

Agol Research
Institute
pase.

94

1920



3:43m2, N20
N20-94
1973/2

Bulletin No. 94

347
AHL
210
1920
151
Agricultural Research Institute, Pusa

**A Preliminary Note on the Behaviour in North
India of the First Batch of Sugarcane Seedlings
distributed from the Sugarcane-breeding
Station, Coimbatore**

BY

T. S. VENKATRAMAN, B.A.

Acting Government Sugarcane Expert, Madras.



CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1920

Price As. 8.

Edited by

The Council of the Pusa Agricultural Research Institute.

Agricultural Research Institute, Pusa

**A Preliminary Note on the Behaviour in North
India of the First Batch of Sugarcane Seedlings
distributed from the Sugarcane-breeding
Station, Coimbatore**

BY

T. S. VENKATRAMAN, B.A.,
Acting Government Sugarcane Expert, Madras.



**Agents for the Sale of Books published by the
Superintendent of Government Printing, India, Calcutta.**

IN EUROPE.

Constable & Co., 10, Orange Street, Leicester Square,
London, W.C.
Kegan Paul, Trench, Trübner & Co., 68-74, Carter Lane,
E.C., and 25, Museum Street, London, W.C.
Bernard Quaritch, 11, Grafton Street, New Bond Street,
London, W.
P. S. King & Sons, 2 & 4, Great Smith Street, West-
minster, London, S.W.
H. S. King & Co., 65, Cornhill, E.C., and 9, Pall Mall,
London, W.
Grindlay & Co., 54, Parliament Street, London, S.W.
Luzac & Co., 46, Great Russell Street, London, W.C.

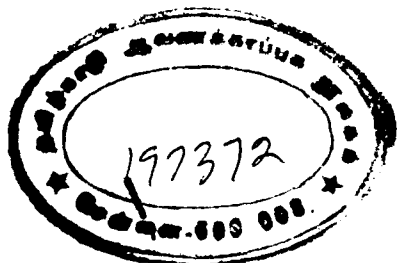
W. Thacker & Co., 2, Creed Lane, London, E.C.
T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London,
W.C.
Wm. Wesley & Son, 28, Essex Street, Strand, London.
B. H. Blackwell, 50 & 51, Broad Street, Oxford.
Deighton Bell & Co., Ltd., Cambridge.
Oliver and Boyd, Tweeddale Court, Edinburgh.
E. Ponsonby, Ltd., 116, Grafton Street, Dublin.
Ernest Leroux, 28, Rue Bonaparte, Paris.
Martinus Nijhoff, The Hague, Holland.

IN INDIA AND CEYLON.

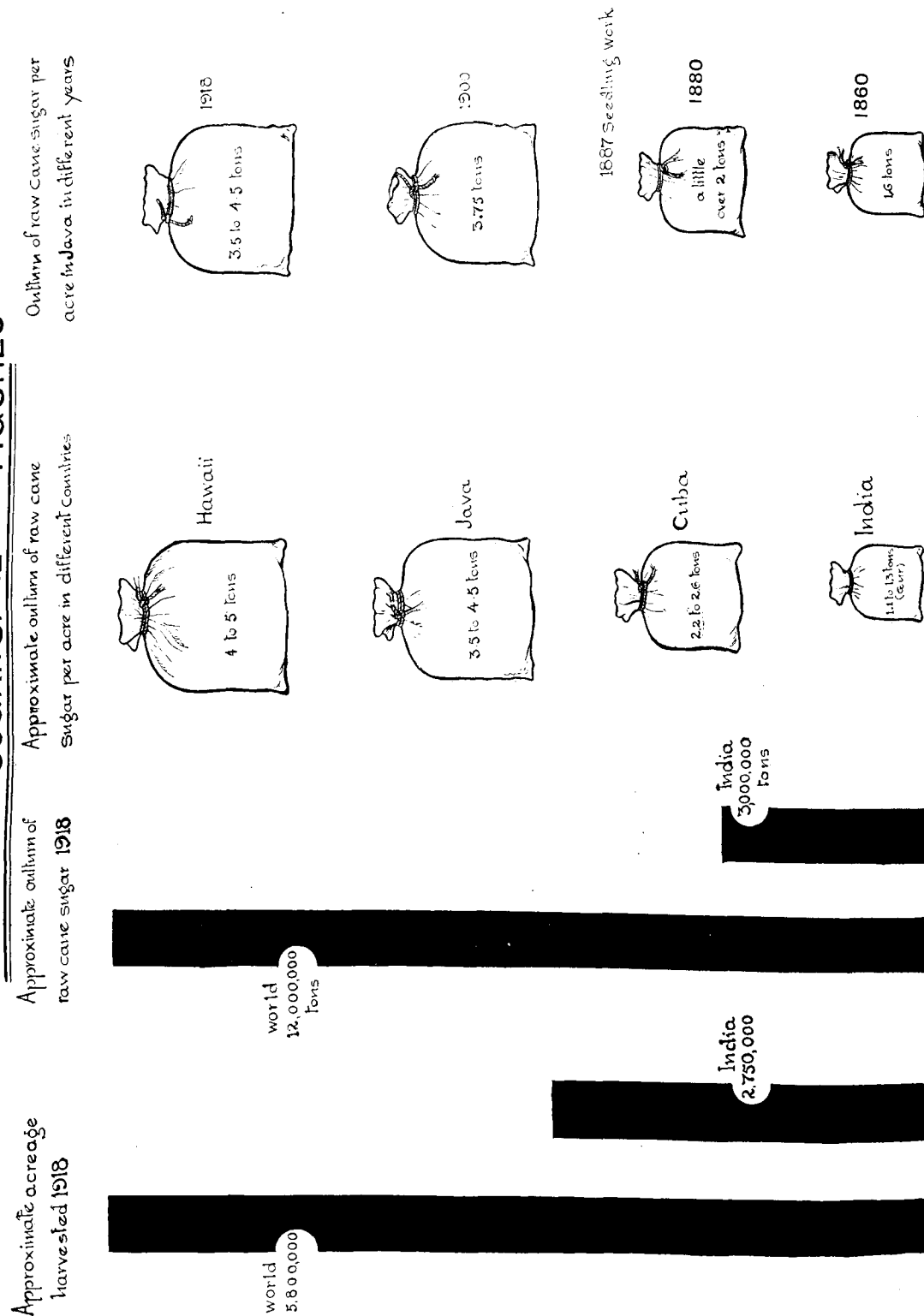
Thacker, Spink & Co., Calcutta and Simla.
Newman & Co., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
B. Banerjee & Co., Calcutta.
The Indian School Supply Depot, 309, Bow Bazar Street,
Calcutta, and 226, Nawabpur, Dacca.
Butterworth & Co. (India), Ltd., Calcutta.
Rai M. C. Sarcar Bahadur & Sons, 90/2A, Harrison
Road, Calcutta.
The Weldon Library, 57 Park Street, West, Calcutta.
Standard Literature Co., Ltd., Calcutta.
Lal Chand & Sons, Calcutta.
Higginbotham, & Co., Madras.
V. Kalyanaram Iyer & Co., Madras.
G. A. Nateean & Co., Madras.
S. Murthy & Co., Madras.
Thompson & Co., Madras.
Temple & Co., Madras.
P. R. Rama Iyer & Co., Madras.
Vas & Co., Madras.
E. M. Gopalakrishna Kone, Madura.
Thacker & Co., Ltd., Bombay.
A. J. Cambridge & Co., Bombay.
D. B. Taraporevala, Sons & Co., Bombay.
Mrs. Radhabai Atmaram Sagoon, Bombay.
Sunder Pandurang, Bombay.

Gopal Narayan & Co., Bombay.
Ramchandra Govind & Son, Kalbadevi, Bombay.
The Standard Bookstall, Karachi.
Mangaldas Harkisandas, Surat.
Karsandas Naranias & Sons, Surat.
A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.
N. B. Mathur, Supt., Nazir Kanun Hind Press,
Allahabad.
Rai Sahib M. Gulab Singh & Sons, Muft-i-Am Press,
Lahore and Allahabad.
Rama Krishna & Sons, Lahore.
Supt., American Baptist Mission Press, Rangoon.
Manager, the "Hitavada," Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
A. M. & J. Ferguson, Ceylon.
Manager, Educational Book Depôts, Nagpur and
Jubbulpore.*
Manager of the Imperial Book Depot, 63, Chandney
Chauk Street, Delhi.*
Manager, "The Agra Medical Hall and Co-operative
Association, Ltd." (Successors to A. John & Co.,
Agra).
Supt., Basel Mission Book and Tract Depository,
Mangalore.*
P. Varadachary & Co., Madras.*
H. Liddell, Printer, etc., 7, South Road, Allahabad.*
Ram Dayal Agarwala, 184, Katra, Allahabad.*
D. C. Anand & Sons, Peshawar.*
Manager, Newal Kishore Press, Lucknow.*

* Agents for the sale of Legislative Department publications only.



A FEW SUGARCANE FIGURES



A Preliminary Note on the Behaviour in North India of the First Batch of Sugarcane Seedlings distributed from the Sugarcane-breeding Station, Coimbatore.

(Received for publication on 9th October 1919.)

Introduction.

THE steady increase in the quantity of white sugar imported into India, together with the depressing effect which such importations, combined with their low prices, was having on the indigenous Gur (crude sugar) industry, made the Government of India, in the year 1911, direct their attention to this important industry with a view to try to put it on a satisfactory basis. The discussions on the subject, at the meeting of the Board of Agriculture in 1911, showed that the problem will have to be tackled in at least two directions, viz., (1) the manufacturing or the mechanical aspect, with a view to improve the present wrong or wasteful methods; and (2) the agricultural, including the botanical aspect, with a view to improve the varieties at present grown and carry out other improvements in the methods of culture.

That the sugar industry in India is, at present, in a bad state, is evident from the figures given in the chart opposite. It is seen that, though India can boast of nearly half the world's acreage under cane, her output is only a fourth. It further contrasts the yield per acre in India with those obtained in the other cane countries, a contrast which gets all the more emphasized to India's disadvantage, when we remember that, whereas in the other countries the figures represent the quantity of refined sugar, the Indian figures are those for *gur* or *jaggery*, a more impure product. But we take heart from the fact that Java, which in the year 1860 was able to produce only about as much sugar per acre as India at the present day, has since been able to force up production in such a manner that in the year 1918 that country ranked second only to Hawaii in the matter of production per acre. In the case of India, it is doubtful, if we shall ever be able to rise to the level of the other tropical countries owing to insuperable difficulties of climate, but let us remember, that even a small increase in production will go a great way to ameliorate the position of India as a sugar-producer.

From the map of India opposite it is further evident that, to improve the Indian industry, attention will have to be concentrated on North India, chiefly the United Provinces, because (1) that province contains nearly half of India's acreage under cane, and (2) it is a vital industry in that province and sugarcane is the chief rent-paying crop, a crop "which could not easily find an equivalent in any other crop grown there." The Punjab and Bengal would come next with their one-third to half million acres under cane.

The purely botanical work, *viz.*, that of breeding a better cane for North India, was entrusted to a breeding station which in November 1912 was started at Coimbatore in the Madras Presidency under Dr. C. A. Barber, C.I.E., who was appointed Government Sugarcane Expert for all-India but with headquarters at Coimbatore. This was sought to be attained by raising canes from seed, instead of from cuttings as is ordinarily done by the ryot, a method which had already proved its utility in the other sugarcane countries of the world. The difficulties experienced in previous trials at raising cane seedlings were soon overcome—in fact even before the land intended for the station was taken possession of—and we soon had a very large number of seedlings, some of them the much-desired crosses between the thin indigenous North Indian and the thick tropical kinds.¹ But it was not until the February of 1918 that the station was able to send out the first batch of selected seedlings for trial to North Indian farms.

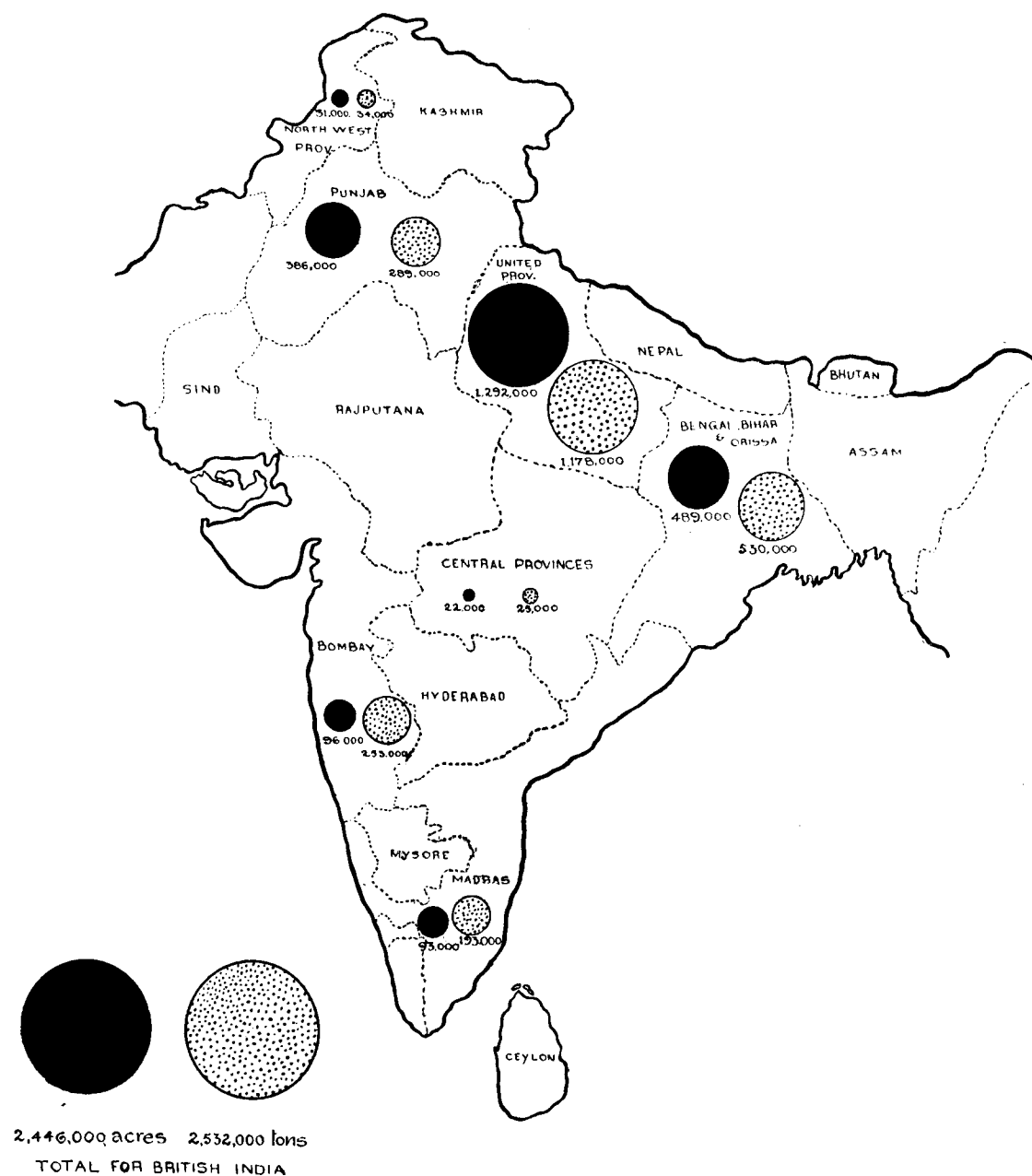
In this bulletin are presented the results of this first year's trials. The subsequent behaviour of the Coimbatore productions, when introduced into North India, has always been a matter of anxious consideration for the station; but it is fortunate that the first year's results appear to be, on the whole, encouraging. It is thought that the results thus published will not only enable the farms to take a more intelligent interest in the growing of these seedlings, but also to offer valuable suggestions for the future work of the station, which, of necessity, had to be located far away from the area for which the seedlings are intended. The station has now reached a stage when a closer connection with the North Indian farms is needed, and constant reports on the progress of the distributed seedlings will greatly help to shape the future lines of work at the station. A few photographs are included to illustrate the growth of the seedlings in the different North Indian farms.

Selection of Coimbatore as the site for the all-India Sugarcane-breeding Station.

Though the main object of the work at the Sugarcane-breeding Station, Coimbatore, was to produce for North India a cane better than

¹ The details of this work are fully described in a Memoir by Dr. C. A. Barber, C.I.E., *Mems. of the Dept. of Agri. in India, Bot. Series*, Vol. VIII, No. 3.

Map of India showing the acreage under cane & outturn of Gur or Jaggery in the different provinces.



The shaded circles represent the acreages under cane in the different provinces and those with dots the total yield for the province in tons. The figures are for the quinquennium ending 1916-17.

the type now grown in that locality, the station itself had to be located at Coimbatore because the sugarcane rarely flowers in North India, and, even if it does, does not generally set seed. The selection of Coimbatore as a site for the station was amply justified soon after its foundation by the very large number of seedlings that it was found possible to raise there.

A minor disadvantage.

This selection—which as shown above was inevitable—carried with it one disadvantage, *viz.*, we had no knowledge as to how the seedlings bred and grown at Coimbatore might behave later when introduced into North India. This was fully recognized even at the outset, and, to gain some knowledge on this point, a set of seedlings—six in number—was introduced into North Indian farms even as early as 1914, *i.e.*, as soon as ever material was available for distribution.

The first batch of seedlings was in no way selected and consequently the various farms were requested to reject them from cultivation as soon as the first set of selected seedlings was available for distribution in February 1918. One of these, however, M.2, a Kaludai Boothan seedling raised in 1911-12, is still grown at Shahjahanpur as a wind-break on account of its good growth and habit (Plate V).

The first seedlings raised at the Station were mostly thick and hence unsuitable for North India.

During the early years of the station the varieties that flowered were mostly thick canes and we had but little control over the parents. The seedlings produced were consequently mostly thick and so unsuitable for introduction into North India. Later on, however, it was found possible to induce many of the thin canes also to flower at the station. This, together with the steadily increasing knowledge of the different parents¹ gained in the meanwhile, enabled the station to plant out, for the season 1917-18, a crop of seedlings more than 50 per cent. of which were of a type suitable to be grown in North India.²

The first distribution to North India was made in February 1918.

This enabled the station to send out its first batch of selected seedlings in February 1918. But a new difficulty presented itself. The final

¹ Venkatraman, T. S. "Study of arrowing in the sugarcane." *Agri. Journal of India*, Special Indian Science Congress Number, 1917.

² It is perhaps worth mentioning here that though it has been possible to effect crosses, between thick canes and most of the groups that occur in North India, the two classes represented by (1) Nargori, Kewali, Sararoo, etc., and (2) Mungo, Hemja, Rheora, Burli Kuswar, etc., offer special difficulties because these do not flower under Coimbatore conditions and, even if they do, produce only unhealthy flowers. These are at the same time very desirable parents, and any information on the arrowing (flowering) of these varieties in any locality will be welcome.

chemical analyses figures for the 1917-18 crop would be available only in March-April, while the North Indian farms wanted the seedlings at least in February—the general planting season in North India. At this stage the accumulated analytical experience was called in for aid. It was found that the final analyses figures varied correspondingly with the results obtained in February when the crop is on the whole immature. This justified the distribution of the seedlings on a comparative basis and saved a whole year for the work.

A statement is appended giving the distribution as made in February 1918. In response to individual requests from the different farms a certain amount of information about the parentages of the different seedlings is also included. Besides the thin seedlings and thin canes mentioned in this statement, certain thick seedlings and varieties were distributed to certain Madras farms, to Hebbal and to Manjri, but their growth in this, the first year, does not justify their inclusion in this report.

Statement showing the distribution of thin seedlings and varieties in February 1918.

(A cross mark placed against a locality indicates that the cane was distributed to that locality.)

Name of seedling or variety	PLACES TO WHICH DISTRIBUTED.							Notes on parentage, origin, etc.		
	Bangalore	Manjri	Gwalior	Gurdaspur	Shajahanpore	Cawnpore	Pusa		Sepaya	Tharsa
Co. 201	×	×	×	×	×		×	×	×	Pansahi seedling. General collection. Selfed or possible cross with M. 2 or M. 1017, two vigorous Madras seedlings of rather low sucrose.
Co. 202	×	×	×	×	×		×	×	×	Chittan seedling. General collection. "Rogue" type. Chittan is a thick striped cane occurring round about Coimbatore.
Co. 203	×	×	×	×	×		×	×	×	Saretha seedling. General collection. Very likely selfed.
Co. 204	×	×	×	×	×		×	×	×	Chittan seedling. General collection. Some vigorous Naanal seedlings, which possess an abundance of healthy pollen, were flowering on the windward side; and cross-pollination with these is highly probable. Arrows of Chittan, collected under conditions, where selfing was the most likely, gave a different type of seedlings.
Co. 205	×	×	×	×	×		×	×	×	Vellai × Saccharum spontaneum. Bagged cross. The mother arrow possessed very few (2 per cent.) slightly open anthers, and as other stray pollen was kept out by enclosing the mother arrow in a muslin bag it may be taken to be a cross between the parents indicated.
Co. 206	×	×	×	×	×		×	×	×	Ashy Mauritius seedling. General collection. "Rogue" type.

Statement showing the distribution of thin seedlings and varieties in February 1918—*contd.*

Name of seedling or variety	PLACES TO WHICH DISTRIBUTED.								Notes on parentage, origin, etc.	
	Bangalore	Manjri	Gwalior	Gurdaspur	Shajahanpore	Cawnpore	Pusa	Sepaya		Tharsa
Co. 207			×		×		×	×	×	J.213 × Saretha. Unbagged cross. The mother arrow had practically no healthy pollen, therefore not selfed. Saretha pollen was constantly dusted over the stigmas when they were receptive, so Saretha is the likeliest male parent. The mother arrow was not protected by muslin bag, so remote chances of cross-pollination with other varieties, chiefly M.2
Co. 208		×	×		×		×	×	×	J.213 seedling. General collection. This variety has no healthy pollen, therefore not selfed. Likely crosses with M.2 or M.1017, two vigorous Madras seedlings of rather low sucrose which were flowering freely in the neighbourhood.
Co. 209			×		×		×	×	×	Khelia seedling. General collection. Very likely selfed. This variety possesses abundant fertile pollen and no others were flowering in the vicinity at the time.
Co. 210		×	×		×	×	×	×	×	J.213 seedling. General collection. This variety has no healthy pollen, therefore not selfed. Likely crosses with M.2. or M.1017, two vigorous Madras seedlings of rather low sucrose which were flowering freely in the neighbourhood.
Co. 211					×		×	×		Green Sport of Striped Mauritius × Saretha. Unbagged cross. The mother variety has a fair quantity of its own pollen, so may be a selfed seedling. The stigmas were constantly dusted with Saretha pollen, so Saretha is a likely male parent. With such an abundance of fertile pollen, possibility of cross-pollination with other varieties flowering in the vicinity is very remote.

J.213 × Saretha. Unbagged cross. The mother arrow had practically no healthy pollen, therefore not selfed. Saretha pollen was constantly dusted over the stigmas when they were receptive, so Saretha is the likeliest male parent. The mother arrow was not protected by muslin bag, so remote chances of cross-pollination with other varieties, chiefly M.2.

J.213 seedling. General collection. This variety has no healthy pollen, therefore not selfed. Likely crosses with M.2 or M.1017, two vigorous Madras seedlings of rather low sucrose which were flowering freely in the neighbourhood.

Khelia seedling. General collection. Very likely selfed. This variety possesses abundant fertile pollen and no others were flowering in the vicinity at the time.

J.213 seedling. General collection. This variety has no healthy pollen, therefore not selfed. Likely crosses with M.2 or M.1017, two vigorous Madras seedlings of rather low sucrose which were flowering freely in the neighbourhood.

Green Sport of Striped Mauritius × Saretha. Unbagged cross. The mother variety has a fair quantity of its own pollen, so may be a selfed seedling. The stigmas were constantly dusted with Saretha pollen, so Saretha is a likely male parent. With such an abundance of fertile pollen, possibility of cross-pollination with other varieties flowering in the vicinity is very remote.

Co. 212	×	×	×	×	×	×	×	×	×	J.213 × M.2. Unbagged cross. The mother variety has no fertile pollen, so not selfed. Probably a cross with M. 2 which was the only variety flowering in the neighbourhood at the time.
Co. 213			×		×		×	×		J.213 × Kansar. Unbagged cross. The mother variety has no fertile pollen, so not selfed. May be a cross with Kansar whose pollen was artificially dusted over the stigmas, or with M.2 which was flowering freely near by.
Co. 214				×	×		×	×		Striped Mauritius × Unbagged crosses. (Saretha × Sacch. Notes on parentage similar to those of Co. 211.
Co. 215				×	×		×	×		Ditto
Co. 216				×	×		×	×		Green Sport of Striped Mauritius × Saretha
Co. 1	×	×	×	×	×		×	×	×	Chittan seedling. General collection. This variety possesses an abundance of fertile pollen, so very likely selfed. Possibility of cross-pollination with Karun or Kaludai Boothan which were flowering freely in the neighbourhood. This is a medium thick cane of high sucrose content (over 20 per cent. in the juice in a field test).
Kassoer	×	×	×	×	×		×	×	×	Two indigenous canes of Java. Kassoer possesses an excellent habit and is now being used as a female parent owing to the absence of fertile pollen of its own.
Taboe					×		×	×	×	These Java seedlings have been growing at the station from the commencement.
Monjet.					×		×	×	×	These were distributed, partly because a few of them were reported to be doing well in North India and partly for comparison with the distributed Co. seedlings.
J. 23a	×	×	×	×	×		×	×	×	
J. 36					×		×	×	×	
J. 139	×	×	×	×	×		×	×	×	
J. 213	×	×	×	×	×		×	×	×	
J. 247					×		×	×	×	

NOTE 1. "General collection" indicates that the arrows were collected in the field without any control over the male parent.

NOTE 2. "Rogue" is the term applied to a seedling of thick parentage in a "General collection," which shows a remarkable resemblance to the North Indian thin cane, being much thinner and more vigorous than the parent. (*Vide* Bateson and Pileuw, "Journal of Genetics", July 1915, page 13).

NOTE 3. In the above statement wherever crosses are involved the two parents are separated by a cross mark; the first named represents the female parent and the second the male parent.

NOTE 4. For explanation of "Bagged" and "Unbagged" crosses see the text.

Explanation of the terms "Bagged" and "Unbagged" crosses with a short note on the methods of crossing in sugarcane current at the Cane-breeding Station.

These two terms require a certain amount of explanation for their being properly understood. Crossing in the sugarcane presents peculiar difficulties, as emasculation is practically entirely ruled out owing to the extreme delicacy of the floral structures; even a prolonged bending of the main axis has been known to result in the complete drying up of the arrow. Fortunately, however, we have in the cane, certain varieties which are male sterile in different degrees. If this male sterility is absolute, we can, by enclosing such flowers in muslin bag and introducing into it some known pollen, obtain a cross, about the male and female parentages of which we can assume a high degree of certainty. Such a one is Co. 205. If, however, the mother shows a certain degree of male fertility and we introduce some other known pollen—keeping the arrow under bag—the resultant seedlings will either be selfed or cross-pollinated with a known father. Both these are referred to as "bagged crosses" in the above statement.

It was found, however, that bagging an arrow frequently exerted an adverse influence on its seed-setting¹; and therefore in later years crossing was frequently done by merely marking the mother arrows in the field and keeping them constantly dusted with some known pollen till the stigmas were found to wither. These are called "unbagged crosses." In these the male parents are only probable as there is an ever-present possibility of any stray wind-borne pollen getting access to the stigmas. The parentage becomes yet more uncertain, when, as in the cases of Cos. 214, 215, and 216, the mother arrow possesses fertile pollen of its own, for there then arises three different distinct possibilities as to the parentage of the resultant seedlings.

- (a) Selfed,
- (b) Cross with the pollinated father,
- (c) Cross with some unknown parent through some stray wind-borne pollen.

The above remarks may perhaps convey to the reader an impression as to the futility of parentage notes in cases like those of Cos. 214, 215 and 216, but against it the following considerations are advanced:—

- (1) In the absence of more accurate information, it is an advantage to know at least the most likely parents, in following the behaviour of such seedlings in future years.

¹ Venkatraman, T. S. "Study of arrowing in the sugarcane." *Agri. Journal of India*, Special Indian Science Congress Number, 1917.

- (2) In the character of the resultant seedlings, we occasionally get some indications by which it is possible to guess the male parents with a certain degree of certainty.
- (3) With the Breeding Station sanctioned only for a limited period, the purely utilitarian aspect had to be prominently kept in view, and, so far, the results would appear to justify the means employed.

Selection of types for each locality.

In the distribution an attempt was made to pick out the seedling with an eye to the cane now successfully grown in each locality, but it is felt that it will be sometime before much specialisation is possible in this direction. The annual visits by the staff of this office and the periodic reports from the different farms will, it is hoped, soon yield valuable data on this question.

A method to minimise "personal equation" in the selection work at the Cane breeding Station.

One very important qualification for a breeder is the ability to quickly compare with one another different plants or strains with a view to selection and propagation. Such a valuation has often to be made on a large number of characters and this is a matter in which "personal equation" is likely to play not an insignificant part. That this work of comparing and selecting is not a light one at the Cane-breeding Station, will be readily conceded, when it is realized that each year the station has as many as 5,000 new seedlings and 600 already selected ones, in different stages of filtration, from which to pick material for further trial and propagation.

The method described.

To systematize this work as far as possible and to guarantee that each character gets its due recognition in the final estimate a system of marking was introduced. A list was prepared of the characters considered important in forming the estimate and each allotted a maximum of ten marks. All the seedlings were then examined for some particular character at a time and marks noted against each in proportion to its merits. This process was then repeated for each of the other characters on the list and the totals made up for each seedling. A large number of marks, in the totals thus arrived at, will indicate the satisfactory nature of the seedling in most or all the characters and it is therefore safe to make the selections on this basis.

The behaviour of the distributed seedlings in the different North Indian farms during the first year of trial.

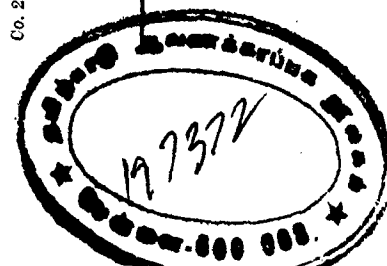
This method, having proved itself useful at the Cane-breeding Station for some time, was adopted in a tour to North India (in December 1918 to January 1919) undertaken with the special object of studying the behaviour of the distributed seedlings in that locality. Besides notes on health, height, arrowing, length of formed cane, thickness of canes, etc., marks were given for four important field characters, viz. :—

- (1) Stand or germinating capacity.
- (2) Vigour or weight of harvest.
- (3) Habit, i.e., whether the canes in the clump stand upright, or are slanting, or fall about in all directions seriously interfering with subsequent cultural operations. Further the straightness of canes is a character of considerable importance in (1) the transport to the factory in carts, and (2) the packing on the hoppers at the mill.
- (4) Tillering, i.e., the number of canes per stool at harvest. This is included in No. 2, but was thought of sufficient importance to be separately considered.

The table hereunder gives the marks obtained by each distributed seedling for the above four characters in each of the farms visited. In the remarks column will be found some tentative notes on the parentages considered likely to be useful in the different tracts.

Statement of marks obtained by the distributed seedlings in the different farms with notes on the parentages likely to be useful in the different tracts. (See Plates I, II, III, IV, V, VI for comparison of growth).

Co. Nos.	Sugarcane-breeding Station, Coimbatore	Bangalore	Manjri	Tharsa	Pusa	Sepaya	Cawnpore	Shahjhanpur	Gurdaspur	REMARKS
Co. 201	32 6, 10, 8, 8.	30 8, 7, 8, 7.	36 10, 9, 10, 7.	32 9, 7, 9, 7.	28 6, 7, 8, 7.	32 9, 8, 9, 6.	..	35 8, 9, 9, 9.	23 6, 6, 6, 5.	(1) The top figure against each seedling represents the aggregate marks obtained by the seedling for all the four characters. The bottom figures represent the marks for each character, for (1) Stand, (2) Vigour, (3) Habit and (4) Tillering. The maximum for each character was fixed at ten.
Co. 202	39 10, 10, 9, 10.	23 6, 6, 4, 7.	35 10, 9, 8, 8.	20 7, 9, 5, 8.	24 7, 8, 3, 6.	33 9, 8, 9, 7.	..	35 10, 8, 7, 10.	33 8, 9, 10, 6.	(2) Dots placed against a locality indicates that the seedling was not available for examination generally because of not having been distributed to that locality.
Co. 203	25 6, 7, 8, 4.	25 6, 7, 4, 8.	28 8, 6, 6, 8.	17 3, 4, 4, 6.	13 3, 4, 3, 3.	..	..	16 6, 4, 3, 3.	12 4, 1, 5, 2.	(3) The distributed seedlings included two "Rogues"—Co. 202 and Co. 206—and their satisfactory behaviour in most of the farms justifies the hopes placed in them on their first appearance.
Co. 204	34 8, 10, 9, 7.	25 7, 6, 6, 6.	36 10, 8, 9, 9.	25 4, 6, 6, 9.	15 3, 6, 3, 3.	29 7, 7, 8, 7.	..	32 8, 8, 10, 6.	29 7, 7, 10, 5.	(4) "Rogues" and Crosses with Sacch. spontaneum (Co. 205) are apparently the most promising lines for the Punjab as that tract requires the hardest kinds.
Co. 205	29 6, 7, 9, 7.	26 7, 6, 6, 7.	38 10, 10, 10, 8.	29 7, 8, 5, 9.	13 3, 4, 3, 3.	31 9, 9, 6, 7.	..	25 6, 7, 6, 6.	34 8, 9, 10, 7.	(5) For the United Provinces "Rogues" and Panshi seedlings, and J. 213 crosses deserve a full trial.
Co. 206	34 7, 9, 10, 8.	32 8, 8, 8, 8.	39 10, 9, 10, 10.	33 8, 8, 9, 8.	29 7, 6, 9, 7.	33 8, 7, 10, 8.	..	31 8, 7, 9, 7.	33 8, 9, 10, 8.	(6) But for the unfortunate tendency to smut shown by J. 213 seedlings (vide note elsewhere in this bulletin) this would appear to be a useful parent for Sepaya, Manjri and Tharsa.
Co. 207	31 7, 9, 8, 7.	..	..	27 7, 9, 5, 6.	15 4, 5, 3, 3.	24 8, 6, 5, 5.	31 9, 7, 7, 8.	22 6, 5, 5, 6.	..	(7) The seedlings showed very poor growth at Gwalior and no notes were recorded for that locality.
Co. 208	31 9, 8, 8, 6.	..	37 10, 9, 8, 10.	35 8, 9, 9, 9.	24 7, 9, 4, 4.	29 8, 6, 9, 6.	..	40 10, 10, 10, 10.	..	
Co. 209	31 8, 9, 7, 7.	..	..	29 7, 9, 5, 8.	21 6, 7, 3, 5.	..	..	28 8, 7, 5, 8.	..	
Co. 210	32 8, 10, 7, 7.	..	36 10, 10, 10, 6.	36 9, 10, 8, 9.	28 9, 9, 3, 7.	34 9, 9, 8, 8.	31 3, 10, 8, 10.	28 6, 8, 6, 8.	..	
Co. 211	26 8, 9, 5, 4.	..	..	..	17 4, 5, 4, 4.	23 6, 7, 5, 5.	..	17 5, 4, 4, 4.	..	
Co. 212	31 9, 8, 8, 6.	..	34 10, 8, 8, 8.	..	30 7, 8, 7, 8.	32 8, 8, 9, 7.	20 4, 4, 5, 7.	29 7, 6, 8, 7.	..	
Co. 213	30 8, 9, 7, 6.	..	..	..	20 9, 5, 3, 3.	28 8, 8, 6, 6.	..	30 6, 8, 10, 6.	24 6, 5, 8, 5.	
Co. 214	30 7, 9, 7, 7.	..	..	..	18 6, 5, 5, 2.	30 10, 7, 7, 6.	..	24 7, 5, 5, 7.	26 7, 6, 8, 5.	
Co. 215	31 9, 9, 7, 6.	..	..	..	23 6, 8, 4, 5.	22 9, 5, 4, 4.	..	21 6, 6, 5, 4.	25 7, 4, 7, 7.	
Co. 216	27 8, 10, 4, 5.	..	..	..	..	32 8, 10, 5, 9.	..	19 4, 6, 3, 6.	23 6, 4, 7, 6.	



52
J. 213 in 2, 220
220-94

"Arrowing" and "smutting" of the distributed seedlings in the different farms.

Tendency to arrow and liability to smut are serious drawbacks in any distributed seedling and the statement below gives the record for the seedlings in respect of these two characters at the time of examination. The upper figure gives the note on "arrowing" and the lower one on "smutting."

Distributed Co. seedlings	Character studied	Cane-breeding Station, Coimbatore	Bangalore	Manjri	Gwalior	Tharsa	Pusa	Sepaya	Cawnpore	Shahjahanpur	Gurdaspur	REMARKS
Co. 201	Ar.	Nil	Few	Prof.		Nil	Nil	Nil	..	Nil	Nil	(1) Note the special liability to smut in the Saretha seedling—Co. 203, and Khela seedling—Co. 209. (2) Seedlings with J. 213 or Saretha as either of the parents show a similar liability to smut. The above parents will, therefore, have to be used with very great caution in breeding cane for a locality where smut is a serious consideration.
	Sm.	Nil	Nil	Nil		1 sht.	Nil	Nil	..	Nil	Nil	
Co. 202	Ar.	Few	Prof.	Prof.		Prof.	Mod.	1 Ar	..	Nil	Nil	
	Sm.	Nil	Nil	Nil		1 sht.	Nil	Nil	..	Nil	Nil	
Co. 203	Ar.	Nil	Prof.	Nil		Prof.	Mod.	...	..	Nil	Nil	
	Sm.	Few	1 sht.	Nil		Nil	1 sht.	Bad	..	Bad	Nil	
Co. 204	Ar.	Prof.	Prof.	Prof.		Prof.	Nil	Nil	..	Nil	Nil	
	Sm.	Nil	Nil	Nil		Nil	Nil	Nil	..	Nil	Nil	
Co. 205	Ar.	Nil	Prof.	Prof.		Prof.	Prof.	Prof.	..	Nil	Nil	
	Sm.	Nil	Nil	Nil		Nil	Nil	Nil	..	Nil	Nil	
Co. 206	Ar.	Prof.	Prof.	Prof.		Prof.	Nil	Nil	..	Nil	Nil	
	Sm.	Nil	Nil	Nil		Nil	Nil	Nil	..	Nil	Nil	
Co. 207	Ar.	Nil	...	...		Nil	Nil	Nil	..	Nil	...	
	Sm.	Nil	...	...		Nil	Nil	Nil	..	Few	...	

conditions and no notes could be recorded.

Co. 208	Ar.	Nil	Few	Nil	Nil	Nil	Nil	Nil	Nil	Nil	...
	Sm.	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Few	1 sht. ?	...
Co. 209	Ar.	Nil	...	...	Few	Nil	Nil	...	...	Nil	...
	Sm.	Nil	...	...	Nil	Nil	Bad	...	...	Bad	...
Co. 210	Ar.	Nil	Few	Few	Nil	Nil	Nil	Nil	Nil	Nil	...
	Sm.	Few	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	...
Co. 211	Ar.	Nil	...	...	...	Nil	Nil	Nil	...	Nil	...
	Sm.	Few	...	...	...	Nil	Nil	Nil	...	Nil	...
Co. 212	Ar.	Few	Few	Few	...	Nil	Nil	Nil	Nil	Nil	...
	Sm.	Nil	Nil	Nil	...	Nil	Nil	Nil	Nil	Nil	...
Co. 213	Ar.	Nil	...	...	...	Nil	Nil	Nil	...	Nil	Nil
	Sm.	Nil	...	...	...	Nil	Nil	Nil	...	Nil	Nil
Co. 214	Ar.	Nil	...	...	...	Few	Few	Nil	...	Nil	Nil
	Sm.	Few	...	...	...	Nil	Nil	Nil	...	1 sht. ?	Nil
Co. 215	Ar.	Few	...	...	...	Nil	Nil	Nil	...	Nil	Nil
	Sm.	Few	...	...	...	Nil	Nil	Nil	...	Nil	Nil
Co. 216	Ar.	Few	...	...	...	Nil	Nil	Nil	...	Nil	Nil
	Sm.	Nil	...	...	...	Nil	Nil	Nil	...	Nil	Nil

The seedlings showed poor growth because of abnormal weather

¹ These seedlings were destroyed at this farm owing to the appearance of smut.

Prof. = Profuse.

Mod. = Moderate in number or quantity.

Sht. = Shoot

... = The seedling was not available for observation generally because of not having been distributed.

Character of the juice of the Coimbatore seedlings in different localities—contd.

Locality	Co. 207.				Co. 208.				Co. 209.			
	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity
	%	%	%	%	%	%	%	%	%	%	%	%
Sugarcane-breeding Station, Coimbatore	16.24	12.81	0.31	78.9	14.27	9.97	1.28	69.9	14.59	11.68	..	80.1
Manjri	..	..	..	..	17.01	12.86	..	75.7	..	..	..	..
Tharsa	19.36	17.68	0.15	91.1	20.80	18.27	0.13	89.6	18.72	15.34	0.18	83.4
Sunnabale, 14.23 per cent. Su. in juice, Khari, 15.15 and J. 247, 16.61.	..	..	..	..	..	..	..	..	..	..	..	..
Pusa	18.34	15.84	0.23	86.3	17.50	14.51	0.63	82.8	17.10	14.19	0.37	83.0
Maneria, 12.07 per cent. Su. in juice, Kuswar 15.41 and Rheora 13.19.	..	..	..	..	..	..	..	..	..	..	..	..
Sepaya	..	15.26	0.23	93.6	..	16.33	0.51	89.4	..	11.57	1.42	..
Shahjahanpur	..	12.48	0.92	..	..	11.67	1.83	..	..	..	..	..
Highest sucrose in selected varieties under field conditions 13.0, average 11.0.	..	..	..	..	..	..	..	..	..	..	..	..
Gurdaspur	..	..	..	..	..	..	..	..	..	..	..	..
The average of a number of analyses of Dhaulti was 14.60 per cent. sucrose in juice.	..	..	..	..	..	..	..	..	..	..	..	..
Locality	Co. 210				Co. 211				Co. 212			
	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity
	%	%	%	%	%	%	%	%	%	%	%	%
Sugarcane-breeding Station, Coimbatore	16.57	13.33	..	80.5	14.93	11.74	..	78.7	17.34	14.31	..	82.5
Manjri	18.34	14.93	0.14	81.5	..	..	..	..	17.04	13.53	..	79.3
Tharsa	19.10	16.24	..	86.9	..	..	..	..	..	..	..	..
Sunnabale, 14.23 per cent. Su. in juice, Khari, 15.15 and J. 247, 16.61.	..	..	..	..	..	..	..	..	..	..	..	..
Pusa	17.94	15.31	0.50	85.5	15.97	13.15	1.15	82.5	18.40	16.13	0.53	87.5
Maneria, 12.07 per cent. Su. in juice, Kuswar 15.41 and Rheora 13.19.	..	..	..	..	..	..	..	..	..	..	..	..
Sepaya	..	17.06	0.39	88.9	..	16.04	0.32	88.6	..	15.42	0.20	90.2
Shahjahanpur	..	8.17	2.82	..	..	11.37	1.94	..	..	9.32	2.32	..
Highest sucrose in selected varieties under field conditions 13.0, average 11.0.	..	..	..	..	..	..	..	..	..	..	..	..
Gurdaspur	..	..	..	..	..	..	..	..	..	..	..	..
The average of a number of analyses of Dhaulti was 14.60 per cent. sucrose in juice.	..	..	..	..	..	..	..	..	..	..	..	..

Character of the Juice of the Coimbatore seedlings in different localities.

Locality	Co. 213				Co. 214				Co. 215				Co. 216			
	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity	Brix	Sucrose	Glucose	Co-effi- cient of purity
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Sugarcane-breeding Station, Coimbatore	15.30	12.13	..	76.1	19.46	16.22	..	83.4	17.04	13.71	0.82	80.5	15.69	12.24	..	78.1
Manjri	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tharsa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sunnabale, 14.23 per cent. Su. in juice, Khari, 15.15 and J. 247, 16.61.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pusa	16.34	15.09	1.01	85.6	18.98	16.56	0.48	87.9	17.50	14.45	0.85	82.5	14.99	11.68	1.07	78.0
Maneria, 12.07 per cent. Su. in juice, Kuswar 15.41 and Rheora 13.19.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sepaya	..	15.25	0.34	85.2	..	18.07	0.28	93.0	..	16.24	0.29	88.0	..	18.09	0.40	95.3
Shahjahanpur	..	8.73	2.61	..	..	12.56	1.65	..	..	11.92	1.71	..	..	11.14	1.97	..
Highest sucrose in selected varieties under field conditions 13.0, average 11.0.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gurdaspur	..	13.11	1.02	80.7	..	17.98	0.37	87.3	..	12.74	0.96	78.1	..	15.19	1.22	83.8
The average of a number of analyses of Dhaulti was 14.60 per cent. sucrose in juice.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

NOTE 1. All available analyses, figures are given in this statement.

NOTE 2. Dots indicate that the figures are not available generally because of the seedling not having been distributed.

NOTE 3. At the cane-breeding station the seedlings were analysed three times and the highest figures are here recorded. Some of the analyses did not include glucose determinations and hence the absence of these figures in a few cases.



Co. 202

Co. 201



Co. 204

Co. 203



Co. 206

Co. 205

Coimbatore seedlings at the Gurdaspur Farm. The variety seen behind is Dhauln, a dwarf local cane. Note the comparative better growth of the Coimbatore seedlings. The gauge seen in the pictures has alternate foot spaces marked black and white and is placed to enable comparison of height of growth.



Co. 210 Co. 209 Co. 208
Coimbatore seedlings at the Tharsa Farm. The growth was so good that some of them had to be heavily supported with bamboos.



J. 247 Khari and Sunnabile (at the Tharsa Farm.)
Some of the promising canes grown by the local Agricultural Department.
The gauge seen in the pictures has alternate foot spaces marked black and white and is placed to enable comparison of height of growth.



Co. 215

Co. 208

Co. 202



Co. 204

Co. 201

Coimbatore seedlings at the Cattle-breeding Station, Sepaya.

Note the free growth and satisfactory habit.

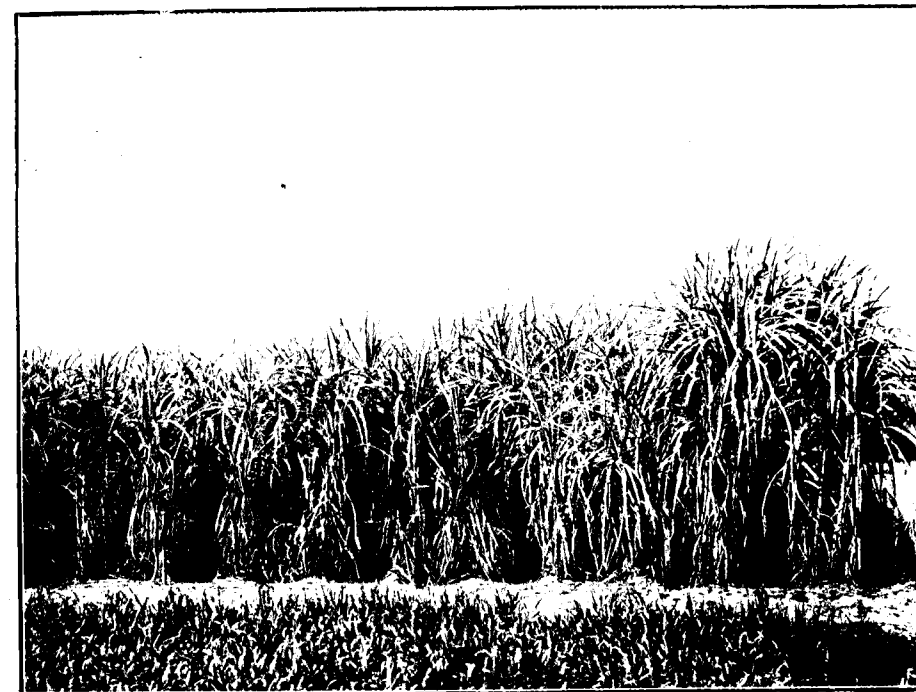
The gauge seen in the pictures has alternate foot spaces marked black and white and is placed to enable comparison of height of growth.



The tall row of cares seen in the picture is that of Co. 210 grown at the Cawnpore Farm. The growth is very promising.



The bulk crop seen in the picture is of J. 33a grown at Cawnpore for seed. To the left are seen a few rows of Ashy Mauritius. The gauge seen in the pictures has alternate foot spaces marked black and white and is placed to enable comparison of height of growth.



A cane plot at the Shahjahanpur Sugarcane Research Station. The two rows to the right are of M. 2, a Madras seedling raised in 1911-12. This seedling has a low sucrose but is grown as a wind-break because of its good growth and excellent habit.



Coimbatore seedlings at the Pusa sugarcane area. From left to right; Karun, Cos. 207, 206, 205, 204, 203, 202, 201, and Kuswar. Karun is a thick cane introduced from Coimbatore, and Kuswar a thin dwarf North Indian cane. Note the comparative better growth of the Coimbatore seedlings. Some of these have arrowed freely here. The gange seen in the pictures has alternate feet spaces marked black and white and is placed to enable comparison of height of growth.



Arrowing of the distributed seedlings at Manjri Farm.



Co. 204

Co. 203

Co. 202

Arrowing of the distributed seedlings at Tharsa Farm.

The gauge seen in the pictures has alternate foot spaces marked black and white and is placed to enable comparison of height of growth.

Publications of the Imperial Department of Agriculture in India.

To be had from :—

The Office of the Agricultural Adviser to the Government of India, Pusa, Bihar,
and from the following Agents :—

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Thacker, Spink & Co., Calcutta. 2. W. Newman & Co., Calcutta. 3. Rai M. C. Sarkar Bahadur & Sons, Calcutta. 4. Higginbothams, Ltd., Madras. 5. Thompson & Co., Madras. | <ol style="list-style-type: none"> 6. D. B. Taraporevala, Sons & Co., Bombay. 7. Thacker & Co., Ltd., Bombay. 8. Sunder Pandurang, Bombay. 9. Rai Sahib M. Gulab Singh & Sons, Lahore. 10. Manager, Educational Book Depôt, Nagpur. |
|---|--|

A complete list of the publications of the Imperial Department of Agriculture in India can be obtained on application from the Agricultural Adviser to the Government of India, Pusa, Bihar, or from any of the above-mentioned agents.

These publications are :—

1. *The Agricultural Journal of India*. A Journal dealing with subjects connected with agricultural economics, field and garden crops, economic plants and fruits, soils, manures, methods of cultivation, irrigation, climatic conditions, insect pests, fungus diseases, co-operative credit, agricultural cattle, farm implements and other agricultural matters in India. Illustrations, including coloured plates, form a prominent feature of the Journal. It is edited by the Agricultural Adviser to the Government of India, and published once every two months or six times in a year. *Annual Subscription*, Rs. 6 or 9s. 6d. including postage. *Single copy*, R. 1-8 or 2s.
2. Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist).
3. Annual Report on the Progress of Agriculture in India.
4. Proceedings of the Board of Agriculture in India.
5. Proceedings of Sectional Meetings of the Board of Agriculture.
6. Memoirs of the Imperial Department of Agriculture in India.
 - (a) Botanical Series.
 - (b) Chemical Series.
 - (c) Entomological Series.
 - (d) Bacteriological Series.
 - (e) Veterinary Series.
7. Bulletins issued by the Agricultural Research Institute, Pusa.

8. Books.

The following are the publications of the last two years :—

- Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist) for the year 1917-18. Price, R. 1-4 or 2s.
- Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Imperial Cotton Specialist) for the year 1918-19. Price, R. 1-4 or 2s.
- Report on the Progress of Agriculture in India for the year 1916-17. Price, As. 12 or 1s. 1d.
- Report on the Progress of Agriculture in India for the year 1917-18. Price, R. 1-8 or 2s. 3d.
- Proceedings of the Board of Agriculture in India, held at Poona on the 10th December, 1917, and following days (with Appendices). Price, As. 13 or 1s. 3d.
- Proceedings of the Second Meeting of Mycological Workers in India, held at Pusa on the 20th February, 1919, and following days. Price, As. 11 or 1s.
- Proceedings of the First Meeting of Agricultural Chemists and Bacteriologists, held at Pusa on the 24th February, 1919, and following days. Price, R. 1 or 1s. 6d.
- Proceedings of the First Meeting of Veterinary Officers in India, held at Lahore on the 24th March 1919, and following days (with Appendices). Price, As. 8 or 9d.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA.

Botanical Series.

- Vol. IX, No. IV. Studies in Indian Sugarcanes, No. 3. The Classification of Indian Canes with special reference to the Sarethia and Sumnabile Groups, by C. A. BARBER, sc.D. Price, Rs. 2-4 or 3s.
- Vol. IX, No. V. *Phytophthora Meadii* n. sp. on *Hevea brasiliensis*, by W. McRAE, M.A., B.Sc., F.L.S. Price, R. 1-4 or 2s.
- Vol. X, No. I. The Rice Worm (*Tylenchus angustus*) and its Control, by E. J. BUTLER, M.B., F.L.S. Price, R. 1-4 or 2s.
- Vol. X, No. II. Studies in Indian Sugarcanes, No. 4. Tillering or underground branching, by C. A. BARBER, C.I.E. sc.D., F.L.S. Price, Rs. 4-4 or 7s.
- Vol. X, No. III. Studies in Indian Sugarcanes, No. 5. On testing the suitability of sugarcane varieties for different localities, by a system of measurements. Periodicity in the growth of the sugarcane, by C. A. BARBER, C.I.E., sc.D., F.L.S. Price, R. 1-12 or 3s.
- Vol. X, No. IV. A *Pythium* Disease of Ginger, Tobacco and Papaya, by L. S. SUBRAMANIAM. Price, R. 1-8 or 2s. 6d.
- Vol. X, No. V. Studies in the Pollination of Indian Crops, 1, by A. HOWARD, GABRIELLE L. C. HOWARD, and ABDUR RAHMAN KHAN. (*In the press.*)

Chemical Series.

- Vol. V, No. II. "Heart Damage" in Baled Jute, by R. S. FINLOW, B.Sc., F.I.C., F.C.S. Price, R. 1 or 1s. 6d.
- Vol. V, No. III. Experiments on the Improvement of the Date Palm Sugar Industry in Bengal, by HAROLD E. ANNETT, B.Sc., F.I.C.; GOSTA BEHARI PAL, M.Sc.; and INDU BHUSHAN CHATTERJEE, L.Ag. Price, R. 1 or 1s. 6d.
- Vol. V, No. IV. Cholam (*A. Sorghum*) as a Substitute for Barley in Malting Operations, by B. VISWANATH, T. LAKSHMANA ROW, B.A., and RAGHUNATHASWAMI AYYANGAR, Dip. Ag. Price, As. 12 or 1s.
- Vol. V, No. V. The Phosphate Requirements of some Lower Burma Paddy Soils, by F. J. WARTH, M.Sc., B.Sc., and MAUNG PO SHIN. Price, R. 1-12 or 3s. 3d.
- Vol. V, No. VI. Absorption of Lime by Soils, by F. J. WARTH, M.Sc., B.Sc., and MAUNG PO SAW. Price, R. 1-2 or 2s.

Entomological Series.

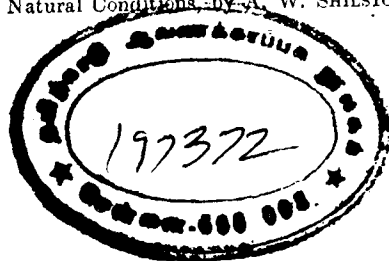
- Vol. V, No. V. The Rice Leaf-hoppers (*Nephotettix bipunctatus*, Fabr. and *Nephotettix apicalis*, Motsch.), by C. S. MISRA, B.A. (*In the press.*)
- Vol. V, No. VI. *Lantana* Insects in India. Being the Report of an Inquiry into the Efficiency of Indigenous Insect Pests as a Check on the Spread of *Lantana* in India, by Y. RAMACHANDRA RAO, M.A., F.E.S. (*In the press.*)

Bacteriological Series.

- Vol. I, No. VII. A Bacterial Disease of Wheat in the Punjab, by C. M. HUTCHINSON, B.A. Price, As. 12 or 1s.

Veterinary Series.

- Vol. II, No. VIII. *Kumri*: Combined Diffuse Sclerosis and Central Poliomyelitis of Horses, by G. H. K. MACALISTER, M.A., M.D., D.P.H., M.R.C.S., L.R.C.P. Price, R. 1-8 or 2s. 6d.
- Vol. III, No. I. The Vitality of the Rinderpest Virus outside the Animal Body under Natural Conditions, by A. W. SHILSTON, M.R.C.V.S. Price As. 12 or 1s.



BULLETINS ISSUED BY THE AGRICULTURAL RESEARCH INSTITUTE, PUSA.

- No. 77. Some Camel-feeding Experiments, by H. E. CROSS, M.B.C.V.S., D.V.H., A.Sc. Price, As. 2 or 3d.
- No. 78. Smuts of Jowar (*Sorghum*) in the Bombay Presidency, by G. S. KULKARNI, L.Ag. Price, As. 4 or 5d.
- No. 79. Prussic Acid in Burma Beans, by F. J. WARTH, B.Sc., M.Sc., and Ko Ko GYL. Price, As. 2 or 3d.
- No. 80. Are Camels Susceptible to Blackquarter, Hæmorrhagic Septicæmia and Rinderpest? by H. E. CROSS, M.B.C.V.S., D.V.H., A.Sc. Price As. 4 or 5d.
- No. 81. The Value of Phosphatic Manures in India and the Possibility of their Manufacture on a Larger Scale. Being evidence submitted to the Committee appointed to discuss this question (Subject IX) at the meeting of the Board of Agriculture, Poona, 1917. Edited, with an Introduction, by W. A. DAVIS. Price, As. 4 or 5d.
- No. 82. The Improvement of the Indigenous Methods of *Gur* and Sugar making in the United Provinces, by WILLIAM HULME and R. P. SANGH. Price, As. 8 or 9d.
- No. 83. Progress of the Sugarcane Industry in India during the years 1916 and 1917. Being notes submitted to the meeting of the Board of Agriculture in India, Poona, 1917. Edited, with an Introduction, by C. A. BARBER, C.I.E., Sc.D., F.L.S. Price, As. 5 or 6d.
- No. 84. The Best Means of Rapidly Increasing the Outturns of Food Crops by Methods within the Power of the Agricultural Department. Being notes submitted to the Meeting of the Board of Agriculture in India, Poona, 1917. Edited, with an Introduction, by J. MACKENNA, C.I.E., I.C.S. Price, As. 4 or 5d.
- No. 85. Soil Drainage, by R. G. ALLAN, M.A. Price, As. 4 or 5d.
- No. 86. A New Nematode causing Parasitic Gastritis in Calves, by A. L. SHEATHER, B.Sc., M.B.C.V.S. Price, As. 4 or 5d.
- No. 87. A Contribution to Our Knowledge of South Indian Coccidæ, by T. V. RAMAKRISHNA AYYAR, B.A., F.R.S., F.Z.S. Price, As. 14 or 1s. 6d.
- No. 88. Cawnpore-American Cotton : An account of Experiments in its Improvement by Pure Line Selection and of Field Trials, 1913-1917, by B. C. BURT, B.Sc., and NIZAMUDDIN HAIDER. Price, As. 10 or 1s.
- No. 89. Second Hundred Notes on Indian Insects. Price, R. 1-4 or 2s.
- No. 90. A Malarial Parasite in the Blood of a Buffalo, by A. L. SHEATHER, B.Sc., M.B.C.V.S. Price, As. 6 or 7d.
- No. 91. Notes on Practical Salt Land Reclamation, by G. S. HENDERSON, N.D.A., N.D.D. Price, As. 6.
- No. 92. *Syngamus laryngeus* in Cattle and Buffaloes in India, by A. LESLIE SHEATHER, B.Sc., M.B.C.V.S., and A. W. SHILSTON, M.B.C.V.S. Price, As. 6.
- No. 93. The Orange : The Trial of Stocks at Peshawar, by W. ROBERTSON BROWN. (*In the press.*)
- No. 94. A Preliminary Note on the behaviour in North India of the first batch of Sugarcane Seedlings raised at the Sugarcane-breeding Station, Coimbatore, by T. S. VENKATARAMAN, B.A. Price, As. 8.

INDIGO PUBLICATIONS.

- No. 1. A Study of the Indigo Soils of Bihar. The Urgent Necessity of Immediate Phosphate Manuring if Crops are to be Maintained, by W. A. DAVIS, B.Sc., A.C.G.I. Price, R. 1-4 or 2s.
- No. 2. Present Position and Future Prospects of the Natural Indigo Industry, by W. A. DAVIS, B.Sc., A.C.G.I. Price, As. 10 or 1s.
- No. 3. The Loss of Indigo caused by Bad Settling and the Means of Obviating this : The use of Dhak Gum—its effect on Yield and Quality, by W. A. DAVIS, B.Sc., A.C.G.I. Price, As. 4 or 5d.
- No. 4. The Future Prospects of the Natural Indigo Industry. The Effect of Superphosphate Manuring on the Yield and Quality of the Indigo Plant, by W. A. DAVIS, B.Sc., A.C.G.I. Price, As. 4 or 5d.
- No. 5. An Improved Method of Preparing Indican from Indigo-Yielding Plants, by BHAILAL M. AMIN, B.A. Price, As. 2 or 3d.
- No. 6. The Effect of Manuring with Superphosphate and Sannai on the Yield of Crops on Indigo Planters' Estates in Bihar—especially of Rabi Crops in the Season 1918-19, by W. A. DAVIS, B.Sc., A.C.G.I. (*In the press.*)

BOOKS.

- "Indian Insect Pests," by H. MAXWELL-LEFROY, M.A., F.E.S., F.Z.S. Price, R. 1-8. (*Out of print.*)
- "Indian Insect Life," by H. MAXWELL-LEFROY, M.A., F.E.S., F.Z.S.; and F. M. HOWLETT, B.A., F.E.S. 786 pp. Price, Rs. 20 or 30s. (*Out of print.*)
- "Wheat in India," by ALBERT HOWARD, M.A., A.R.C.S., F.L.S.; and GABRIELLE L. C. HOWARD, M.A. 238 pp. Price, Rs. 5 or 7s. 6d.
- "A Description of the Imperial Bacteriological Laboratory, Muktesar : Its Work and Products," by Major J. D. E. HOLMES, M.A., D.Sc., M.R.C.V.S. Price, As. 8 or 9d.
- "Agriculture in India," by JAMES MACKENNA, M.A., I.C.S. Price, As. 4 or 5d.
- "Some Diseases of Cattle in India." A handbook for stock-owners. Price, As. 8 or 9d.
- "The Importance of Bacterial Action in Indigo Manufacture," by C. M. HUTCHINSON, B.A. Price, As. 2 or 3d.
- "Report of the Proceedings of the Second Entomological Meeting held at Pusa on the 5th—12th February, 1917. Rs. 3 or 4s. 6d.

Report of the Indian Cotton Committee. Vol. I, Report; Vol. II, Maps and Plans. Price, R. 1 per volume. (Superintendent, Government Printing, India, Calcutta.)