

granular to sub-angular blocky. They are fair to low in plant nutrients. The alluvial soils are very deep red brown sandy clay loam to sandy loam and granular to sub-angular blocky. They possess medium amounts of plant nutrients.

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## Ideal Breeding and Selection of Sugarcane

by

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**Introduction:** For a long time upto 1959 breeding was being done broadly for the requirements of the Sub-Tropical Northern India, and the Tropical Southern India. Since 1959 the Indian union was divided into seven main regions according to the soil and climatic conditions, and breeding programme was re-orientated accordingly. It is therefore necessary that certain norms or guide lines should be investigated and fixed up for each region to evolve an ideal cane.

**Materials and methods:** The yield attributes in cane viz. the length and thickness of cane, number of internodes, individual weight of cane, tillering or population per acre and juice quality were studied in 200 selections from six parental crosses at the Sugarcane Research Station, Cuddalore, in 1965. Thickness of cane was determined by recording the girth at top middle and bottom of the cane and taking the average. From the length of cane and the number of internodes the average length of internode was worked out. From the weight of individual cane and the number of internodes, the average weight of internode was calculated.

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Correlation co-efficients for the relationship between the length of cane and average length of internode, between the weight of cane and the average weight of internode, between the thickness of cane and tillering or population per acre, between the juice quality and vigour or weight of cane were worked out. Also the nature of inheritance of progenies of parents with thick long internodes, of parents with good tillering, of parents with good sugar content and their significances were worked out.

**Results and Discussion:** *Individual length and weight of cane in relation to its internode:* Correlation co-efficients for the relationship between (1) cane length and internode length and (2) cane weight and internode weight were found to be 0.61 and 0.80, respectively and highly significant.

The high positive relationship existing between the length and weight of internode to the total length weight of cane showed that the number of internodes in cane varieties of the same age is constant. The average number of internodes of varieties under different parental crosses in the present study varied only from 24 to 26 and was similar. In another independent study it has also been found that the number of internodes in canes of the same age remains the same irrespective of the varieties and the levels of manure and irrigations given to them (Ekambaram, 1966). The growth or the length of cane depends on the number of internodes and the length of each internode. Since the number of internodes remains the same, the length of cane depends on the length of internodes as is evident from the high positive correlation existing between the length of cane and average length of internode.

The weight of cane depends on the length of cane and thickness of cane. Since the length of cane depends on the length of internode, the weight of cane depends on the length and thickness of the internode or rather the weight of internodes. The high positive correlation existing between the weight of cane and average weight of internode confirmed this.

It therefore resolves, that if the internode content of a cane is high (i. e.) if it is thick and long, the total weight of cane will be also high.

*Inheritance of thickness and length of internode:* The length and thickness of internodes is influenced by environmental conditions like manures and irrigations given and also the seasonal conditions. But there are inherent differences in the length and thickness of the internodes of the varieties, which are genetic.

In two varieties of cane viz. Co. 419 and Co. 449, which were raised at the Sugarcane Research Station, Sirugumani under different manurial treatments with no manure, 250 lb. N, and 350 lb. N. per acre, though the

length and thickness of the internodes varied according to the manurial treatments in both the varieties, Co. 419 remained with comparatively thicker internode of medium length, and Co. 449 as a medium cane with long internode.

	<i>Length of Internode in cm.</i>			<i>Thickness in cm.</i>		
	0 N	250 N	350 N	0 N	250 N	350 N
Co. 419	7.2	9.2	9.2	2.34	2.73	2.64
Co. 449	7.5	9.8	10.5	1.96	2.23	2.39

Hebert and Henderson (1959) have recorded that in general, progenies of crosses involving large diameter parents, were large in diameter, and conversely progenies of crosses involving small diameter parents were small in diameter, and that there were exceptions, and many individual single stools were either larger or smaller than either parent involved in the crosses.

In the present study, progenies of two parental crosses *viz.* Co. 658 x Co. 1287 and Co. 775 x Co. 678 were studied for inheritance of length and thickness of the internodes. Both Co. 658 and Co. 1287 have long thick nodes. Co. 775 and Co. 678 are medium canes with comparatively shorter internodes. Twenty four of the progenies from each of the crosses were compared for the length and thickness of the internodes and the results are given below:

Parentage	Average length of internode (cm.)	Average thickness of internode (cm.)
Co. 658 x Co. 1287	11.11	2.76
Co. 775 x Co. 678	9.86	2.31
Significance	significant	highly significant
S. E.	0.03	0.04
C. D.	0.94	0.12

The progenies of crosses of Co. 658 x Co. 1287 had significantly longer and thicker internodes than progenies of crosses of Co. 775 and Co. 678. The results confirmed the findings that progenies of crosses involving large diameter parents are large in diameter and progenies of crosses with long internodes have long internodes. Thus length and thickness of internode were found to be inheritable, long and thick ones producing similar progenies.

*Tillering and thickness of cane:* As the yield of cane per acre depends both on the individual weight of cane and number of canes per acre, a cane with thick long internode should have good tillering capacity also.

To examine whether thick canes are shy tillerers and thin canes are profuse in tillering, 199 selections of seedling canes were studied at the Sugarcane Research Station, Cuddalore in 1965 for their thickness and number of canes harvested. Value of correlation coefficient for the relation between the two factors was worked out.

The result showed a non-significant negative correlation of 0.13. Although the number of varieties studied was as large as 199, and the cane population varied between wide limits from 20,000 to 99,000 per acre, there was no significant negative correlation between the thickness of cane and number of canes per acre. This is in agreement with the findings of Hebert and Henderson (1959) who concluded that no important association occurred between stalk diameter and number of stalks per stool. In the sample studied, medium thick and thick canes with over 2.65 cm diameter, and 40,000 canes per acre amounted to 39 per cent, while absolutely thick canes with 3 cm diameter and above and over 40,000 population per acre amounted to as much as 12 per cent. There were thick canes with even over 60,000 population per acre. Hence chances of producing thick canes with good tillering do exist.

*Inheritance of tillering:* Hebert and Henderson (1959) in studying inheritance of characters found that besides thick stalked parents yielding thick stalked progenies, tillering is a heritable character. The inheritance of population or tillering in two parental crosses, one with good tillering capacity like Co. 419 and Co. 798 and the other with rather shy tillering, like Co. 658 and Co. 1287 was studied. The population in 25 progenies of the two crosses were compared. It was found that difference in population means between the two parental crosses was highly significant, it being more in the progenies of cross Co. 419 x Co. 798 which are good tillerers, while variation in population within the varieties of a parental cross was not significant. This proved that tillering is heritable, parents with good tillering contributing similar progenies with good tillering. The results are given below.

<i>Parentage</i>	<i>Population per acre</i>	<i>S. E.</i>	<i>C. D.</i>
Co. 419 x Co. 798 (A)	59,608		
Co. 658 x Co. 1287(B)	44,776	1,699	4,805
A, B			

*Vigour and juice quality:* It is not enough if varieties with thick and long internodes with good tillering habit capable of giving high yields of cane are produced. They should also contain high sucrose content.

There is generally an impression that vigorous growing canes are low in sugar content. In a vigorous growing thick cane, even with low level of sugar content the total accumulation of sugar in its roomy stalk portion can be more. A total number of 199 seedling cane varieties was studied for their sugar content in relation to the average weight of individual cane representing vigour or development of cane. Value of correlation co-efficient for relation between the two factors was worked out, and a very low non-significant correlation of-0.08 was obtained between the weight of cane and C. C. S. per cent.

The average weight of cane varied from 0.3 to 1.9 kg and the C. C. S. per cent from 3 to 14. Even under such a wide range of values of the two attributes, their mutual dependence could not be proved, suggests that they are independent of each other unrelated for all practical purposes. The above finding is in agreement with the conclusion drawn by Hebert and Henderson (1959) that there was essentially no association between the stalk diameter and sucrose content. It is therefore to be concluded that a high yielding cane with thick long internode can have high sugar content.

*Inheritance of sugar content:* Thick juicy canes belonging to the *Sacharum officinarum* group are high sugared and are also known to transmit their qualities to their progenies. Though sugar content in canes may be influenced by environmental conditions more particularly by the manure applied and seasonal conditions, there are inherent differences between varieties which are genetic. The table below giving the C. C. S. per cent of the standard varieties under three levels of nitrogen illustrates the point.

*Ratoon manurial experiment Sugarcane Research Station,  
Cuddalore, 1963—'64.*

Variety	C. C. S. per cent		
	250 N	300 N	350 N
Co. 419	11.3	11.4	10.6
Co. 449	12.0	11.4	10.4
Co. 658	13.6	12.4	12.1

Though the sugar content is lower in plots with high level of manuring, the variety Co. 658 continued to register high C. C. S. per cent in all the levels of manuring while Co. 419 was the least in this respect.

The inheritance of sugar content in the progenies of three parental crosses was studied at the Sugarcane Research Station, Cuddalore in 1965, and the results are given below.

Parentage	Average wt. of millable cane (kg)	Girth (cm.)	C. C. S. per cent	Significance	S. E.	C. D.
(1) Co. 419 x Co. 798	1.12	2.56	8.46	...	...	...
Co. 658 x Co. 1287	1.15	2.76	10.37	highly significant	0.37	1.04
(2) Co. 775 x Co. 678	0.99	2.31	10.35	...	0.097	...
Co. 658 x Co. 1287	1.15	2.76	10.37	not significant		

Co. 419 and Co. 798 are thick vigorous growing canes with low or moderate sucrose. Co. 658 and Co. 1287 are medium thick and vigorous growing canes with better quality of which Co. 658 is a high quality cane. Comparison of their progenies show that while both are thick and vigorous, the quality of the progenies from the cross Co. 658 x Co. 1287 was distinctly superior to the progenies of the cross Co. 419 x Co. 798.

In the second comparison, the parents Co. 775 and Co. 678 are comparatively thinner canes with less vigour, though good in quality, while the parents Co. 658 and Co. 1287 are medium thick vigorous growing cane with good quality. Their progenies have likewise inherited the high quality of both parental crosses, at the same time inheriting the comparative thickness and vigour of the parents.

The progenies of the cross Co. 658 x Co. 1287 are not only rich but also thick and vigorous growing, with high individual weight of cane. It is therefore possible to have thick vigorous growing high yielding canes which are also quite rich in sugar content.

**Summary and Conclusion:** (i) There is a constancy in the number of internodes in canes of the same age irrespective of the varieties, or manures and cultural treatments under which they are grown. This means that the internode content of canes is a determining factor in the total weight of cane.

(ii) A cane with thick long internode and good tillering has the potentialities of high yield.

(iii) A thick cane need not necessarily be a shy tillerer. There is no significant negative correlation between thickness and tillering. Both these characters are independent and heritable. It should be possible to produce canes with thick long internodes and good tillering.

(iv) The popular impression that vigorous and high yielding canes are less in sugar content is not borne out by facts. There is no significant relationship between the vigour of cane and its sugar content. A thick high yielding cane can be high sugared. Sugar content in cane though may be influenced by environmental conditions is essentially genetic and inheritable, high sugared parents producing high sugared progenies.

(v) The size of stalk or rather the internode, tillering, and sugar content are independent of each other and are heritable. Hence it should be possible to breed a cane with thick long internodes, with good tillering and high sugar content, which will be near about the cane ideal.

(vi) The value of an otherwise good cane will be detracted if it fails to have good field habit and falls a prey to diseases and pests.

A cane with good internode content *i. e.* thick, long internode; good tillering, and high sugar content at the same time having good field habit and possessing resistance to diseases and pests will indeed be the cane ideal.

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