INVESTIGATIONS ON SUGARCANE BREEDING IN NATAL DURING 1949

By P. G. C. BRETT.

The past season has been a successful one for sugarcane breeding and for the first time more seedlings were raised than could be planted in the Experiment Station fields. This success was due partly to the good results obtained in increasing pollen fertility and partly to plenty of inflorescences being available for crossing. Although adversely affected by drought later on, the season on the whole was a good one for flowering, and the special breeding plots planted several years ago in different areas proved their usefulness by supplying many of the tassels used for crossing.

Experiments on increasing Pollen Fertility.

A method of increasing pollen fertility by keeping under artificial conditions cut canes that were going to flower has been described previously.[1,2] In the first experiments on this work, temperature, daylength and humidity had all been increased, but an increase in the daylength was later on found to be unnecessary. From the results obtained during the last season it would appear that increased humidity also is not essential, for just as successful results were obtained in the one cubicle in which the humidity was not increased as were obtained in the other three cubicles which were made more humid by steam. From these results it would appear that temperature is the only factor which limits the formation of fertile pollen of sugarcane in Natal.

Varieties differ fairly considerably in the way they react to the artificial conditions under which they are kept after cutting. All show a certain amount of injury, but in some this is very slight. The damage is usually less if the canes root quickly in their surrounding tins of compost and hence soon cease to depend upon the preserving solution for their water supply. No inflorescences emerged when cut canes of the varieties N:Co.291, N:Co.310, Co.301 and Co. 432 were kept in the solution only, though at least some canes of all these varieties flowered when they were given the opportunity of rooting. A few varieties are apparently so slow in rooting or react so severely to the preserving solution that the tassels are usually all killed : no inflorescences emerged in an experiment with three canes of P.O.J.2725 and six of a seedling from a cross between N:Co.79 and Glagah. The canes of this seedling were found to have been attacked by *Thielaviopsis paradoxa,*

TABLE I.

The Effect of Warm Conditions on the Fertility of Pollen of Sugarcane.

Date experiment started.	Variety subjected to warmer conditions.	Number of inflorescences. Total.	Failing to emerge.	With slight dehiscence.	With good dehiscence.	Number of cross in which tassels used. (Refer to table 2)	Fertility of tassels in the field.
May 8 . ..	N:Co.310	3	—	2	1	4	Anthers with only a few and badly distorted pollen grains and some disorganised tissue.
May 25 ..	Co.301	18	8	—	10	7	No starch-filled pollen grains found.
June 1 ..	N:Co.310	12	6	5	1	15	No starch-filled pollen grains found.
June 3 ..	N:Co.291	6	—	6	—	—	No starch-filled pollen grains found.
June 3 ..	Co.432	6	3	—	3	17	Dehiscence occuring, but distinctly less than that of treated canes.
June 22-29 .	Co.331	18	1	—	17	19, 20, 21 25, 28, 30	On August 8th, when some treated canes were dehiscing, no starch-filled pollen grains were found, but by Sept. 13th all tassels examined had some pollen grains with starch, though no dehiscence was seen.
June 29 ..	Co.290	6	1	—	5	32, 34	No flowering occurred.
July 12 ..	Co.312	12	7	—	5	29	Pollen grains large, abnormal and without starch—perhaps really aborted pollen mother cells.
July 12 ..	Co.421	12	9	—	3	27	Some pollen grains as for Co.312; others of normal size but also without starch.
August 8 ..	Co.356	12	3	—	9	31, 33	Dehiscence occurring, but distinctly less than that of treated canes.

a fungus responsible for the "pineapple" disease of sets after planting and normally not attacking growing canes. In the case of Uba, only one of four embryonic inflorescences developed so far as to start emerging, but it showed no starch-filled pollen grains and died soon afterwards. In all the other varieties subjected to treatment at least some of the tassels emerged fully and in these at least a few anthers were found to have dehisced; the fertility of all the inflorescences that emerged appeared to have been increased by the treatment. These results are summarised in Table I. In these experiments the thermostats were usually set so that the cubicles would start heating as soon as the temperature fell to 70°F., although in the first experiment with N:Co.310—started on May 5th—the minimum temperature was set for 75°F. (*See Table 1 on p. 1.*)

The fact that Co.421 was induced to form fertile pollen is interesting, as at the cane-breeding station of Coimbatore in India—where sugarcane normally shows very good fertility—this variety can be used as a female only, though it has been reported to produce viable pollen under increased daylength.[3]

At the same time as eighteen canes of Co.301 were put into cubicles with their minimum temperatures set for 70°F., six canes of this variety were put into the main part of the glasshouse, which received no heat except through such leakage as there was from the cubicles, and another six were put outside. In each of the two groups of six canes only one inflorescence completely failed to emerge though the others took longer to develop than those kept in the cubicles. Of the five inflorescences to emerge outside only one showed any pollen grains filled with starch, and in this one the number of such pollen grains was very small. In the field, too, most inflorescences appeared completely sterile, only a few having any starch-filled pollen grains. This similarity in fertility of the tassels in the field and those from the cut canes placed outside the glasshouse indicated that the method of preserving the cut canes did not in itself have any effect on fertility. Of the inflorescences that emerged in the main part of the glasshouse four showed fair dehiscence and one profuse. Although fertility in these inflorescences was not as high as in those which had been kept in the cubicles—where all that emerged showed profuse dehiscence—there was nevertheless a marked increase in fertility compared with tassels from the field. Although no attempt had been made to heat the glasshouse, there were fairly marked differences between the temperatures inside it and those in the field. The minimum screen temperatures for the period May 26th to July 11th, i.e. from the start of the experiment until the time when all the inflorescences to emerge were fully expanded, were 53°F. for the average minimum and 48°F. for the absolute minimum. There were not enough thermometers for complete records to be kept in the main part of the glasshouse but, during a period of nine days, the minimum temperatures averaged nearly 4°F. higher than those of the screen, while the maximum temperatures averaged just over 11°F. higher than those of the screen.

Replacing the phosphoric acid of the preserving solution by a mixture of mineral nutrients, or by mineral nutrients and sugar, was tried when the varieties Co.312 and Co.421 were subjected to treatment. These substances seemed to interfere with the uptake of solution by the cut canes, possibly because of the impurities they contained. Though rather few inflorescences emerged, all that did so showed good dehiscence irrespective of the solution in which they had been kept.

Temperature and Flowering in Sugarcane.

The production of fertile pollen by inflorescences of Co.290 subjected to treatment is probably of less interest than the actual emergence of the inflorescences in the first place. Co.290 rarely flowers in Natal; the embryonic inflorescences which sometimes form nearly always fail to develop properly, and eventually die while still enclosed within their surrounding leaf-sheaths. This happened during the last season in the plot from which the canes used in the experiment had been taken; in fact, the only tassels seen of this variety last year were the five that emerged in the cubicle—one of the original six canes had been dissected before emergence—though two of these had some imperfectly developed branches.

Earlier flowering of canes in the cubicles compared with those in the field has been noticed several times in the past, and this suggests that temperature is the factor limiting the rate of development in the field. In the case of the variety Co.290 it appears that field temperatures lie below not merely the optimum, but the minimum temperature necessary for floral development. As this factor seems to limit not only pollen fertility but also the development of inflorescences, it is possible that it is responsible as well for the relatively small amount of flowering in this country. In an experiment with Co.312, there were found to be only embryonic inflorescences—less than an inch long—in two canes dissected nearly two months after being put into one of the cubicles. These canes had had to be selected in the field at rather an early stage of development. It seems likely that in selecting them a mistake was made and two canes were taken which had not at the time started to flower but which began to do so after being put into one of the cubicles. This of course does not imply that the canes would not have started to flower if left in the field, but it indicates that the artificial conditions to which the canes were exposed did not in themselves prevent the initiation of flowering. One attempt was made to induce flowering by keeping cut canes under relatively warm conditions. Twelve shoots of the variety Uba Marot were put into one of the cubicles on September 2nd, that is to say at a time of year when the length of day was—or soon became—what is usually regarded as correct for the initiation of flowering in sugarcane. The minimum temperature of the cubicle was set for 70°F. The only effect of the treatment, however, was greatly to stimulate vegetative growth.

Although this experiment gave negative results, it is intended to continue with work on these lines; the effect of temperature—especially night temperature—upon the flowering of plants is well-established, and there is some evidence that it may account for the distribution of flowering in sugarcane in Natal. Flowering of sugarcane in this country is on the whole rather poor, at any rate in comparison with tropical parts of the world. It is usually most profuse close to the sea, becomes sparser inland and eventually ceases altogether at the higher altitudes. In contrast to this apparent effect of high altitude decreasing flowering, there is a tendency for the sugarcane within a given area to flower more readily on the hillsides than in the valleys below. These effects would be explained if the temperatures over the whole cane-belt lay fairly close to the lower limit for flowering, only rising above this limit close to the sea and on the hillsides further inland, and falling below it in the other parts of the cane-belt with their colder nights. It is interesting that in some tropical countries, such as Java and Puerto Rico, it has been found that flowering is more profuse at higher altitudes.[4] If this effect is produced by the same cause, it would mean that the temperatures capable of producing good flowering lie within rather narrow limits.

It is generally believed that the length of day favourable for the initiation of flowering in sugarcane is about twelve hours. Except near the equator, periods of this daylength occur only at the time of the two equinoxes, and it might be expected that each period would be followed by a distinct flowering season. This is not so in Natal, nor apparently, in other parts of the world. It is interesting that profuse flowering seems to occur after the autumnal equinox only, that is to say after the equinox with the higher temperatures.

Some Effects of Drought on Flowering.

The most obvious effect of drought upon flowering is to reduce its intensity. This appears for the most part to be due to many of the embryonic inflorescences—which are apparently far more susceptible than growing points in the vegetative state—being killed by the unfavourable conditions. It is possible that drought may also prevent the actual initiation of flowering. It would seem, however, that apart from preventing the initiation of inflorescences or killing them after their formation, drought may also cause their reversion to vegetative growth. That it can do so was suggested by the following occurrence.

Sets of a seedling from a cross of N:Co.310 with Amu Darya were planted in a drum on November 11th, 1948. The soil was allowed to dry out almost completely between the 16th and 18th of April, 1949, by which time flowering had started. The whole stool was severely damaged; tassels which had already emerged were killed. On May 13th a shoot was noticed whose topmost—and fully-developed—leaf did not enclose any younger leaves. This shoot did not, however, show the usual indications of flowering such as shortening of the blades and elongation of the sheaths of the upper leaves. On dissection a malformed embryonic inflorescence was found which looked as if it would either fail to develop further or give rise to a so-called "bunch-top." This is an abnormality in which the single terminal growing-point is replaced by a number of buds, and these, continuing to grow, eventually give rise to a thick cluster of leaves at the top of the stem. By May 28th this type of leaf-cluster was beginning to emerge from the youngest leaf-sheath of one abnormal shoot, and in another the bunch-top condition was found after dissection. The only other shoot not in the typical vegetative condition was one showing the usual signs of flowering, and a normal inflorescence was found within the enclosing leaf-sheaths. No bunch-tops were found in this variety in the field, but it had stopped flowering before the drought of last season became severe.

When the variety collection at the Experiment Station was examined on October 26th, 1949, by which time the severe drought of the preceding months had broken, many dead embryonic inflorescences were found in many varieties. C.P.29/116, C.P.34/118 and C.P.29/103 showed in addition to dead or unhealthy-looking inflorescences, a bunch-top condition of some of the shoots. N:M.37, N:M.51, P.O.J.36M and P.O.J.213 all showed some abnormal shoots similar to those of the seedling of N:Co.310 and Amu Darya and, on dissection, they too were found to contain bunch-tops at an early stage of development. This type of abnormality had not been seen anywhere in the field before the drought became severe.

It would seem that the bunch-top condition is produced because an embryonic inflorescence has a number of growing points, and when drought causes a reversion from flowering, many of them give rise to vegetative growing points. This reversion to vegetative growth has apparently some effect on the upper leaves, which do not develop the characteristics of leaves subtending an inflorescence.

It is interesting to contrast this behaviour with that of cane attacked by the disease known as "smut," for then the last-formed leaves usually resemble those of a flowering cane. It has been suggested that the "whip" produced in this disease is the product of a malformed inflorescence, first initiated and then attacked by the smut fungus. This suggestion is probably wrong, for whip and inflorescence are distinct even in their embryonic stages. It may be that, although the fungus does not produce a flowering hormone, it does form a growth substance which is similar to that made by the developing inflorescence and which, amongst other things, causes elongation of the sheath and shortening of the blade.

TABLE II.

List of Crosses made during 1949.

Cross No.	Parentage.	No. of female inflorescences.	Number of Seedlings. Germinated.	Transplanted.	Planted in field.
1 & 3	N:Co.79 × (N:Co.310 × Amu Darya) ...	2	1200	519	300
2	N:Co.330 × (Co.205 × Glagah)	1	900	233	199
4 & 15	N:Co.79 × N:Co.310*	2	700	690	640
5	N:Co.310 × Glagah	2	1100	220	195
6	P.O.J.2725 × Glagah	2	140	137	137
7	N:Co.79 × Co.301*	5	8000	6523	2330
8	N:Co.79 × Co.285...	2	4500	4000	1137
9	N:Co.147 × Co.285	1	2	2	1
10	P.O.J.2803 × Co.285	1	2000	1000	183
11	N:Co.310 × (Co.205 × Glagah)	1	300	211	196
12	P.O.J.2725 × (Co.205 × Glagah)... ...	1	11	11	10
13 & 22	N:Co.310* selfed	4	500	219	200
14	P.O.J.2725 × Co.285	4	900	827	644
16	P.O.J.100 × Glagah	2	4	4	4
17	P.O.J.2725 × Co.432*	2	1400	1346	701
18	P.O.J.2725 × Co.432	1	0	0	0
19 & 30	Co.421 × Co.331*	6	7000	3254	2465
20	Tuc.2645 × Co.331*	1	0	0	0
21	Tuc.5142 × Co.331*	2	80	76	76
23	Co.421 × Co.285	3	1600	1525	1282
24	N:Co.154 and Co.421 × Co.285	4	650	489	235
25	P.O.J.2725 × Co.331*	2	2000	1751	1482
26	Co.432* selfed	3	1500	318	216
27	Uba × Co.421*	1	8	8	7
28	Co.331* selfed	14	2500	540	429
29	Uba × Co.312*	1	20	19	19
31	Uba × Co.356*	1	30	29	28
32	N:Co.310 × Co.290*	2	20	15	15
33	N:Co.310 × Co.356*	2	10	10	10
34	Co.290* selfed	3	200	182	175
35	Uba × Co.301	1	0	0	0
36	C.H.64/21 × Co.301	3	250	15	15
	Total	82	37,525	24,173	13,331

* Pollen fertility had been increased by treatment.

Types of Crosses made.

A list of the different crosses made during 1949 is given in Table II. A few first crosses with Glagah were made again this season; it is hoped that after several further crosses seedlings may eventually be obtained similar in type to the Co. varieties at present grown in Natal but with greater resistance to mosaic. Any *Saccharum spontaneum* "blood" in these Co. varieties is derived not from Glagah—the Javanese form of the species—but from one of the Indian forms, which do not usually impart their own mosaic immunity to their seedlings. Local seedlings from a cross of Co.205 with Glagah were also used in crossing. These seedlings should incorporate some of the characteristics of both the above-mentioned forms of *S. spontaneum*, as Co.205 is itself a seedling from a first cross with the Indian form. As Amu Darya—another type of *S. spontaneum*—is believed to impart its cold-resistance to its progeny, seedlings from a cross of this variety with N:Co.310 were in turn crossed with a thicker type of cane although they did not appear to show resistance to mosaic.

Crosses such as those mentioned above are unlikely to give rise directly to seedlings of agricultural value, and in the hope of obtaining more immediate results other crosses involving thicker types of cane were made. The largest number of seedlings planted in the field came from a cross of Co.421 with Co.331, and the seedlings are therefore similar in derivation to the newly released N:Co. varieties and have the same proportions of different *Saccharum* species in their make-up. The next largest number of seedlings came from a cross of N:Co.79 with Co.301, and are therefore derived from the varieties Co.281, Co.301 and P.O.J.2725.

Some crosses were made with forms of *S. sinense*, and a few seedlings from Uba—the inflorescences of which were obtained from the Umzinto district—and C.H.64/21 were raised. More selfings were made during the last season, mostly with the object of obtaining breeding canes.

Not all the seedlings raised could be planted in the Experiment Station fields; about four thousand were planted on the Burnside section of the Natal Estates and many more were discarded. Of 13,331 seedlings planted in the field, 8,793 (or nearly two-thirds) were from crosses in which the fertility of the male parents had been increased by subjecting them to artificial conditions. The practical value of this method of increasing pollen fertility is therefore well-established, and the chief difficulty in raising sugarcane seedlings in Natal would appear no longer to be the poor fertility of pollen in the field, but rather the relatively small amount of flowering that occurs in this country.

Summary.

In Natal temperature is apparently the factor limiting not only the fertility of pollen of sugarcane but also the development of the inflorescences. Although embryonic inflorescences are sometimes formed, Co.290 rarely flowers in this country, apparently because the prevailing temperatures are too low for the proper development of the tassels. Floral development is completed in this variety if cut canes are kept under warm conditions such as have been found to increase the pollen fertility of many varieties. Temperature may also be the factor responsible for the rather small amount of flowering in Natal and for the manner in which it is distributed.

It appears that a severe drought can cause a reversion to vegetative growth after embryonic inflorescences have formed, and that the condition known as "bunch-top" is usually produced in this way.

During the last season seedling raising proved very successful. From 29 different crosses more than thirty-seven thousand seedlings were raised, and thirteen thousand were planted in the field. About two-thirds of these came from crosses in which the fertility of the male parents had been increased by artificial treatment.

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The PRESIDENT said that the paper outlined a very important branch of the work of the Experiment Station. It was now possible to raise a large variety of hybrids from various canes—certainly a far wider range than before.

The variety Co.421, which was doing well in many parts of the world, had proved a failure at the Experiment Station and at Tongaat. In view of its success in other countries, however, it was worth while trying on alluvial flats like Umfolozi, and a small stock was therefore being built up for that purpose.

Mr. RAULT asked if the amount of flowering in canes was a varietal feature, and also what was the effect of the flowering on the cane.

Mr. BRETT replied that the amount of flowering did depend very largely on the variety. Some varieties had never flowered here at all, while others flowered every year.

The PRESIDENT stated that in the majority of modern varieties the cane did not fall off in sucrose after flowering. It did put a stop to growth, however, and if the cane were not big enough to send to the factory it might be a rather serious matter. If otherwise healthy, such canes made very good planting material, but there might be more than was required for such purpose, especially if the particular variety flowered extensively in a particular locality.

Mr. BECHARD said that flowering was a serious matter for the grower, for cane flowered when it was too young to mill and often when only four or five months old. He would like to know of any method whereby flowering could be controlled. It was noticeable that last year when his neighbour's N:Co.310 had all flowered, he had not a single flower in this variety. Furthermore, the experimental farm at Chaka's Kraal showed but little flowering, while all the surrounding cane was in flower.

Mr. DU TOIT said that, as far as sucrose content was concerned, tests showed that flowering, as such, had no effect. If anything it might tend to raise the sucrose slightly. Even cane which had flowered the year before and had side shoots about three feet long was unaffected. However, cane which had flowered might more easily get diseased, and this could bring down the sucrose content very much.

The point raised about the control of flowering was important and should be followed up. Fertilizers might have an effect.

Dr. MCMARTIN thought that Mr. du Toit's reference to flowering leading to disease concerned a certain field of Co.290. This cane was thought to have red rot, but actually what had happened was that some sticks had attempted to flower in their first year of growth. In the second year many of these sticks had died and were not sent into the mill. Others had produced side shoots, thus keeping alive, but at the end of the second year were in a very deteriorated condition, testing only 6 or 7 per cent. sucrose. The cane going into the mill was thus a mixture of one-year-old tillers and the canes which had produced a growth of side shoots. The reported outbreak of red rot was not a disease condition and the low test was a result of flowering.

An important point about the paper was that it indicated the progress of the study undertaken by the author a few years ago on the physiology of pollen formation. This study could have remained one of academic interest only, but it was developing on lines which appear likely to give very good practical results. He considered that we were now witnessing, in the glass-house, the sythesis of varieties likely to come into commercial production in the not-too-far distant future.

Mr. CHRISTIANSON enquired about the bunch-top, saying that some people claimed that after the fully developed flower had died off, the growing point could grow again.

Mr. BRETT replied that he thought that was not so. The bunch top was merely the growing point subdividing into several shoots.

Mr. PEARCE said that he had found that N:Co.310 cane planted in late December and early January did not flower, while that planted in October and November, in soil which was to all appearances the same, flowered a great deal. Another interesting point was that where there was 100 per cent. of flowering of N:Co.310 at seven months old, there were now none of the original sticks left. They had all died off and the field was now growing only the secondary shoots.

In another field, at the bottom of a valley where the cane was very good, it did not flower, whereas just a few yards away there was profuse flowering. It was difficult to understand why this should be, because both had been irrigated and had had considerable nitrate of soda. The nitrate of soda had been applied in an attempt to stimulate flowering, but seemed to have no effect at all.

He understood that in Hawaii success in inhibiting the flowering of cane had been obtained by applying light about midnight, but he could give no details as to the varieties of cane or the intensity of the light applied.

Mr. BRETT commented that, while the inhibition of flowering by using light had not been tried, the Experiment Station intended to arrange tests during the next flowering season. He was surprised to hear Mr. Bechard say that cane flowered at four to five months.

Mr. BECHARD was of the opinion that cane planted in October or November, if it flowered at all, would do so in March or April.

Mr. BRETT thought it might be possible to avoid some flowering by planting late. N:Co.310 was particularly inclined to flower early.

Mr. BECHARD pointed out that he planted at the same time as his neighbour, and whereas his neighbour's cane flowered, his did not show a single tassel. Also cane at the experimental farm at Chaka's Kraal showed but little flowering, and he asked if these two facts could be followed up to investigate if there were any cultural methods which could be followed to inhibit flowering.

Mr. GARLAND said the effect of flowering in N:Co.310 was worse than in any other variety, and he strongly advised not planting N:Co.310 in fields where cane flowered badly, especially on sandy soil. As an example, sandy fields which normally yielded 45 tons to the acre would give less with N:Co.310 which flowered. N:Co.310 died after flowering on sandy soils, whereas Co.301 did not.

The PRESIDENT remarked that experience at the experimental farm at Chaka's Kraal showed that N:Co.310 which had flowered heavily had still given a very good yield. He thought a good deal depended on the conditions under which the cane had been grown.

When he was at Canal Point, Florida, floodlighting all night had been tried in order to promote flowering. That had been tried here also, but without definite results. He had read that in Hawaii light had been used under certain conditions to inhibit flowering. That also would be tried here.

The case described by Dr. McMartin, in which Co.290 after showing incipient flowering in the first year, gave a poor crop in the second year, had been repeated on several occasions. That was one of the faults of Co.290. Nevertheless he thought that Co.290 had so many good points that it was well worth keeping, and planters would be well advised to grow small quantities in suitable areas. Stocks were being built up at Chaka's Kraal to see what could be done with Co.290. This variety suffered not only from red rot, which was prevalent only in the mist belt, but because it could not tolerate being kept for three years. Its period of maximum development coincided with the period of overflow production of cane when a good deal of cane was left over for a year or more after maturity before cutting.

Mr. GARLAND said that growers were concerned about what variety they could use to replace Co.281. No variety yet released could do so well on areas affected by drought and where the soil was shallow. It was important that we should have a variety to replace Co.281 for these conditions. In effect, we want a drought-resistant cane for these conditions.

Mr. BECHARD considered that the Co.281 growing at the experimental farm at Chaka's Kraal was superior to any growing in the vicinity of his farm; he also thought that too much interest was taken in N:Co.310, which, apart from a slight tendency to smut disease, flowered young, and came away badly the first year. Co.331 was also not very satisfactory, as it often showed a hollow centre, and also a large percentage of dead sticks was found in the field at cutting time, if at all delayed; he could not say if incipient flowering, as in Co.290, was the cause. That cane was also more intolerant to excessive moisture than was Co.301. He was therefore anxious to know what varieties could replace Co.281 and Co. 301.

The PRESIDENT stated that it had been intended to release three new varieties, N:Co.291, N:Co.339 and N:Co.349, but owing to secondary infection of mosaic disease their release had been delayed. As yet there was not much known of the range of these three varieties, and how far they could replace Co.281 depended a good deal on locality.

Mr. BECHARD said that a high sucrose cane was required in this country because of the high transport costs.

The PRESIDENT agreed with this view, and also pointed out that as high sucrose was associated with high purities, they were desirable from that point of view also.

Mr. BECHARD said, that he was convinced that at equal purities, one-year-old cane yielded its sugar more easily than cane that had stood through more than one winter; he thought that the reason could well be that during the cold months condensation products of sucrose had accumulated in the cells of the cane.

Mr. ELYSEE had had the same experience and said that extraction of sugar by the milling plant became more difficult as the age of the cane increased.

Mr. RAULT had found that when canes were cut at about 12 months old, they produced about 25 tons per acre, as against 40 tons per acre when left to grow two years. It would seem that the second period of growth was a very slow sugar producer.

Mr. PEARCE thought that a figure which would be useful in judging the value of cane from the grower's point of view would be the number of pounds of sucrose produced per acre for each month of the cane's life. He enquired about the difference in lignin content of cane at 12 months old as compared with four months old.

Dr. MCMARTIN stated he had done some work on the subject, and had found big differences in the proportion of lignified tissues to unlignified tissue between different varieties.

He enquired of the author if it was possible to tell, by splitting up the tops of samples of cane, if there were going to be profuse flowering or not.

Mr. BRETT considered it would be possible, if a sufficient number of sticks were examined, to forecast a few months ahead whether flowering would be profuse or not in a particular field.