

Report of the Sugarcane Expert

1933-34



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REPORT OF THE SUGARCANE EXPERT.

(RAO BAHADUR T. S. VENKATRAMAN, B.A., I.A.S.)

I. CHARGE AND STAFF

I held charge of the office of the Government Sugarcane Expert throughout the year except for one month's absence on leave in September 1933, when the Second Cane Breeding Officer, Mr. N. L. Dutt, M.Sc., held charge. The Second Cane Breeding Officer was absent on leave till 3rd August 1933 and during the period Mr. M. K. Krishnaswami, M.A., his senior Assistant, held charge of duties of Second Cane Breeding Officer in addition to his own. Mr. G. V. James continued to be in charge of the Sub-station at Karnal throughout the year.

With the help of funds kindly sanctioned by the Imperial Council of Agricultural Research, the staff at the Station was strengthened by the appointment of a Sugarcane Geneticist and Dr. Miss E. K. Janaki-Ammal, M.A., M.Sc., D.Sc., F.L.S., joined the post on the 25th May 1934.

II. SUGARCANE BREEDING (MAINLY SUB-TROPICAL TYPES)

(a) BREEDING TECHNIQUE

(i) *Controlling time of arrowing.*—The planting of canes at different seasons and under different soil conditions synchronised their times of arrowing to such an extent as to enable effecting of crosses not possible hitherto. A modified form of topping—concentrating on the side shoots—was started with the object of further influencing time of arrowing.

(ii) *Isolation of arrowing canes.*—The Coimbatore method of isolation of arrowing sugarcanes in tile pots for purposes of hybridization—which had proved so useful in the past—was further simplified by Mr. R. Thomas, who obtained equally good results by isolating the canes in water culture and in earthen pots.

(b) THE BREEDING PROGRAMME

The arrowing during the season was normal and satisfactory; and this enabled the carrying out of the programme laid down for the year more or less fully, so far as the breeding of economic types was concerned. Certain of the trial crosses had, however, to be postponed owing to the disparity in the times of arrowing of the parents, which had not been specially planted for the purpose.

The economic bulk crosses included six combinations, three of them being made for supplying seedlings as seedlings to the Substation at Karnal and the Sugarcane Research Station at Shahjahanpur. The parents employed in these bulk crosses were mostly Coimbatore canes of proved utility such as Co.'s 213, 244, 281, 285, 290 and 313. Six trial combinations were made to pick out the most promising of them for the bulk crossing of economic type during subsequent years. Nine combinations—involving types of *Saccharum spontaneum* or *Sorghum*—were effected in connection with cytological studies of the genus *Saccharum*. During the season about a lakh and a half of seedlings were raised of which about half were planted in the first ground nurseries. These were thinned down to about 18,000 while planting in the second ground nurseries for a full year study.

(c) NEW PARENTS

Certain of the hybrids between P. O. J. 2725 and various types of *S. spontaneum*—originally raised for academic studies—showed distinct promise of use as parents on account of their health and good tillering power. These were, therefore, added to the plot of parents at the station. Other new parents thus added during the year included three of the hybrids between P. O. J. 2725 and *Sorghum Durra* Stapf raised in the year 1930. These hybrids, which showed little healthy pollen in the first year, are now producing a fair amount of such pollen and setting seed freely as well. As the resultant seedlings showed satisfactory vegetative and juice characters the above hybrids have also been added to the collection of parents.

(d) SELECTION OF USEFUL TYPES

Of the 126 seedlings under test in rows during the year seventeen were raised to the status of Co.'s on data obtained from periodic root and shoot studies and juice analysis. These studies have revealed interesting differences between varieties in the manner by which the tonnage at harvest is built up during the different stages of growth. Whereas in certain cases the full growth of cane is laid fairly early in the ripening season, in others the process would appear to be continuous during the ripening period. The selections include five 'early', three 'medium' and nine 'late' maturing types. The outstanding 'early' types include one seedling obtained by selfing Co. 214 which is itself an early maturing cane; the second is a hybrid between P. O. J. 2725 and *Sorghum Durra* Stapf.

III. RESEARCH AND INVESTIGATIONS.

(i) *Studies in germination.*—Quick and vigorous germination being a most desirable character in a new cane, work was started

by the Assistant Sugarcane Expert, Mr. K. Krishnamurthi Rao, on possible correlations and devising means to improve germination in the field. Promising results have been obtained both from topping canes in the field and soaking the setts previous to planting. The data obtained confirm the previous finding at the station that, in a three budded sett, the central one germinates the quickest and the best.

(b) *Effect of arrowing on juice quality.*—Periodic juice analyses of arrowing canes by Mr. K. V. Gopala Iyer, B.A., showed that improvement in both sucrose and purity is possible long after the arrows are out—as much as two months in certain cases. While it is true that in the same field the arrowed canes show slightly higher sucroses and purities than non-arrowed ones, the arrowing by itself is not a sign of cane maturity.

(c) *Cytological studies.*—A certain amount of new ground in sugarcane cytology was covered during the year through the enthusiastic work of Mr. T. S. N. Singh, B.Sc., largely on material carefully preserved and planted from year to year for over a decade by Mr. R. Thomas. Chromosome countings were made not only of the different types of *S. spontaneum* and of *Saccharum munja* but also of the various inter-specific and intergeneric hybrids available at the station. Certain of the results obtained and since published have been confirmed by a recent publication by Dr. G. Bremer till recently and for long the cytologist at the Sugarcane Experiment Station at Pasoeroean in Java. The *Sorghum* hybrids would appear to contain at least two groups—one in which there is a doubling of chromosomes on the mother side at *Karyokinesis* and the other where there is no such doubling.

(d) *Saccharum spontaneum types.*—A tour in Bihar by Mr. R. Thomas with the active help and full co-operation of the Bihar Department of Agriculture—through Mr. D. R. Sethi, the Director and Mr. K. L. Khanna, the Sugarcane Specialist—has resulted in the addition of eight new types to the collection of *S. spontaneums* at the station. One hundred seedlings from most of the types are growing in the plots for morphological and cytological studies. A form from Burma is easily outstanding on account of its great tillering power, but its arrowing is neither steady nor abundant.

(e) *Soil types to suit different canes.*—A cheap and simple method was devised to get indications about the kind of soil best suited to particular canes. Briefly stated the method consists in growing the plants above and away from the soil by an arrangement previously evolved at the Station and developing a definite number of shoot roots from a node well above the soil level. An equal number of these roots are now made to grow and develop in different pots each containing one of the soils under test. Data thus obtained have largely corroborated the recorded experience with different

canes ; and Mr. S. A. Hussainy has made himself responsible for an extensive study on these lines.

(f) *Sugarcane-Sorghum hybrids*.—The rather extensive series of these crosses between Sugarcanes and *Sorghum* mentioned in the last report yielded a certain number of selections, some of which were characterized by high sucrose and purity percentages. The combinations with Coimbatore canes gave, on the whole, better types than that with P. O. J. 2725.

F₁ hybrids between P. O. J. 2725 and *Sorghum Durra* Stapf crossed with the *Sorghum* male parent, yielded a rather interesting series. Besides plants which showed very obvious traces of the *Sorghum* parent, the series included certain peculiar types which showed rather continuous flowering and thick coriaceous leaves very dissimilar to those of either Sugarcane or *Sorghum*. (Plate II, fig. 1.)

IV. RESEARCH AND INVESTIGATIONS BEARING MAINLY ON THICK CANE BREEDING

(N. L. DUTT, M.Sc.)

(a) BREEDING.

An important feature of the hybridization programme during the year was the further utilization of certain of the hardier medium Coimbatore canes as one of the parents, *viz.*, Co. 205, Co. 243, Co. 244, Co. 285 and Co. 290. This was done because canes like Co. 402, Co. 408, Co. 413, Co. 417 and Co. 419—which contain the blood of the hardier types—are proving a success in the preliminary trials at the various Experiment Stations in India. The following crosses were, therefore, made on a bulk scale :—

(1) *Vellali* × Co. 243, (2) P. O. J. 2725 × Co. 243, (3) P. O. J. 2878 × Co. 290. Other combinations which are expected to yield good seedlings are Co. 419 × Co. 244 and Co. 411 × Co. 243.

One of the problems in the breeding of the tropical types for India has been to breed varieties that will resist wind and cyclones. Some success was obtained in this direction as the majority of the seedlings in the cross Co. 408 × Co. 415 have the needed habit with short erect canes. (Plate II, fig. 2.)

(b) SELECTION

The selection of suitable thick type of canes has now reached an important stage as the satisfactory growth of recent distributions has enabled the setting up of standard types for the various tracts. Accordingly 15,000 seedlings, which had been raised from seed, and had completed their full growth in the field were studied and 210 of them as conformed to the standard types in growth and

sucrose percentage were selected for further testing. Similarly eleven seedlings from the final test plots were selected after comparing their yields with the standards and were raised to the status of Co.'s during the year. Their parentages are given elsewhere in the report.

(c) CHARACTERISTICS OF CERTAIN THICK CANE SEEDLINGS

It is proposed to study definite characteristics of such thick cane seedlings as show promising growth in various Experiment Stations During the year observations were, therefore, made on the late ripening quality of Co. 402. This cane is a fairly heavy yielder and is at the same time relatively non-flowering. It is unimpressive in the early stages of its growth, but pulls up later and finishes as a good yielder. It is, however, a full eleven to twelve months cane and capable of standing in the field without significant deterioration upto thirteen to fourteen months. Rao Sahib B. P. Vagholkar, Principal Agricultural Officer, Padegaon Sugarcane Research Station (Bombay Presidency), reports that this cane has done "exceptionally well". It is, therefore, likely to find favour for making jaggery with such ryots as are accustomed to growing green or yellow coloured noble canes like *Pundia*, *Poovan* or *Vellar*, while for factories its chief attraction will be that it can be crushed late. The following table gives analyses of a few rows of this variety which were left over un-harvested after the fourteenth month.

TABLE I

Fortnightly analyses of Co. 402 from the fourteenth month onwards in Field No. 7. (Planted on 12th February 1933)

Date of analyses	Brix Per cent.	Sucrose Per cent.	Co-efficient of purity
5th April 1934	17.60	15.49	88.0
20th April 1934	17.55	15.46	88.1
5th May 1934	15.57	13.54	87.0
21st May 1934	14.49	12.57	88.4
5th June 1934	16.44	14.06	85.5

(d) MORPHOLOGICAL STUDY OF THICK CANES

Some attention was devoted to the study of morphological characters of thirty varieties of the noble or thick type grown in India. These have been tentatively assigned to various groups and a few points still remain to be cleared up. These have been planted according to groups to facilitate observations *en masse*.

(e) CYTOLOGICAL STUDIES

Botany Assistant, Mr. K. S. Subba Rao, B.A., continued his studies on chromosomes in noble canes as also on fertilization and embryogeny with interesting results.

Mr. Rao has investigated six more varieties including *Kaludai Boothan*, *Striped Mauritius*, and *Badila (Fiji B)*. He has also fixed material for the study of the morphology of chromosomes, a necessary complement to the study of morphological characters of varieties.

Further progress was made with regard to fertilization studies. In the cross P. O. J. 2725 \times *Glagah*, a sperm nucleus was noticed near the egg nucleus five hours after pollination. This shortens the time taken by the pollen tube to reach the embryo-sac by about two hours from the previous record of seven hours. Sugarcane varieties differ in the rate of growth of their pollen tubes in artificial culture and the time taken by the pollen tubes to reach the embryo-sac probably varies with the pollinating parent.

During the course of the study of embryogeny a few cases of the abnormal position of the egg were noticed. In one of the preparations the egg was near the antipodals, while in another two eggs were noticed, one at each end of the embryo-sac.

A case of polyembryony has already been recorded in one of the previous reports. That was noticed in one of the microtome sections and attempts have since been made to see whether the same phenomenon occurs in the actual germination of seeds. In the seeds collected from the cross Co. 400 \times Co. 205 two independent plumules and radicles were noticed coming from one and the same seed.

(f) CONTROLLING TIME OF ARROWING

Canes of Co. 290 were subjected to six hours day light. These flowered twenty-six days earlier than the controls. The pollen, however, gave only one per cent. germination when cultured artificially.

The experiment on "Topping" was conducted on a somewhat larger scale than in previous years. Canes of P. O. J. 2878 were 'topped' twice and flowered eleven days later than the controls. This enabled their crossing on a bulk scale with Co. 290. The germination of the seeds was satisfactory.

(g) POLLEN STUDIES

An interesting observation made during the course of the pollen studies was that in the artificial cultures the pollen grains in crowded portions germinated much better than where the grains were scattered, indicating some effect of massing.

In working with a crop like sugarcane the principle operations such as crossing, study of flowering habits, pollen viability, etc., have to be crowded in a period of about two months, and when for a single item like pollen germination, over 300 cultures have to be gone through, any method which will help in taking up the cultures at leisure will be an advantage. Unless the cultures are examined on the same day or at the utmost on the next day, fungal growths appear and besides, the contents of the burst tubes and grains render the making of observations a difficult task. Botany Assistant, Mr. M. K. Krishnaswamy, M.A., has devised a method by which the cultures in petri dishes can be examined even after about a fortnight. He tried form-acetic-alcohol but with not much success, as dessication and consequent bursting of grains and tubes set in. If, however, a few drops of formalin are added to the bottom dish it keeps the pollen tubes intact and also prevents growth of fungi.

(h) GERMINATION IN THICK CANE SEEDS

Experiments were continued on the comparison of *Vellai* with two of its seedlings, viz., Co. 400 and Co. 403 for seed germination when the same pollinating parent was employed. Equally weighed quantities—three grms. per seed pan—were sown. The parentage of Co. 400 is *Vellai* × Q. 813 and of Co. 403 is *Vellai* × Co. 243. The male parents used were E. K. 28 and Co. 205. The germinations obtained are given in Table II.

TABLE II

Germination per pan

	10 days	20 days	30 days
<i>Vellai</i> × E. K. 28 . . .	239	175	122
„ × Co. 205 . . .	14	12	12
Co. 400 × E. K. 28 . . .	749	718	661
„ × Co. 205. . .	789	675	597
Co. 403 × E. K. 28 . . .	39	49	55
„ × Co. 205. . .	72	114	112

It will be seen from the above that the largest number of germinations were obtained when Co. 400 was employed as the ovule parent.

In order to ascertain if there is any correlation between size and germination capacity, measurements of seeds were taken in the varieties, *S. spontaneum*, *Glagah*, *Saretha*, Co. 205, *Vellai* and

Kaludai Boothan. The following table gives their comparative sizes. It is proposed next year to find out the comparative weights also.

TABLE III

Size of seeds in different species of Saccharum

Name of the variety	Length and thickness in microns	Average of Seeds
<i>S. spontaneum</i>	1192.95 × 461.45	100
Glagah	1416.25 × 555.50	129
Saretha	1301.02 × 569.25	100
Co. 205	1574.37 × 523.05	100
Vellai	1787.50 × 607.95	103
Kaludai Boothan	1561.17 × 582.17	100

V. DISTRIBUTION FROM THE STATION

(a) AS TRUE SEED

Seeds obtained by crossing P. O. J. 2725 with hardy Coimbatore canes like Co. 243 and Co. 244 were sent to the Director of Plant Breeding, Sydney, Australia, on request. The object of this importation by the recipient country is to secure canes resistant to both frost and diseases. Previous consignments sent to Australia are reported to have yielded promising types.

(b) AS SEEDLINGS

Five thousand seedlings of Co. 213 crossed with Co. 285 and Co. 244 were sent to the Sub-station at Karnal and an equal number of Co. 290 × Co. 281 to the Sugarcane Research Station at Shah-jahanpur. Both the above schemes are financed by the Imperial Council of Agricultural Research and the above seedlings are for exploring the possibilities of selecting and rejecting new seedlings in sub-tropical India even in the nursery stage

(c) AS CANES

Over 200 packets containing sixty varieties, mostly Co.'s, were distributed to over thirty places within Indian limits. The foreign sendings consisting of twenty-one packets were sent to Abyssinia, Leningrad, Washington, Formosa, Sydney and Kenya.

PLATE II.



Fig. 1. One of the many curious types obtained from the combination (P. O. J. 2725 X *Sorghum Durra* Stapf) X *Sorghum Durra* Stapf. The plants are much stunted in growth and possess short thick coriaceous leaves very dissimilar to those of either the sugarcane or Sorghum parent.

PLATE II—*continued.*

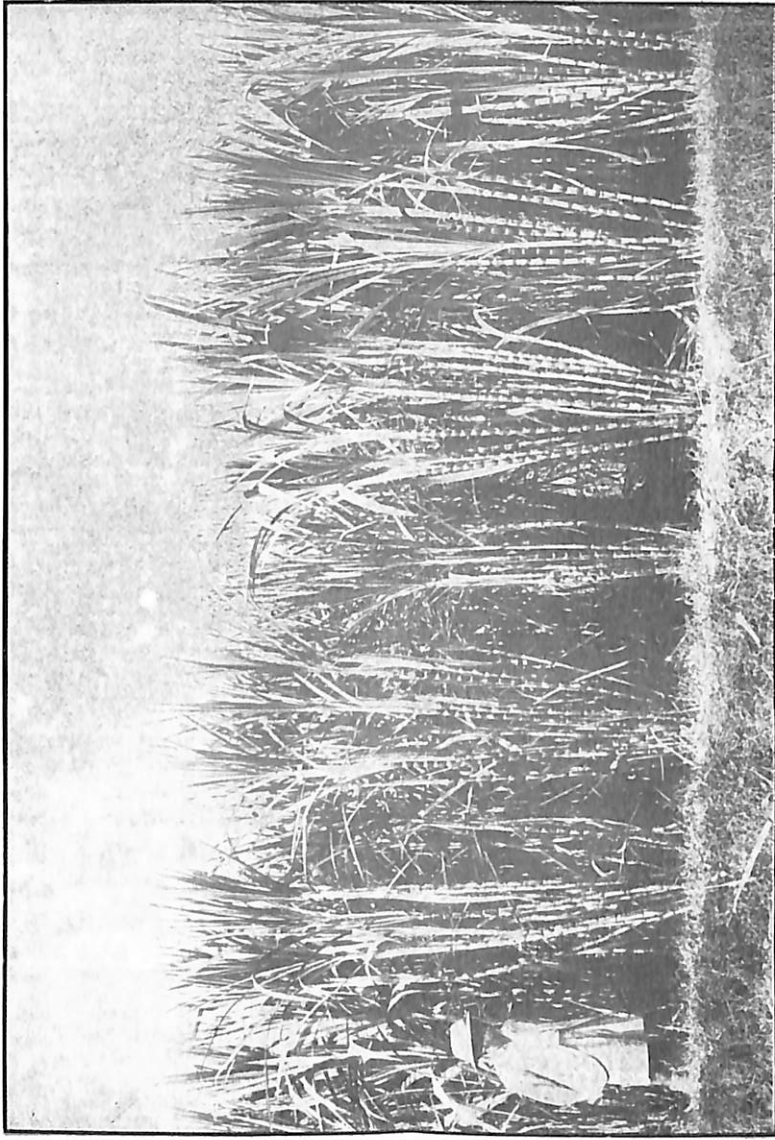


Fig. 2. The cross Co. 408 X Co. 415 yields seedlings with short erect canes a type likely to be useful in the breeding of canes to resist wind and cyclones. The above shows a plot of seedlings from this combination.

VI. PERFORMANCE OF COIMBATORE CANES

(a) COIMBATORE CANES IN SUB-TROPICAL INDIA

A rather pleasant surprise during the year was the manner in which Co. 223 was working its way in the Kangra District of the Himalayas and at altitudes of over 4,000 feet above sea level. With the cheap water power available in the tract, there would appear to exist distinct possibilities in the future. This discovery is due to the enthusiasm of Khan Bahadur Fateh-ud-din, Officiating Director of Agriculture, Punjab, whose co-operation with the work of Coimbatore has been both long and continuous.

The types mentioned as promising in the previous report are continuing to hold their own, Co. 313 and Co. 331 being rather outstanding. Co. 349 and the Sugarcane \times *Sorghum* hybrid Co. 356 would appear to be among the canes of the future. The area under the improved canes—which is steadily becoming synonymous with Coimbatore canes—touched fifty per cent. during 1932-33. These canes are primarily responsible for increasing the average acre tonnage for the whole of India from eleven to fifteen tons.

(b) COIMBATORE CANES IN TROPICAL INDIA

The new series bred at the thick cane area by Mr. Nand Lall Dutt, M.Sc., has begun to attract attention in most farms both in North and South India. Co. 361 in North-West Frontier Province, Co. 408 at Karnal (Punjab), Co. 413 at Shahjahanpur (United Provinces), Co's. 361 and 407 at Jorhat (Assam) and Co's. 360 and 402 at Padegaon (Bombay Presidency) are at present heading this batch of Coimbatore thick types.

Co. 213, Co. 281 and Co. 290 continue to be popular over certain areas in tropical India, the first named being the most sought for for covering new or indifferent lands. Co. 243 and Co. 313 are the new medium canes of promise in the Anakapalle tract of the Madras Presidency while Co. 290 has found a definite place in parts of the Bombay Presidency under comparatively adverse conditions of soil and irrigation.

(c) COIMBATORE CANES IN FOREIGN COUNTRIES

Co. 281 and Co. 290 followed by Co. 213 are proving useful in foreign countries like Argentina, Louisiana, South Africa and Australia. The former two would appear to have revealed un-suspected resources of both drought and disease resistance, out-rivalling a cane of even such outstanding merit in this direction as Uba.

(d) SUGARCANE-SORGHUM HYBRIDS

These have been growing in sub-tropical India now for the last two seasons. Though it is perhaps too soon to judge, the indication exists that in sub-tropical India they may not show fitness for milling in six to seven months as at Coimbatore. This might be due either to the employment of the Coimbatore type of *Sorghum* in the first hybridization or to the fact that the crop in sub-tropical India is faced with heavy rains six to seven months from planting. In tonnage and other characters some of these *Sorghum* hybrids (in North India) are hardly distinguishable from the interspecific hybrids now spreading in the tract. One of these—Co. 356—has shown promise of usefulness in more than one North Indian Station. From available information it would appear that certain of them—though not fit for milling in six or seven months as at Coimbatore—might yet be the earliest to mature during the ripening period for canes in the area.

In tropical India the most extensive tests with these hybrids have been in the Madras Presidency where they have been planted and analysed almost month-war. The first year results have been published and it has been found that certain of them attain "a purity of 85 and over in about 200 to 220 days from the time of planting and tend to improve in quality for nearly 100 days afterwards". "The juices of *Sorghum* hybrids at the point of their maximum efficiency were decidedly richer than those of other Coimbatore canes." (Viswanath, B., 1934, *Ind. J. Agric. Sci.* 4, 215.)

VII. THE KARNAL SUB-STATION

(a) PROGRAMME OF WORK

The two years' experience, from growing seedlings at Karnal in different ways and planting them in the ground at different times of the year, has given indications about the most effective manner in which to carry on the work programmed for the Sub-station. The best method would appear to consist in effecting the desired crosses at Coimbatore right at the beginning of the arrowing season, sow them in pans at Coimbatore almost immediately after collection, transport the young seedlings to Karnal in a through railway wagon (the seedlings being carefully hardened for the journey) and plant them in the lands at Karnal at the usual planting time for canes in tract. Thus handled, the seedlings show normal growth and allow preliminary selections being made at the end of their first year at Karnal. It is proposed to pursue this method till further experience definitely indicates a better one.

(b) SUGARCANE STUDIES

(i) *Shoot and root studies.*—Results of periodic shoot and root studies were not so effective owing to the absence of a pronounced summer during the year. In a testing station an unfavourable year is of distinct use as it enables the picking out of types that can stand adverse conditions.

(ii) *Juice quality.*—Periodic hand refractometer readings started in August 1933 and continued till February 1934 gave useful information not only on the time of maturity of the different types but also the period during which the different canes maintain their juice quality without serious deterioration; the latter is an important character in cane cultivation, whatever be the nature of the end product, *gur*, *rab* or white sugar.

(c) SELECTION

Of the over 5,000 seedlings grown as seedlings at Karnal, 126 showed sufficient promise for trial in rows. Of the 121 seedlings grown in rows and originally obtained from Coimbatore as cuttings most of them grown at Karnal for two seasons—forty-two were selected for further trial at Karnal and in certain of the Punjab farms. At the end of the year there were 180 new seedlings in row tests besides the 5,000 transported from Coimbatore as seedlings.

(d) DISTRIBUTIONS

Material of the different canes growing at Karnal and consequently, partially acclimatized to sub-tropical conditions, were supplied to the two Sugarcane Research Stations in the Punjab financed by the Imperial Council of Agricultural Research. Material thus supplied exceeded a thousand maunds and included nearly 100 types.

Among material thus distributed mention needs to be made of three canes which were originally obtained from seed collected at Coimbatore and germinated at Karnal. These are early ripeners and should give valuable indications about the future line of work at Karnal. These have been distributed to the Sugarcane Research Station at Shahjahanpur as well, at the desire of the Honourable the Minister for Agriculture in the Punjab.

VIII. PARENTAGE OF COIMBATORE SEEDLINGS

Parentages of seedlings raised to the status of Co.'s during the year are given in Table IV.

TABLE IV

Parentage of Co. canes

Seedling No.	Parentage
Thick Types—	
Co. 421	P. O. J. 2878 × B. 3412.
Co. 422	P. O. J. 2878 × Co. 214.
Co. 423	P. O. J. 2878 × Co. 364.
Co. 424	Kassoer G. C. (likely father Ges. Preanger).
Co. 425	P. O. J. 2727 × P. O. J. 2878.
Co. 426	(Vellai × P. O. J. 1410) × Co. 360.
Co. 427	(Vellai × P. O. J. 1410) × (Kassoer × Badila).
Co. 428	P. O. J. 2725 × Co. 290.
Co. 429	Co. 402 × P. O. J. 2878.
Co. 430	Co. 407 × E. K. 28.
Co. 431	Co. 363 × C. A. C. 87.
Medium Types—	
Co. 500 }	Co. 221 × Co. 229.
Co. 501 }	
Co. 502	Co. 243 × Co. 244.
Co. 503	
Co. 504 }	Co. 317 selfed.
Co. 505 }	
Co. 506 }	
Co. 507 }	
Co. 508 }	Co. 214 selfed.
Co. 509 }	
Co. 510 }	Co. 213 × Co. 244.
Co. 511 }	
Co. 512 }	
Co. 513 }	Co. 213 G. C.
Co. 514 }	
Co. 515 }	
Co. 516 }	
	P. O. J. 2725 × <i>Sorghum Durra</i> Stapf.

IX. STUDENTS UNDER TRAINING

Two post-graduate students, who joined the station in November 1932, finished their first year at Coimbatore and left for Pusa to do the second year training there. Post-graduate student, Mr. Imdad Ali Khan, joined the Station on 1st December 1933 after completing his first year course at Pusa.

X. MISCELLANEOUS

The study of *S. spontaneums* at Coimbatore carried on under the auspices of the Madras University was completed during the year and the results published in the *Indian Journal of Agricultural Science*.

The sixth meeting of the Sugar Committee appointed by the Imperial Council of Agricultural Research was held at the station 14th to 16th November 1933. This gave a much desired opportunity to the members of the Committee to get first-hand knowledge of the work of the station.

The visitors during the year included Dewan Bahadur Sir T. Vijayaraghavacharya, K.B.E., Chairman, and members of the Sugar Committee, Dr. C. D. Darlington of the John Innes Horticultural Institution, Merton, Dr. P. S. Hudson, Deputy Director, Imperial Bureau of Plant Genetics, Cambridge, Mr. Ebrahim Mahdavy, Officer in charge of the Government Experiment Stations, Iran, and Mr. G. M. Schuitenmaker, Representative of the N. I. V. A. S., Java.

XI. PROGRAMME OF WORK FOR 1934-35

MAJOR

The breeding of medium and thick canes will be carried on with the object of effecting further improvements, covering new tracts or cheapening cost of cultivation.

Attempts will be made to further improve the breeding technique and secure better germination with thick cane seeds.

Studies on the genetics of the sugarcane and of the genus *Saccharum* will be continued and extended.

MINOR

Morphological studies of the thick canes, studies of fertilization and embryogeny and of morphology of chromosomes will be pursued as also of sugarcane roots and of pollen and seed viability.

XII. PUBLICATIONS

- (1) Dutt, N. L. and Krishna-swami, M. K. The Breeding of the Thick Type of Canes for India. *Madras Agric. Jour.*, Vol. XXII, No. 3, March 1934.
- (2) Dutt, N. L. and Subba Rao, K. S. A Preliminary Note on the Membrane Body in the Cytoplasm as characteristic of the Indigenous Indian Canes. *Ind. Jour. Agric. Sci.*, Vol. IV, Pt. I, February 1934.

- (3) Singh, T. S. N. . . . Chromosome Numbers in the Genus *Saccharum* and its Hybrids.
Ind. Jour. Agric. Sci., Vol. IV, Pt. II, April 1934.
- (4) Gopala Iyer, K. V. and Venkatraman, T. S. Suggested method of juice analyses for sugarcane plantations devoid of laboratory facilities. (Accepted for publication in the July 1934 issue of *Agric. & Live stock in India.*)
- (5) Panje, Rama Rao . . . *Saccharum spontaneum* L. A comparative study of the forms grown at the Imperial Sugarcane Breeding Station, Coimbatore.
Ind. Jour. Agric. Sci., Vol III, Pt. VI, December 1933.