FURTHER REPORT ON SUGARCANE BREEDING IN SOUTH AFRICA

By P. G. C. BRETT.

This report is confined to problems and successes in sugarcane breeding in South Africa during 1947 and 1948, and seedlings raised from seed imported from other countries are not considered. As one of the chief difficulties in raising sugarcane seedlings in this country is the small amount of viable pollen usually formed under field conditions, work on this problem has been continued, in addition to the more routine work of making such crosses as were possible with the rather limited amount of pollen available. The problem of pollen scarcity has been approached in three different ways : the effect of artificial conditions upon the production of viable pollen has been investigated, selections and introductions of varieties with good pollen fertility have been made, and pollen has been imported from Mauritius.

The effect of artificial conditions upon the production of viable pollen.

In a previous paper[1] mention was made of an experiment in which cut canes that were going to flower were kept under artificial conditions of increased temperature, day-length and humidity, and pollen fertility found to be thereby increased; a more detailed account of this work was given later.[2] As a suitable method of increasing pollen fertility would be of great value to sugarcane breeding in South Africa, work on this problem was resumed at the beginning of the flowering season in 1947. Unexpected difficulties soon arose, for when, using the variety Co.205 instead of Co.301, an attempt was made to repeat the results previously obtained, the inflorescences of all the canes used in the experiment failed to emerge from the leaf sheaths. The death of the embryonic inflorescences may have been caused by the wilting which occurred to a greater or less extent in all the canes while they were being preserved in the standard solution of 0.01 per cent. sulphurous acid and 0.01 per cent. phosphoric acid. A great deal of this trouble was to occur later; attempts to prevent wilting by making the preserving solution more effective are discussed under a separate heading.

In these first experiments it had been necessary to remove the canes at night from the glasshouse and transfer them to a small room which could be easily heated. To avoid having to move the canes, and at the same time increase the number which could be used in an experiment, part of the glasshouse was temporarily partitioned off into four separate compartments which, being small, could be kept warm at night relatively easily. In the first experiment after these alterations had been made, each cubicle was heated at night by a 1,000-watt heater, over which water was boiled to increase the relative humidity; the length of day was increased by lighting the cubicles till 8 p.m. every night. In each compartment were put three canes of Co.301 showing indications of flowering, two of N:Co.310, and one each of the varieties Co.453, Co.455, N:Co.341 and P.O.J. 2803. One cane of Co.301 in each cubicle was kept in preserving solution only, while all the rest were treated as in previous experiments and allowed to root into tins of compost placed above the preserving solution.

Out of the thirty-six inflorescences used in this experiment only fifteen emerged, and of these eight protruded only slightly before drying out. A few starch-filled pollen grains were found in one of the Co.453 inflorescences and in two of the Co.301; the latter came from canes that had not been rooted, and dried out soon after beginning to emerge. The anthers of the other inflorescences were somewhat papery and often brown in colour, being altogether worse formed than those produced under natural conditions. The development of side-shoots on many of the canes, including some which flowered, was another indication that conditions hae been unfavourable for proper growth; on the other hand, the production of a few starch-filled pollen grains indicated the removal of whatever factor had been limiting the formation of viable pollen in the field. During this experiment the maximum temperature had usually been about 100°F. and the minimum about 80°F.; as embryonic inflorescences seem to be particularly susceptible to unfavourable conditions, it was thought that these rather high temperatures might have been either directly or indirectly responsible for the poor development of the flowers.

In the second experiment an attempt was made to investigate the effect of temperature : the first compartment received no artificial heating, the second and third contained 1,000-watt heaters controlled by thermostats to start heating only when the temperature fell to 60°F. and 70°F. respectively, while in the fourth one heater was kept on all night and another set to come on when the temperature fell to 80°F. Although the windows of the first two compartments were kept open during the day, this was found to make but little difference to the maximum temperatures, which were nearly always between 90° and 100°F. in all compartments. All cubicles were lighted till 8 p.m. Three canes of each of the varieties Co.281, Co.301 and N:Co.310 were put in each cubicle. After a few days many of them had to be replaced because of wilting. The mortality of the embryonic inflorescences proved even higher in this experiment than in the first, none of the Co.301 and N:Co.310 inflorescences emerging from their leaf sheaths. All three of the Co.281 inflorescences emerged in the first cubicle, none in the second, two in the third and one in the fourth, but the anthers of all were small and abortive. Hence in this experiment not only was the mortality very high, but no increase in pollen fertility was shown.

The reasons for this failure not being known, no change in the heating and lighting of the different cubicles was made in the next experiment. In each cubicle were put three canes of both Co.281 and Co.301, two of N:Co. 310 (these had already been rooted in tins), one cane of C.P.34/118, and one of a seedling from an N:Co.310 and Glagah cross. Again only very few inflorescences emerged—none in the third and fourth cubicles, and only one from the second. This was an inflorescence of Co.301, which, like the single one of the same variety to emerge in the first compartment, showed good dehiscence, the fertility appearing to be a little higher than that of flowers in the field. The only Co.281 to emerge in the first compartment eventually produced some pollen grains with starch but showed no dehiscence, and its fertility could not be said to have been improved by the treatment. The only N:Co.310 cane which flowered showed fairly good dehiscence eventually, whereas in the field at the same time only a few anthers had pollen grains with starch and none were dehiscing. The seedling of N:Co.310 and Glagah, which was the only other cane to flower, showed good dehiscence; no starch-filled pollen grains were found in the only inflorescence of this variety in the field at this time. There seemed, therefore, to be little doubt that the conditions to which the canes had been exposed in the first compartment had led to an increase in fertility. Although this cubicle had not been heated at night, it was slightly warmer than outside; its average minimum and absolute minimum temperatures were 64.4°F. and 54°F. respectively, while the corresponding screen temperatures were 59.0°F. and 48°F., hence it was not possible to exclude temperature from the factors which might have produced increased fertility.

During this experiment it had been found that a rather sharp temperature gradient from top to bottom existed within the cubicles, and hence that the recorded temperatures were lower than those actually occurring in the upper portions of the cubicles. As during these experiments the canes had usually grown up to reach to near the glass roof, it seemed likely that over-heating of the young inflorescences might have been the cause of their deaths. By this time the flowering season was practically over and no more experiments could be carried out until the next year. In the meantime the cubicles were so altered that their top portions could be opened during the day and uneven heating of the cubicles prevented; from this time onwards the windows of all cubicles were kept open on all fine days.

The first experiment of the 1948 season was started on May 25. The first cubicle was not heated, but in the second, third and fourth, the minimum temperatures were set for 65, 70 and 75°F. respectively, and all were lighted till 8 p.m. every night. Three canes each of Co.205, Co.455 and N:Co.310, and one of N:Co.349 were put in each cubicle. The variety Co.455 would appear to be rather easily affected by artificial conditions, for although at least half of the inflorescences of the other varieties emerged, none of those of Co.455 did so. Of the singles canes of N:Co.349, the one in the fourth cubicle did not emerge, while the remaining three all had cream-coloured anthers with distorted pollen grains no different from those in the field at this time. The pollen produced by both Co.205 and N:Co.310, however, showed that an increase in fertility in these varieties had been produced by treatment, the fertility appearing to vary with the minimum temperature and to be greater at higher temperatures. On June 23, for example, of four inflorescences of Co.205 in the field, one showed no dehiscence and had only a few starch-filled pollen grains, but the other three were dehiscing well and about half the pollen grains contained starch. One inflorescence of Co.205 in the first compartment resembled the latter in fertility, one had no pollen grains with starch, and the third did not emerge. In the second cubicle the only inflorescence of this variety to emerge showed good dehiscence and most of the pollen grains appeared viable. In the third cubicle nearly all the pollen grains were viable and good dehiscence was shown by the only inflorescence to emerge. In the fourth cubicle the fertility of the two inflorescences to emerge was still higher, there being only a few pollen grains lacking in starch. As regards N:Co.310, in four inflorescences from the field examined at this time, the pollen grains were nearly all shrivelled and none contained starch. In cubicle 1, however, two out of the three inflorescences produced a few pollen grains with starch; in cubicle 2 one had no viable pollen grains, the second only a few, while one side of the inflorescence of the third showed good dehiscence with about a quarter of the pollen grains filled with starch. In cubicle 3 the fertility was still higher, at least a portion of all three inflorescences showing dehiscence with half or more of the pollen grains apparently viable, and when the seed from one of these inflorescences was sown, twenty-six seedlings germinated. In cubicle 4, however, none of the inflorescences emerged.

In table 1 are given some details with regard to maximum and minimum temperatures during this experiment.

TABLE 1.

Maximum and minimum temperatures during the period May 25 to June 23, 1948.

	Average minimum.	Absolute minimum.	Average maximum.	Absolute maximum.
Cubicle 1....	59.8	52	91.3	101
Cubicle 2....	64.7	57	88.9	103
Cubicle 4....	69.3	65	87.6	102
Cubicle 4....	74.0	68	88.4	100
Screen	54.1	45.5	76.6	86.5

This was the first time that a marked increase in pollen fertility of varieties other than Co.301 had been found. The fact that in some inflorescences dehiscence had been confined to definite portions or even side-branches suggested that the sterility of the remaining portions might have been due to an inadequate water supply resulting from the blocking of some of the vessels normally supplying these parts.

As it had not yet been found whether increased length of day had been partly responsible for increased fertility, in the next experiment the duration of lighting was varied from cubicle to cubicle, while the minimum temperatures of all were set for 70°F. The first cubicle was lighted throughout the night, the second till midnight, the third till 8 p.m., while the fourth received daylight only. The experiment was started on July 16, 1948, three canes each of the varieties Co.281, Co.301, Co.331 and N:Co.310 being put in each cubicle. Observations made on the different inflorescences during this experiment are summarised below.

Cubicle 1.

N:Co.310. By August 23 two inflorescences were showing fair dehiscence in their lower portions, the one with about 50-60 per cent. starch-filled pollen grains, the other with about 80 per cent. The third showed no dehiscence though about 40 per cent. of the pollen grains appeared viable.

Co.331. One inflorescence did not emerge, another dried out after starting to protrude (its anthers did not dehisce and contained about 20 per cent. starch-filled pollen grains), while the third showed some dehiscence on August 16, and this increased till by the 30th practically all anthers were dehiscing with about 80 per cent. starch-filled pollen grains.

Co.281. Some branches of one inflorescence were showing good dehiscence (about half the pollen grains contained starch) by August 23; in another it was not until the 30th that a few starch-filled pollen grains were found, and in the third not until September 6, at which time some branches were showing fair dehiscence with 10-50 per cent. apparently viable pollen.

Co.301. One inflorescence did not emerge, but the anthers of the other two were nearly all dehiscing by August 23, about half the pollen grains being apparently viable in the one and 80-90 per cent. in the other.

Cubicle 2.

N:Co.310. By August 23 two inflorescences showed some branches with good dehiscence and 50-60 per cent. starch-filled pollen grains, while the third, in which up to half the pollen grains in some anthers appeared viable, was not emerging properly and showed no dehiscence.

Co.331. One inflorescence did not emerge, and the second dried out after having shown on August 23 some branches with good dehiscence and about a quarter to half the pollen grains apparcntly viable. In the third the anthers were nearly all dehiscing with about 40-70 per cent. starch-filled pollen grains by August 16, when it was removed from the cubicle to use in a cross with N:Co.310.

Co.281. In one inflorescence the anthers remained minute, brown and lacking any formed pollen grains; in the second some branches showed a few anthers dehiscing with up to about 40 per cent. apparently viable pollen grains; while the third at the same time (August 23) had only up to about 5 per cent. starch-filled pollen grains and no dehiscence.

Co.301. None of the inflorescences emerged.

Cubicle 3.

N:Co.310. Two inflorescences did not emerge; the third showed fair dehiscence with 40-70 per cent. apparently viable starch by August 23.

Co.331. By August 16 two inflorescences had nearly all their anthers dehiscing, the one with about 50-75 per cent. starch-filled pollen grains and the other with 80 per cent. or more; both were then removed and used for crossing. The third inflorescence had practically all anthers dehiscing with about 60-80 per cent. starch-filled pollen grains on August 23, and it too was then removed for use in crossing.

Co.281. One inflorescence did not emerge; the other two showed fair dehiscence with up to about half their pollen grains apparently viable by August 30.

Co.301. Two inflorescences did not emerge, but in the third by August 23 all anthers appeared to be dehiscing with 90 per cent. starch-filled pollen grains.

Cubicle 4.

N:Co.310. By August 23 one inflorescence had a few of its branches with some dehiscence but only 10-20 per cent. starch-filled pollen grains; the second showed fair dehiscence with 10-50 per cent., and the third fair to good dehiscence with 25-70 per cent.

Co.331. By August 16, in two inflorescences nearly all the anthers were dehiscing with up to about 70 per cent. starch-filled pollen grains, and they were then removed for use in crossing. In the third inflorescence by August 23 all the anthers were dehiscing with 70-80 per cent. viable pollen grains, and it too was then removed for use in crossing.

Co.281. One inflorescence did not emerge, but the other two showed rare dehiscence with up to 40 per cent. and 50 per cent. starch-filled pollen grains by August 30.

Co.301. Two inflorescences did not emerge, but in the third by August 23 all anthers appeared to be dehiscing with 70-80 per cent. viable starch.

Field.

N:Co.310. No starch-filled pollen grains were found in inflorescences in the field on August 23.

Co.331. Only a rare starch-filled pollen grain was found in inflorescences in the field on August 8, at which time, unfortunately, the plot was cut, making further comparisons with the treated canes impossible. It was noted, however, that inflorescences of Co.301 in an adjoining field showed no increase in fertility during the time the experiment was in progress.

Co.281. On August 16 the anthers of five inflorescences were brown and minute and contained no pollen grains; a sixth had small, cream, papery anthers with mostly distorted pollen grains and only a few round ones, which, however, contained no starch. On August 23 the anthers of four inflorescences examined were minute and either white or brown in colour, and no pollen grains could be seen; two other inflorescences had small cream anthers with a few distorted pollen grains. On September 6 the anthers of four inflorescences examined were minute, either white or brown in colour, and had no pollen grains

Co.301. On August 23 no starch-filled pollen grains were found in one inflorescence, only very few in another but in a third there were up to 50 per cent. in some anthers and rare dehiscence was occurring.

The average minimum temperatures of all the cubicles during this experiment were within a degree of 70°F.; the absolute minimum for any cubicle was 64°F. Corresponding screen temperatures were 53.9°F. and 44.5°F. The average maximum temperatures of the cubicles were between 85° and 86°F. except for the first, in which it was 90°F. Absolute maximum temperatures were 104°, 95°, 93° and 93°F. for cubicles 1, 2, 3 and 4 respectively. The average maximum screen temperature during the same period was 75.6°F. and the absolute maximum 91.5°F.

It will be seen from the observations on flowering recorded above that there was no indication that an increase in length of day led to an increase in fertility. There was a definite variation in fertility between varieties, corresponding to a similar variation under natural conditions but on a higher scale of fertility. In some inflorescences, especially those of Co.281 (which in the field seldom formed pollen grains), dehiscence often did not begin until the majority of flowers in the inflorescence were old. As there is a limit to the time canes can be subjected to treatment (external indications of flowering are manifest only some time after the inflorescence has started development), it may not prove worth while from a practical point of view to attempt to increase the fertility of some varieties, unless there are special reasons for trying to do so. It seems likely, however, that other varieties whose sterility under natural conditions would be nearly complete, can be changed by treatment into useful male parents; the six Co.331 canes used as male parents for crossing with N:Co.310 gave 363 seedlings, and when the selfed seed was sown about 5,000 seedlings germinated.

In the next experiment the minimum temperatures were set for 75°, 70°, 65° and 60°F. for cubicles 1, 2, 3 and 4 respectively; the day-length was not increased in any of them. In each compartment were put four canes each of the varieties N:Co.310, Co.281 and Co.301. Three canes of each of these varieties were also kept in the main glasshouse, which was not heated at night. The experiment was started on September 7, 1948. At this time the drought was severe, and it was found that many canes which in the field showed indications of flowering actually contained dead embryonic inflorescences; in other canes the inflorescences were far smaller than the external appearance suggested. Some of the latter had to be used to obtain sufficient canes, and some with dead embryonic inflorescences were doubtless included, it usually not being possible to distinguish them by their external appearance. This probably explains why so few inflorescences eventually emerged. The only inflorescence of the variety N:Co.310 to emerge was one from the second cubicle; it showed some dehiscence at a time when no starch-filled pollen grains could be found in flowers of this variety in the field. No definite variation in fertility from cubicle to cubicle was shown by the six Co.301 inflorescences to emerge, but the fertility of all was higher than that of inflorescences in the field. Only four inflorescences of the variety Co.281 emerged normally, two being in cubicle 4 and two in the main glasshouse; one of the latter showed some dehiscence, its fertility being higher than that of inflorescences in the field, but the other three showed no increase in fertility. The minimum temperatures in the field from which the canes had been taken are not known, but those of the main glasshouse were practically the same as the minimum temperatures recorded in the Stevenson screen at the Experiment Station. On a previous occasion also increased fertility had been found in some inflorescences which had been kept in the unheated glasshouse before emerging. The variety used on this occasion was Co.205 and the field from which the inflorescences had been taken was very close to the Stevenson screen, so that there is not likely to have been much difference in the night temperatures between the cut canes in the glasshouse and those growing in the field. On the other hand, it it interesting to note that the minimum temperatures recorded on three successive nights in two plots of Co.301 where the fertility was good were slightly higher than in a third plot where the fertility was poor, although the plots were not far distant from one another.

To sum up, it may be said that while the increased fertility obtained in these experiments was probably due to higher temperatures, especially higher minimum temperatures, other factors cannot be excluded. The effect of humidity has not yet been investigated, but the indications are that pollen fertility can be increased without artificially increasing humidity; it may, however, have an indirect effect by influencing the health of the cut canes. The use of this method of increasing pollen fertility still remains to be tested on a large scale; it is to be hoped that the considerable increase in fertility which can be brought about in some varieties will prove a useful tool in the work of cane-breeding in South Africa.

Prevention of wilting in cut canes.

Mention has already been made of how during the first of the experiments described above, wilting of the cut canes caused considerable trouble. It seemed that in a few canes the wilting might have been due to the contamination of the preserving solution with traces of compost. Precautions were taken to avoid any further contamination after it had been found that, when even quite small amounts of compost were were added to the preserving solution, its efficiency was decreased; a less marked lowering of efficiency occurred in a 0.05 per cent. solution made up of equal parts of the six acids phosphoric, oxalic, sulphuric, benzoic, acetic and nitric. This solution had previously been found to be quite effective for preserving cut canes; attempts were made to improve it still further. Different concentrations were tried but none were found better than that first used. Its efficiency was decreased by the addition of molasses, sucrose or the proprietary wetting agent Turgitol; Aerosol was without effect. In tests made to find the effect of different acids upon preserving cut canes, perchloric, salicylic, sulphanilic, picric, carbolic and tannic acids were found effective in the order given, the perchloric acid solution being nearly as good as the standard one, while that of tannic acid was less less effective than water alone. The best three of these, together with citric acid and the six acids first tried out, were used in equal proportions to give a solution whose total concentration was 0.05 per cent. This solution seemed slightly less effective than that of the six acids alone, but in the test in wnich they were compared both seemed better than the standard solution. In this experiment, however, vegetative shoots had been used; these mixtures of acids appeared less effective than the standard solution when they were tried out on flowering canes.

The effectiveness of the strong oxidising agent perchloric acid is interesting to note, for the prevention of wilting by sulphurous acid has sometimes been ascribed to its reducing action. What would seem another erroneous suggestion is that blocking of the vessels of canes occurs at their cut ends. That it takes place at the nodes (where the vessels end) is indicated by the fact that, if in wilted canes equal lengths are cut off under water, turgidity is regained only by those canes from which a node has been removed.

Introduction of pollen from Mauritius.

As a result of a suggestion by Dr. Dodds, Dr. Evans kindly agreed to send some pollen from Mauritius to be used for making crosses in this country. The pollen was collected in Mauritius on June 3 and 4, 1947, packed in tubes surrounded by crushed ice in a thermos flask and sent by cargo ship travelling direct to Durban. Some of the pollen was packed over calcium chloride and the rest over pieces of damp cotton-wool; both lots were found on arrival to have caked. It seemed that the tube with pollen fitted too closely into that with calcium chloride for the latter to exert its drying effect. Pollinations were made at the Experiment Station on the mornings of the 12th, 13th and 14th; they were not carried out in the field but in the glasshouse, where the outbreak of a new disease could be more easily controlled should this have followed the introduction of disease spores in the pollen. The pollen was applied with a camel-hair brush because, having caked, it could not be dusted over the inflorescences. On several occasions stigmata were removed and the adhering pollen grains examined, but no germination was ever seen. As the pollen had not been applied until at least eight days after it had been collected, it was not expected to have retained its fertilising capacity; one seedling, however, was obtained from the sixteen inflorescences used in this experiment. It came from a supposed cross of Co.205 with M.196/31, but the extremely thin canes of the seedling, together with the fact that the pollen had shown no indications of viability, makes it doubtful whether it actually arose from a cross between these varieties. It is also unlikely that it arose from selfing; apart from the fact that very few starch-filled pollen grains and no dehiscence had been found in the Co.205 inflorescence, selfed seedlings of this variety normally resemble Co.205 itself fairly closely, having distinctly thicker canes than this particular seedling. There remains the possibility that it arose by parthenogenesis, the development of the unfertilised egg cell perhaps being stimulated by the hormones in the rather large number of caked pollen grains applied to some stigmata.

Selection and introduction of varieties for male fertility.

Varieties which have proved useful males in other countries are being imported in the hope that some at least will be capable of producing viable pollen under South African conditions. At present there are in the quarantine glasshouse at Durban the varieties U.S.1694 and C.P.'s 1161, 1165, 27/108 and 36/111; these have been found useful males under the sub-tropical conditions of Canal Point. The varieties G.255 and G.257, both of which include in their parentage the cold-resistant variety of *Saccharum spontaneum*, Amu Darya, have arrived from Queensland. Mention should also be made here of the introduction of a number of wild forms of sugarcane to find their value in breeding commercial canes; wild forms of sugarcane usually show pronounced male fertility. A seedling of *Saccharum robustum* and six forms of Glagah (Djatiroto, Kepandjen, Kletak, Kloet, Mauritius and Tabango) have arrived from Mauritius; and seedlings of *Saccharum spontaneum* var. *ægyptiacum* have been grown from seed sent from Uganda.

Another attempt to obtain more male varieties is being made by selecting seedlings grown at the Experiment Station on a basis of pollen fertility, all seedlings flowering at the single stool stage being examined for viable pollen. Up to the present one seedling of Co.301 selfed, two seedlings from a cross of N:Co.310 with Amu Darya and three from a cross of N:Co.79 with Glagah have been selected because of good pollen fertility. It is hoped that if these introduced or selected varieties do not themselves prove useful male parents giving seedlings of commercial types of cane, it may be possible to breed from them varieties fulfilling these requirements.

Technique of crossing and seedling raising.

At the present time the usual method of crossing is based on that of Hawaii, in which units of ten cut canes, four of which are females and six males, are preserved in a 0.01 per cent. sulphurous acid and 0.01 per cent. phosphoric acid solution. Female varieties which do not keep well in the preserving solution are rooted in compost. Crossing is carried out in the glasshouse. The seed after bagging is allowed to dry for two days, dusted with Agrosan GN and sown in sterilised soil prepared according to recommendations by the John Innes Institute.[3] Covering the seed tins with glass has been found to shorten the time of germination, increase the percentage germination, and reduce seedling diseases. The seedlings when about a month old are transplanted to clay or tin pots; planting in the field is done about a month later if the ground is sufficiently damp.

In tables 2 and 3 are given some details of the seedlings raised in South Africa.

TABLE 2.

Numbers and parentages of Seedlings raised during 1947 and 1948.

Parentage.	Number of female inflorescences.	Number of seedlings germinating.	Number of seedlings planted in field.
1947 season—			
N:Co.310 × N:F.35	4	14	3
N:Co.79 × N:F.35	1	200*	37
N:Co.310 × Co.301	20	16	14
Total		230*	54
1948 season—			
(Seedling of N:Co.310 × Amu Darya) selfed	8	33	17
N:Co.79 × Co.205	1	800*	567
N:Co.310 × (N:Co.79 × Glagah) ...	2	91	91
N:Co.79 × seedling of Co.301 selfed	3	200*	158
(Seedling of Co.301 selfed) selfed...	3	4	2
N:Co.310 × Co.285	4	640	597
N:Co.310 selfed	1	28	26
N:Co.310 × Co.331	4	363	363
P.O.J.2725 × Co.285	6	112	112†
Co.281 × Co.301	4	14	14†
Co.331 selfed	6	5,000*	1,000*†
Total		7,285*	2,947*

* Approximately   † Still to be planted.

TABLE 3.

Numbers and parentages of seedlings selected for planting into single lines.

Parentage.	Number planted into single lines.
Varieties selected as possible commercial canes.	
N:Co.310 × Co.301	16
Selfed Co.301...	52
N:Co.310 × Co.356	1
N:Co.310 × Co.285	2
Co.281 × Co.301	3
N:Co.339 × Co.285	2
Varieties selected for breeding purposes only.	
N:Co.352 × Amu Darya	1
N:Co.310 × Amu Darya	3
N:Co.79 × Glagah	6

Summary.

Attempts to overcome the difficulty that few varieties in Natal produce much viable pollen have been made in three ways.

1. Cut canes that were going to flower have been subjected to artificial conditions in an attempt to find a suitable method of increasing pollen fertility. Increase in day-length appeared to be without effect; increase in humidity, while perhaps of value in keeping the canes in better condition, did not seem essential. The marked increase in pollen fertility which has been obtained in some varieties was probably due to preventing the minimum temperatures from falling too low. Definite increases in fertility have been produced in the varieties N:Co.310, Co.281, Co.301, and almost certainly Co.331 as well.

2. A preliminary attempt has been made to use pollen introduced from Mauritius for crossing. Only one seedling germinated, and this is believed to have arisen by parthenogenesis.

3. A number of varieties which have proved useful males in other countries have been introduced, in the hope that they will retain their fertility here. In

addition, selections for pollen fertility are being made amongst seedlings raised in this country.

It has not been found possible to improve upon the standard Hawaiian solution of 0.01 per cent. sulphurous acid and 0.01 per cent. phosphoric acid for preserving inflorescences of cut canes, though some solutions when first tested upon non-flowering canes had appeared better than the standard one.

The technique of crossing in use at present is based upon the Hawaiian system. Seedlings are raised under conditions as sterile as is reasonably possible.

In 1947 only about 230 seedlings were germinated and 54 planted in the field; in 1948 the numbers were about 7,000 and 3,000 respectively. From seedlings raised previously, 76 have been selected as possible commercial canes and planted into single lines; 10 have been selected for breeding purposes only.

REFERENCES.

[1] Brett, P. G. C. (1947):An Investigation into Sugarcane Breeding in South Africa. Proc. S.A. Sugar Tech. Assn., **21,** 104-108.

[2] Brett, P. G. C. (1948): A Possible Method for Increasing Pollen Fertility of Sugarcane in Natal. S.A. Jour. Sci., **44,** 122-124.

[3] Lawrence, W. J. C., and J. Newell (1945): Seed and Potting Composts with Special Reference to Soil Sterilization. 3rd edn. George Allen and Unwin Ltd., London.

Experiment Station,
South African Sugar Association,
Mount Edgecombe.

March, 1949.

[Instead of the whole paper, Mr. Brett read a specially prepared precis.]

The PRESIDENT told the author that the meeting really appreciated the trouble he had gone to and said that his example should be followed as often as possible. Papers were printed with all relative detail; but it was seldom necessary to read whole papers for these would be published in the Association's Proceedings and the detail could be followed up by any investigator.

Dr. DODDS agreed, and pointed out that there were few scientific or similar organisations where papers were read in full at conferences. Only abstracts such as Mr. Brett's were read, if at all, and those who wished to discuss papers were presumed to have read them beforehand.

Dr. MCMARTIN said that a distinct advance had now been reported in the production of seedlings from Natal seed. The type of cane produced from local seed a couple of years ago did not hold much promise of ever being of commercial value in this country. This was no longer the case and the progress made was a great achievement.

The particular work that Mr. Brett was doing brought to mind the remarks of Dr. Malherbe's opening address to this Congress, wherein he had pointed out the necessity for a certain amount of pure research, with the ultimate hope of leading to some useful application. This study itself, leading to the introduction of new canes for Natal, began really not so much to see whether cane propagation could be carried out locally, but as a study into the physiology of pollen-production. In other words, the beginning of this study was a piece of more or less pure research. It was having now a distinct practical application, and he himself thought that this particular work was, more than anything else, going to affect the varietal position in Natal.