when the amount of weeding required to keep a field clean is taken into consideration, and a variety which keeps competitive weeds in check from the earliest possible stage becomes increasingly necessary as labour difficulties increase and costs rise.

Another varietal character which affects weeding costs is the manner in which the young shoots emerge. In some varieties, e.g., P.O.J.2725, the shoots when

young very often assume a semi-recumbent position thus leaving an open centre in the young developing stool through which weeds grow, and cannot be removed except by hand. (This may also be noted with Co.281 when growing in conditions which are somewhat wetter than can be tolerated by that variety.)

Of prime importance among characters of a variety is the manner in which it reacts towards the limiting factors of its environment, and in Natal without doubt one of the most important features of any cane is its reaction during drought.

It is probably erroneous to refer to sugarcane varieties as being drought-resistant, as this plant is not drought resistant in the same manner as a cactus; the important matter is the degree of tolerance shown and the amount of recovery shown after the drought has passed. Several characters may contribute towards drought tolerance: the leaves may inroll (a marked feature of P.O.J. 2725) and reduce transpiration; or the total transpiring area may become reduced by the withering of some parts. The latter presents the appearance of a cane suffering badly, but it may not be so, as the withering of some leaf area may prevent drying out of the stalks. The appearance of a variety remaining green during a drought may thus be deceptive; the impression gained that it is unaffected requiring correction if the canes be split open.

The water requirement of a sugarcane crop probably varies with the stage of its development in the same manner as other members of the grass family, where the greatest demand for water is during the period of most active stem elongation, i.e., when cane is being formed. During the early developmental stages of germination, and tillering prior to stem elongation, the water requirements are possibly low. Indeed, experiments show that during the pre-emergence stage of germination the water requirements are exceedingly small, and in fact too much water is more disastrous on germination than too little. It can also be observed during a drought how young tillering cane is less affected than cane which is growing to height, confirming the general observation referred to above.

The main requirement of a young tillering grass crop is usually nitrogen, and it may be expected that the more profuse the tillering capacity, the greater the demand for this plant food. At the same time the greater the tillering, the more copious the development of young roots, and the greater the demand for phosphates to permit sufficient root development. Thus a deficiency of the plant food in the early stages and a deficiency of water during a later stage provide two critical stages in the development of a crop. Different varieties, as is commonly known, vary in the manner in which they react towards water deficiency, but they also vary in their reaction towards the plant food status of the soil, some for example having a higher nitrogen requirement than others.

Another important factor which acts in a limiting capacity on growth is that of temperature, but again varietal differences are known to exist in their reaction towards this factor; where some varieties practically cease growth during the colder months, others appear to have the ability of maintaining a greater, although still slow, rate of growth. In the same manner germination may proceed with some varieties at a lower soil temperature than with others. The low temperatures experienced in Natal are of course beneficial in the development of the sucrose contents of the cane.

In areas where low soil temperatures are experienced over a prolonged period and where the growth period is short, cold tolerant varieties are of greater importance than in more congenial environment.

Varieties and Diseases.

The different susceptibilities of varieties towards diseases has been already referred to, and as our knowledge of the distribution of disease in Natal increases, so do we find that resistance towards a particular disease may be of more importance in one area than another. For example, in areas of high altitude where mists are experienced Red Rot disease can assume epidemic intensity in a susceptible variety, whereas the same variety grown in drier localities only suffers from the disease to a minor extent.

Again mosaic disease is little found on the sandy soils near the sea, but is more prevalent in certain areas inland.

Smut disease, on the other hand is being found (at present at least) to be more prevalent on coastal sands than in inland areas. On the other hand, root disease is largely absent in these sandy soils; where it does occur it is usually in heavy soils, particularly if the latter are cold. Thus in different types of localities resistance to red rot, smut, mosaic and root rot assume different proportions.

The complexity of the relationship between environment, disease and variety is illustrated by the root rot complex in some areas.

In these, where low soil temperatures and high rainfall are experienced and an unusually high organic matter content of the soil is found, root development tends to be poor. A suggested explanation is that the low temperatures inhibit normal decomposition of organic matter, and lead to the presence of by-products of its decomposition in amounts greater than is usual. It is known that certain of these by-products although in themselves not necessarily toxic, can slow down root development and render them liable to invasion by root

rotting soil organisms when a variety with a susceptible root system is grown, whereas the same variety can grow in the presence of these organisms and remain unharmed if these substances are absent. A variety which exhibits this susceptibility is Co.281, which develops an extremely poor root system under the above conditions; on the other hand some varieties which have shown no promise at the Experiment Station appear to be eminently suited to these other conditions and develop a very vigorous root system in soil in which Co.281 is largely a failure.

These examples show how specialised the requirements of different localities are, and also how they may be met by the cultivation of varieties adapted to these requirements.

Specialisation of Varieties.

It is obvious that we can no longer expect one variety to suit all conditions and maintain high yields in the whole sugarcane growing area; specialisation of varieties is accepted as a necessary factor in high production, and as our experimental work unravels the complexity of the problem, the tendency will be towards still greater specialisation.

One other aspect of this development, however, requires consideration. As greater emphasis is laid upon adaptation to one set of conditions and resistance towards one particular disease, there is a tendency to introduce types in which other diseases may build up to the extent of eventually interfering with cropping capacity.

Sugarcane, being vegetatively propagated, does not inherently deteriorate but may do so owing to an accumulation of disease, thus a variety after cultivation for a number of years may become subject to a disease which was of a very minor nature at the time of release of the variety. In this manner it is possible to have high-yielding but short-lived varieties in contra-distinction to lower yielding, but long-lived varieties. Indeed it has recently been suggested that with another vegetatively propagated crop, the potato, that the highest yields over a period of years will be attained by the cultivation of the former rather than the latter. With sugarcane, however, the problem is more complicated than with the potato; the important question of ratooning does not enter into the farming system of the potato grower, and at the same time it is easier to replace a potato variety than a sugarcane one. Nevertheless, future developments in sugarcane cultivation might lie along a modification of this line of approach, and the varieties yet to come might be those of a shorter life than those of the past, but yet by more frequent varietal replacement a higher continuous yield is attained.

Varietal Research.

We now may consider how varietal research is being conducted to evolve new types which will satisfy the exacting requirements to be imposed upon them.

With the introduction and trial of so many varieties from practically all sugarcane growing countries, certain broad lines of approach to the subject have become apparent. Thus varieties of the "noble" group *Saccharum officinarum*, whether naturally occurring types, or seedlings resulting from self-fertilization of a noble cane or of a cross between two of these types, are all susceptible to mosaic disease, many are susceptible to streak, and most of them ratoon badly. Varieties of the group *S. sinense* are all susceptible to streak but resistant to mosaic; these however, ratoon well.

The varieties which are most suited are those however of a complex hereditary constitution, arising from the breeding between different groups in sugarcane breeding stations—crosses between members of the group *S. officinarum*, *S. spontaneum*, and *S. barberi*. The incorporation of wild blood of the group *S. spontaneum* gives mosaic resistance to members of the *S. officinarum* group, and at the same time produces a more hardy type of cane. This fact has been made use of in breeding the modern P.O.J. varieties, which, however, have only a limited scope in Natal these varieties which have done best here are those which have some of the Indian gropu, *S. barberi* in their constitution either with or without *S. spontaneum*. Indeed Co.301 is a cross between only *S. officinarum* and *S. barberi*.

A recent development in cane breeding is the incorporation of another wild type, *S. spontaneum* from Turkestan which exhibits a high degree of cold tolerance; some seedlings containing this blood we now have in this country, but none are at the stage of field trial. A recently discovered new species *S. robustum* in New Guinea, also adds further to the material which may be used for breeding, but we do not yet know whether this type holds out any opportunity of use for Natal conditions. We have, however, some young seedlings with some of this type in their parentage. Varieties thus become more and more complex from the hereditary aspect, and as more knowledge is gained of their behaviour under our conditions the more precise will become our estimation of the type of hereditary constitution required. Thus, as has been said, varieties of *S. officinarum* are susceptible to mosaic but resistance is imparted by crossing these with forms of *S. spontaneum*; further crossing with types of the former or "nobilisation" produces a better type of cane, but if the *S. spontaneum* blood becomes too dilute, then mosaic susceptibility returns. Thus a cane which has both lines of descent in its constitution and is resistant, when crossed with a pure *S. officinarum*

type may give rise to progeny with a large porportion of susceptible seedlings, whereas if crossed with another cane which also contains some wild blood, may give a progeny with a high proportion of resistant types.

Three avenues are open to us whereby new varieties may be introduced into Natal. Firstly, we can test under our conditions varieties which have been found suitable in other countries, mostly to-day the products of sugarcane breeding; secondly we can import seed from abroad either resulting from the self-fertilization of cane flowers or from hybridisation between different varieties; thirdly there is now a newly opened up possibility of carrying out breeding work of our own in Natal.

The introduction of varieties from abroad under stringent quarantine regulations is now well known to growers and needs no further amplification, except to say that this method is a slow one and only results in a limited number of varieties each year for trial.

By importing seed the possibility is realised of raising new varieties in very large numbers—several thousand each year can be reared, and the chances of securing suitable types are enormously increased. It has been estimated that to obtain one good variety, one thousand should be raised.

Resulting from such imported seed, we have at the moment large numbers of seedlings in varying stages of trial, developed from seed from Mauritius, India, Hawaii and Queensland. Many of these arise from crosses made specifically for trial here.

An early attempt to use this method for producing suitable types for Natal were the crosses made at Coimbatore of P.O.J.2725 with Co.281, and with Co.301; these gave rise to the varieties which have been tried out for some years, such as N:Co.79 (P.O.J.2725×Co.281), N:Co.151 (P.O.J.2725×Co. 301), each of which has shown a certain amount of promise under some conditions, but none has as yet been considered good enough for release.

These varieties, if not suitable for commercial cultivation, however, might possibly be suitable parents from which to breed other varieties; an interesting experiment, which it is intended to have carried out if the opportunity presents itself, is to take those varieties which are derived from the Co.281 parent and have them crossed with Co.301, and those derived from the Co.301 parent crossed with Co.281; we would thus have varieties which consisted of 50 per cent. Co.281, 25 per cent. Co.301 and 25 per cent. P.O.J.2725, or 50 per cent. Co.301, 25 per cent. Co.281 and 25 per cent. P.O.J.2725. The incorporation of some P.O.J. blood with Co. varieties in an attempt to produce a thicker type of cane, with higher sucrose and yet retaining the hardy qualities of the Indian cane has attracted attention of late in many countries, especially in India, and has yielded promising results in Natal in the development of our recent variety N:Co.310. The female parent of this variety is Co.421, which itself is a cross between P.O.J.2878 and B.3412, and the male parent is Co.312, a cross between two Co. varieties. N:Co.310 is thus the second generation from P.O.J. 2878, and is a cane of good growth and high sucrose content but with a wider adaptability than the P.O.J. grandparent. The influence of a parent on producing suitable progeny for our conditions has also been noted with seedlings of Mauritian origin. One line of descent in these varieties starts with the crossing of P.O.J.2878 with Uba Marot, itself a cross between a wild cane and a noble cane the resulting seedlings crossed with another variety which is more of a noble type produces seedlings which have not shown much promise in Natal, but when Co.301 is introduced as a parent, much better results are achieved.

The introduction of seed from abroad during late years, while it has considerably increased the rate of new variety production, still is obviously not as satisfactory as breeding varieties in the country for which they are intended, and the recent developments in the production of local seedlings are therefore of great importance.

The reason for importing seed has been its non-production in sugarcane in this country. It has, however, been shown that this infertility is due, in part at least, to incomplete pollen development, resulting from the weather conditions at the time of flowering (in the winter months), but that if the arrows are subjected to artificially produced summer conditions, then pollen development may be normal and seed is produced.

Although one major difficulty which appears to be capable of solution is that pollen production can be initiated or increased when a variety flowers, there still remains the big problem of obtaining flowers in varieties that would appear to be suitable parents. At present the varieties which have yielded the largest progenies are canes which themselves are not of much use for producing commercial types. Thus before a satisfactory breeding programme can be started in Natal, methods must be found of obtaining flowers in canes to be used as parents. This may be done either by inducing flowering in a usually non-flowering variety, the means of doing which is not yet known, or by the maintenance of a stock of varieties which do flower, and are satisfactory from the breeding point of view. This may be done either by introducing from abroad such varieties which may have no hope of being grown commercially, but are only parent stock, or by breeding such parent stock here from what material we have available. Thus many seedlings which have been produced locally within the last few years are of a semi-wild type, but if they produce pollen they may be used again as parents to produce a better type of cane

while still retaining the flowering habit, and thus be the forebears of a breeding stock from which to produce commercial types.

Having produced, or introduced, the varieties which appear worthy of extended field trial, the long process of finding those suitable for cultivation in different environments begins. From the fields which act as a nursery and trial ground for preliminary trials the selected types are extended into larger trials and as soon as possible included in trials in estates outside the Experiment Station. This is necessary as a means of discovering the adaptability of a variety, and is a phase of our work which has been extended of late years. As was stated earlier, it has become obvious that different localities require different varieties to produce high yields and overcome the depredations of disease, and the best means of evaluating the potential use of a variety is by its trial under different conditions. We have good evidence already that a variety quite unsuited for example for the lower coastal regions may be of considerable promise in the higher inland areas. As more knowledge is gained of the requirements of different localities, it might be possible in the future to know the extent of the area which could be served by particular trials, and where these can best be placed to yield most representative results. Thus a series of regional trial grounds might evolve of a more or less permanent nature, and the establishment of propagation centres for the varieties found best suited to the area may be visualised. In this way a constant stream of varieties could be maintained between the Experiment Station and the grower; as was stated previously, the solution to continuous high yields over the industry as a whole might lie in the utilisation of high yielding types which may not necessarily have a prolonged life, but which require frequent replacement. Should a position such as this ever be arrived at, then the flow of varieties from the producer to the grower via the trial grounds and the propagation plots would be a necessity for the maintenance of an increasingly higher output per acre.

Experiment Station,
South African Sugar Association,
Mount Edgecombe.

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Summary.

The experience with sugarcane varieties of recent years gives clear evidence that different localities have specialised requirements, and that the distribution of diseases, as well as the other environmental factors of different areas, necessitate the cultivation of different varieties to suit local conditions.

As more knowledge of the requirements of different localities is gained, this may lead to an even greater specialisation in varieties than we are yet accustomed to. The suggestion is made further that high yields over the industry as a whole might follow this greater specialisation, even if it meant the cultivation of high yielding types with a shorter life than we are accustomed to; this in turn would lead to the more frequent replacement of varieties.

The introduction of new varieties by means of introduced types from abroad, and by raising seedlings from introduced seed, may in the future be supplemented by raising our own varieties from locally produced seed. This raises the problem of maintaining breeding stock, which will probably require to be introduced or bred here before commercial types can be raised in any large numbers.

The testing of new varieties involves their extension from preliminary trials into an increasing number of trials in various localities, a sphere of activity which ought to increase as our knowledge of varietal requirements increases; a series of carefully chosen regional trials to serve areas with their own peculiarities will be a necessity to increasing and maintaining yields under conditions different to those under which the varieties undergo their preliminary trials.

APPENDIX.

New Varieties under Trial: Recent Results of the More Promising Seedlings.

1. **N:Co.79.**—Parentage P.O.J.2725 × Co.281.

This variety has been under trial for several years now. At the Experiment Station it has not shown any improvement in yield per acre over the standard varieties, but has on the whole a higher sugar content. At Umhlatuzi it has outyielded Co.281 as follows:—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Plant cane, 22 months old...	101.00	15.15	15.30
Co.281	93.20	13.37	12.46
1st ratoon, 11 months old ...	53.97	11.77	6.35
Co.281	47.58	11.56	5.33

At Natal Estates, however, under irrigation, it was not as good as Co.301; nor was it as good as the standard varieties at Eshowe. At Verulam and Tongaat in trials it is little different to the standard varieties. It is very susceptible to mosaic, but resistant to red rot.

2. **N:Co.291.**—Parentage Co.421×Co.312.

A variety which usually makes good growth in length of stick during the first season, and has attracted attention by the manner in which the trash falls naturally away from the canes. It is a variety of a low sucrose content. The following is a summary of yields in recent trials :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Fields E & B, plant cane 20 months	55.98	13.97	7.82
Co.301	46.59	15.22	7.09
1st ratoon, 24 months ...	50.32	13.40	6.75
Co.301	45.76	13.99	6.39
Field L, plant cane 22 months	34.68	14.24	4.94
Co.281	26.51	16.00	4.24
Umhlatuzi Valley, plant cane 22 months	117.40	12.59	14.78
Co.281	93.20	13.37	12.46
1st ratoon, 11 months ...	62.79	10.42	6.54
Co.281	47.58	11.56	5.33
Tongaat Sugar Co., Nyaninga, plant cane 24 months	40.58	14.51	5.89
Co.281	24.66	16.01	3.95
Natal Estates, Cornubia, plant cane 24 months-...	41.26	14.86	6.13
Co.301	49.91	15.53	7.75
Chaka's Kraal, plant cane 23 months	37.89	14.15	5.36
Co.301	38.40	14.76	5.67

This variety is fairly susceptible to mosaic.

3. **N:Co.293.**—Parentage Co.421×Co.312.

A variety which shows little promise at the Experiment Station, but at a higher altitude, at Eshowe, has given a good yield in one experiment, as follows :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Plant cane, 22 months old ...	69.97	15.00	10.50
Co.301	51.60	15.70	8.10

4. **N:Co.330.**—Parentage Co.421×Co.312.

A variety which usually gives good tonnage; has been found in one case to suffer badly from red rot. Some recent yields are as follows :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Experiment Station, Fields E & B, plant cane 20 months	52.15	15.76	8.22
Co.301	46.59	15.22	7.09
1st ratoon, 24 months ...	42.82	14.65	6.22
Co.301	45.76	13.99	6.39
Field L, plant cane 22 months	32.45	15.97	5.18
Co.281	26.51	16.00	4.24
Umhlatuzi Valley, plant cane 22 months	109.20	14.00	15.29
Co.281	93.20	13.37	12.46
1st ratoon, 11 months ...	57.92	10.12	5.86
Co.281	47.58	11.56	5.33
Tongaat Sugar Co., Nyaninga, plant cane 24 months	21.29	16.22	3.45
Co.281	24.66	16.01	3.95
Natal Estates, Cornubia, plant cane 24 months*...	26.98	13.42	3.62
Co.301	49.91	15.53	7.75

* Severely damaged by wild pig.

5. **N:Co.334.**—Parentage Co.421×Co.312.

A variety which has outyielded the standard varieties at the Experiment Station, and has shown recent promise at Natal Estates on sandy soil, and at Chaka's Kraal, as follows :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Natal Estates, Cornubia, plant cane 24 months...	51.70	16.42	8.49
Co.301	49.91	15.53	7.75
Chaka's Kraal, plant cane 23 months	41.04	14.67	6.02
Co.301	38.40	14.76	5.67

6. **N:Co.339.**—Parentage Co.421×Co.312.

A variety giving heavy tonnage, whose propagation was stopped some years ago when some stools affected with mosaic were found. This was before this disease was found on Co.281 however, and in view of the mosaic position to-day N:Co.339 need no longer be condemned on this account. Some recent yields are as follows :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Experiment Station, fields E & B, plant cane, 20 months	51.76	15.26	7.90
Co.301	46.59	15.22	7.09
1st ratoon, 24 months ...	54.32	14.19	7.70
Co.301	45.76	13.99	6.39
Field L, plant cane 22 months	35.62	14.22	5.07
Co.281	26.51	16.00	4.24

7. **N:Co.349.**—Parentage Co.421 × Co.312.

A variety which in most trials has outyielded the standard varieties, giving a heavy yield of cane.

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Experiment Station, field L, plant cane 22 months ...	34.85	15.14	5.28
Co.281	26.51	16.00	4.24
Fields E & B, plant cane, 20 months	55.26	14.91	8.24
Co.301	46.59	15.22	7.09
1st ratoon, 24 months ...	53.14	14.19	7.53
Co.301	45.76	13.99	6.39
Umhlatuzi Valley, plant cane 22 months	116.40	12.69	14.77
Co.281	93.20	13.37	12.46
1st ratoon, 11 months ...	56.60	11.57	6.44
Co.281	47.58	11.56	5.33
Tongaat Sugar Co., Nyaninga, plant cane 24 months	39.51	14.98	5.92
Co.281	26.66	16.01	3.95
Natal Estates, Cornubia, plant cane 24 months ...	55.04	14.96	8.23
Co.301	49.91	15.53	7.75
Estate late C. R. Butcher, plant cane 22 months ...	61.04	15.98	9.76
Co.301	51.60	15.70	8.10
Chaka's Kraal, plant cane 23 months	45.68	14.68	6.70
Co.301	38.40	14.76	5.67

This variety appears fairly susceptible to mosaic.

8. **N:Co.351.**—Parentage Co.421 × Co.312.

This variety did not show much promise at the Experiment Station, but on sandy soil in a recent trial has yielded well :—

	Tons cane per acre.	Sucrose per cent. cane.	Tons sucrose per acre.
Natal Estates, Cornubia, plant cane 24 months...	59.14	14.91	8.82
Co.301	49.91	15.53	7.75

The PRESIDENT said that the paper showed how the search for new varieties, which started by the importation of commercial varieties from other countries, had now become more exacting and was largely concentrated on producing seedlings at the Experiment Station.

Dr. DODDS remarked that among the many interesting points raised in the paper, Dr. McMartin had mentioned the characteristics which had determined the suitability of the varieties Co.281 and Co.301 to this country. When these varieties were first grown here, it was a surprise to find that Co.281 was suited to the heavier soils and Co.290 to lighter soils. This was contrary to experience in Louisiana. The difference lay in the dissimilar soil-water conditions in the two countries. In Louisiana there was always a certain amount of water-logging which Co.281 could not stand in heavy soil, whereas Co.290 was more tolerant to such conditions. Wetness of soil also accounts for the extent of red-rot in Louisiana in varieties found unsusceptible here.

It was interesting to recall that when the Experiment Station was first opened, the local Sugar Journal expressed the opinion that all that was required of it was that it would produce one good variety to replace Uba. This work it said, should be completed within ten years. Now, however it was realised that we are approaching the degree of specialization that occurs in Queensland and Hawaii, where there are perhaps twenty or more varieties adapted to certain local conditions.

Dr. McMartin had quoted an estimate that it was necessary to raise a thousand seedlings to produce one of commercial importance. This estimate was now-a-days rather optimistic, for the standard was now very high and the numerous conditions required of a new cane so exacting, that the odds are more than a thousand to one.

It was difficult to decide what parents to use in a cross. We have several promising seedlings, among them N:Co.310, derived from Co.421 and Co.312, both of which parents were a failure at the Experiment Station. This cross was used only because the Coimbatore people assured us that it would have some promise for our conditions.

He referred again to the importation of pollen from the nearest possible source—Mauritius. In the past the only means of transport was by sea and an attempt made to obtain pollen was not successful. The parcel of pollen took five days to arrive here and five days is about the maximum life of sugarcane pollen. Now that an air service has begun, he believed it possible to get pollen from Mauritius in far less than five days, and he hoped some experiments might be done on these lines during the next year.

The appendix was one of the most interesting and important parts of the paper. It showed that we have a number of promising varieties. Many which are lower in sucrose content, gave a higher yield of sucrose per acre than did others with a higher test. Co.331 is an example. A comparison between yields of sucrose per acre was not the only desideratum however, for canes showing a high yield might have a high fibre or a low purity. Factory overall recovery was one of the conditions to be considered, and this was another of the many factors which complicated the selection of new varieties.

Mr. DYMOND said he knew of Uba cane which was planted twenty-four years ago and which was now

in its twenty-fourth ratoon. He had some Uba which was now tenth ratoon and was growing very well. He believed that given proper conditions of soil and water one could go on growing any variety of cane indefinitely.

Dr. DODDS believed that most botanical authorities were of the opinion that plants propagated vegetatively, such as sugar cane, given reasonably fertile conditions and kept free from disease, could be grown indefinitely. We knew that Uba lasted for fifty years in this country and in other lands some of the older varieties of cane, such as Otaheite, had existed for a hundred years or more without loss in vitality or general usefulness.

Dr. MCMARTIN referring to Mr. Dymond's remarks on the longevity of Uba, said that Uba was a primitive cane and it would seem that most primitive types grown in suitable environment could be cropped for a great number of years.

However, with other varieties such a satisfactory state of affairs might not be possible, for the genetic constitution of the plant as well as its environment must be borne in mind. It should be remembered that in our newer types of canes we have had more unbalanced individuals. They were, in other words, freaks, whose future behaviour was unpredictable.

Mr. RAULT asked if it were established that a high yield was generally accompanied by a low sucrose content. At times at Natal Estates when they obtained a better yield than did other people, the sucrose content was rather low.

Dr. DODDS replied that it did not follow that a high yield meant a low sucrose percentage, for some varieties, such as N:Co.310 were capable of combining high yields with high sucrose. Mr. Rault probably referred to the same variety under different conditions, for conditions promoting high yields of cane in a variety were likely to lead to a relatively low sucrose content.

Dr. SAUNDERS enquired if any work had been done on increasing chromosome numbers, by treatment with drugs.

Dr. MCMARTIN did not think there was anything to be gained in this direction for cane varieties had a very high number in any case. Treatment by drugs had not resulted in any satisfactory result. In reply to a query by Dr. Dodds, he said that he had heard nothing further of the production of mutations by X-ray treatment of buds.

Mr. DU TOIT drew attention to the statement that the mass of leaves of Co.301 might, by providing shade, help preserve moisture in the soil. He wondered if it were a fact that Co.301 had more leaf than Co.281, and again, if it had more leaves, if this would not tend to take more moisture out of the soil.

With regard to resistance to disease it was stated that mosaic was more prevalent in inland areas and smut more common on the sandy soils nearer the coast. Was it meant that soil type affected the disease, or was it not a question of variety, the varieties suited to sandy soils for instance, being more susceptible to Smut? In connection with red-rot in soils of low temperature and high rainfall areas, it was emphasised that in these soils organic matter content was high. He thought that mist belt soils were indicated, but if it were implied that high organic matter content was due to low temperature and high rainfall, he would point out that many soils in these areas had a low organic matter content.

He would like to know the effect of the burning of cane on these high organic soils. Trashing of cane was generally recommended, but where high organic matter might constitute a danger where disease was concerned, might it not be advantageous to burn?

Dr. MCMARTIN said that in connection with the comparison between the shading effect of heavy foliage and the loss of moisture by transpiration, he considered that usually the balance was in favour of water retention.

As far as the distribution of Smut was concerned, it was found that where Co.301 and N:Co.310 were grown on sand and on contiguous inland heavy soils, the Smut infection was far heavier on the sand.

With mosaic it was a curious fact that on the North Coast there was little of the disease on the sea side of the main road, while there was a far greater amount on the inland side. On the South Coast, where the Co.281 approached nearer the sea, mosaic was again more prevalent inland. Dr. Vanderplank had suggested that humidity might have an effect on the insect vector.

There might be a case for burning on soils with a high organic matter content, but he was not prepared to commit himself on this subject without experimental evidence.

Mr. DU TOIT asked for more explanation about the statement that it might be necessary in future to plant vigorous varieties with a short life. Did it necessarily follow that a very vigorous variety would not be able to last as long as, say, Uba? He wished to know if Dr. McMartin had in mind varieties now in commercial production or any being experimented with, which might have a short life or poor ratooning quality.

Dr. MCMARTIN explained that in the past we had been accustomed to Uba, which had a long life. With the introduction of Co.281 and Co.290 it looked as though we now had varieties with a shorter

term of life than had Uba. Co.290 was a variety which cropped very well for a number of years and then dropped out of the picture fairly suddenly. Co.281 lasted longer but was now on the down grade. Breeding tends to over emphasise one set of conditions. There was a possibility for other diseases which might be present in inconspicuous manner at the start, building up, especially in a vegetatively propagated crop like sugarcane.

This was happening, for instance, in P.O.J.2878, which was very disease resistant, but which in Cuba was now being attacked by yellow spot, up to the present one of the most inconspicuous diseases.

Therefore some varieties now giving high yields might last only a few crop cycles, say one plant and two or three ratoons, and then have to be replaced by other varieties.

Mr. LEWIS enquired if Co.281 could not be planted in rows closer together than was the case at present. Weeding of this upright-leafed variety was expensive and he would like to know the minimum distance at which the lines could be placed.

Dr. MCMARTIN stated that some producers placed Co.281 in lines as close as 3 feet 6 inches apart, but even so more weeding was necessary than with other canes. He doubted if it could be planted close enough to produce a good canopy early. Too close planting would inhibit the use of implements, but he did not consider that these could damage the roots under rather close planting as the root system of Co.281 was deep.

Mr. RAULT drew attention to the wonderful improvement shewn in the beet industry where the plant had been changed from its wild condition with a very low sucrose content, to the present sugar-beet of such high quality that it reached as high as twenty per cent. of sucrose. Such remarkable improvement in quality had not yet been made by sugarcane breeders who had merely raised the yield of cane. He hoped, however, that similar progress would eventually be attained with cane, and he looked to Dr. McMartin and his compatriots for advance of this nature.