

Internode Formation in Sugarcane—Its Nature and Rate

by
C. EKAMBARAM¹

Introduction: Progress in cane growth is in effect progress in internode formation. On account of a close association between the two, it is of considerable interest to examine the nature, and rate of internode formation under the different conditions of growth, so that the information obtained may be usefully employed for improvement of the crop and the methods of growing. A study of internode formation in the various sugarcane experiments of the Research Stations of the State was therefore conducted for three years and the results obtained are reported.

Review of Literature: MacMartin (1957) observed that the length of joints in sugarcane, was influenced by the amount of water applied for irrigation and that on an average, three joints of millable cane were produced in two months. Humbert Rogor (1963) reported that at Hawaiian Sugarcane Experiment Station, the rate of node formation varied with air and root temperatures and that under field conditions an average of three internodes per month were usually produced in younger canes and slightly longer time intervals gave more mature canes.

Materials and Methods: The number of internodes in each cane stalk in a clump was observed and periodical counts were taken on the same crop and on different varieties at the Sugarcane Research Station, Cuddalore, the Sub-stations at Gudiyatham and Sirugamani, and also Zonal Farm at Rajadhanikottai. Observation on the internode formation was recorded in varieties with thick and thin internodes, with long and short internodes and of the same variety under varying manurial and irrigational treatments.

The fourth leaf which marks a developed internode was taken as the upper limit for counting the number of internodes. Internode formation was counted from the bottom most visible internode upto the internode attached to the fourth leaf.

Results: A. Nature of Internode Formation: (1) VARIETIES:

(a) *Internodes in clumps and stalks within clumps of different varieties:* Internode formation was studied in three popular varieties viz., Co. 419, Co. 449 and Co. 658 at Cuddalore. *Vide* Table 1. The data revealed that (i) The primary or the mother stalks have the greatest number of

¹ Sugarcane Specialist, Cuddalore, Madras State.



PLATE I.

Co. 1287 (long internode) and Ragnar (Short internode) of the same age having similar number of internodes.

in girth and length of internodes have the same number of internodes on any date. In another trial, four varieties with different thickness and length of internodes were also studied for their number of internodes. There have been apparent differences in the number of internodes between the varieties but the variation was not significant.

In varieties Co. 62178 with long internode and Co. 62034 with short internode, the number of internodes was the same, in canes of the same age on the date of observation. Internode formation in Co. 62011 with thin short internode, in Co. 62197 with thick short internode, in Co. 658 with medium thick long internodes, and Co. 6317 with thick internode revealed that inspite of variation in the length and thickness of internodes there was no significant variation in the number of internodes (Table 2).

(2) INTERNODE FORMATION UNDER DIFFERENT LEVELS OF MANURE : The internode formation under different levels of nitrogen was studied at Cuddalore, Rajadhanikottai and Sirugamani. The results obtained are furnished in Tables 3 (a) and (b). The number of internodes formed at the different centres was the same at all the levels of N including a zero level

TABLE 2. Showing Internode formation in different varieties

Particulars	Date of planting	Date of observation	Internode				S. E.	Remarks on internode
			Average girth in cm.	Average length in cm.	Average weight in gm.	Average No.		
Cuddalore:								
1. Ragnar	16-2-1963	30-9-1963	8.8	3.0	57.5	20	0.5	Short
Trojan			10.0	3.2	62.4	19		Short
Co. 1287			14.5	3.0	96.3	20		Long
2. Ragnar	1-10-1966	28-10-1967	6.3	2.3	41.1	27		
Co. 1287	1-10-1966	28-10-1967	12.4	2.5	54.8	27		
Gudiyatham:								
3. Co. 62034	17-3-1963	12-11-1963		3.3		15	0.7	Thick
Co. 62131				3.3		16		Thick long
Co. 62010				1.9		16		Thin
Co. 62034	17-3-1963	15-12-1963		3.3		19	0.7	
Co. 62131				3.3		20		
Co. 62010				1.9		19		
4. Co. 6241	18-4-1965	12-4-1966	11.0	2.0	45.6	26	1.2	Thick short
Co. 1163			10.6	2.9	61.3	24		-do-
Co. 1285			12.3	2.3	63.1	21		Thick long
Co. 1303			11.5	2.1	48.4	19		-do-
5. Co. 62178	15-4-1965	24-11-1965	13.6			17	0.7	Long
Co. 62034			10.1			17		Short
Cuddalore:								
6. Co. 62011	28-2-1964	11-1-1965	13.9	1.78	79.4	17	0.7	Thin
Co. 62197			12.1	2.66	83.3	18		Medium
Co. 6317			12.6	2.80	73.7	19		thick
Co. 658			15.3	2.58	63.0	18		Medium thick long

Note: Differences between number of internodes were not significant

and combinations of manure with and without phosphate, potash and compost. The thickness, height and weight of cane, of course, were better with increasing doses of N or with the application of compost, phosphate and potash in addition to N as seen from table 3 (b). *Vide* Plate II. These point to the fact that the different doses of manure have effect only on the internode contents such as girth and length and leave the internode number unaffected.

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TABLE 3 (a). *Internode formation in stalks under different manurial treatments*

Variety	Date of planting	Date of observation	Number of internodes per cane*		
			150 N	250 N	350 N
CUDDALORE :					
Co. 449	5-5-1963	13-9-1963	5	5	5
	5-5-1963	14-12-1963	14	14	14
* Mean of 800 canes — No difference for manurial treatments					
			No. of internodes per cane per clump (Mean of 20 clumps)		
			Ammonium sulphate		C. A. N.
			100 N	150 N	200 N
RAJADHANIKOTTAL :					
Co. 419	3-1-1963	26-8-1963	11	12	12
Differences not significant. S. E. = 0.3					

TABLE 3 (b). *Internode formation in stalks under different anurial treatments*

Particulars	Variety	Date of planting	Date of observation	Length of cane in cm.	Girth of cane in cm.	Average weight of cane in kg.	No. of internodes	Remarks
SIRUGAMANT :								
0 N	Co. 449	17-2-1964	27-12-1964	172.5	2.34	0.64	24	Average of 20 canes
250 N	Co. 419			212.5	2.73	1.02	23	
350 N	Co. 419			217.5	2.64	0.97	24	
0 N	Co. 449			172.5	1.96	0.60	23	
250 N	Co. 449			245.0	2.23	0.96	25	
350 N	Co. 449			252.5	2.39	1.11	24	
No. of internodes between manurial treatments not significant. S. E. = 0.36								
No. of internodes between varieties not significant. S. E. = 0.30								
CUDDALORE :								
C ₁ P ₁ K ₁								
250 N (A+G)	Co. 449	17-5-1966	27-3-1967	262	2.16	1.12	21	
C ₁ P ₁ K ₁								
250 N (A)	Co. 449	17-5-1966	27-3-1967	236	2.12	1.08	29	Mean of 10 clumps
C ₀ P ₀ K ₀								
250 N (A+G)	Co. 449	17-5-1966	27-3-1967	212	1.95	0.81	21	

TABLE 3 (b). (Contd.)

Particulars	Variety	Date of planting	Date of observation	Length of cane in cm.	Girth of cane in cm.	Average weight of cane in kg.	No. of internodes	Remarks
G ₀ P ₀ K ₀								
250 N (A)	Co. 419	17-5-1966	27-3-1967	151	1.87	0.52	20	
								Difference in number of internodes not significant. S. E. 0=30
250 N	Co. 419	12-4-1967	28-10-1967	125	2.30	0.50	10	
0 N	Co. 449	12-4-1967	28-10-1967	75	1.40	0.12	10	

Note: C₁ = Compost 10 tons per acre; P₁ = Phosphate 100 lb. P₂O₅;

K₁ = Potash 300 lb. K₂O

A + G = Ammonium sulphate + Groundnut cake in the ratio of 2 : 1

A = Ammonium sulphate alone

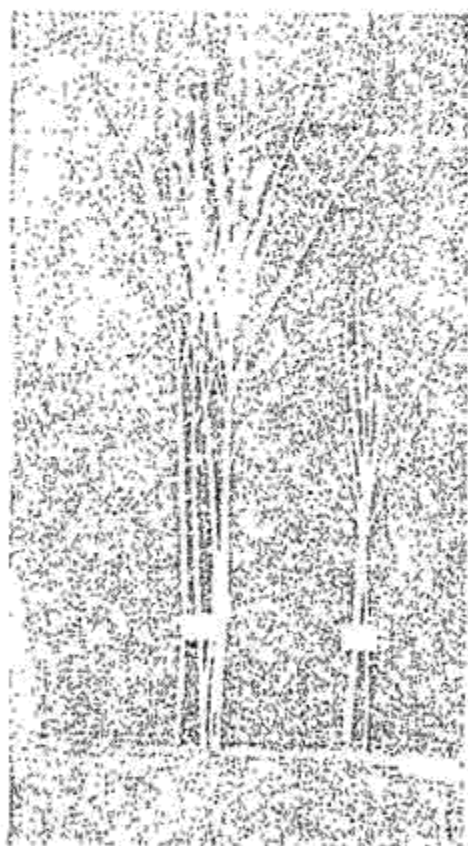


PLATE II.

Co. 449 under 250 N and 0N, but of the same age, having same average number of internodes per stalk.

(3) INTERNODE FORMATION UNDER DIFFERENT LEVELS OF IRRIGATION: The internode formation under different levels of irrigation was examined. *Vide* Table 4. The different frequencies of irrigation did not

produce any significant variation in the number of internodes per cane on a given date of observation. Their effects were, however, noticeable in the length and thickness of internodes formed.

TABLE 4. *Internode formation under different levels of irrigation*

Particulars	Variety	Date of planting	Date of observation	No. of internodes	S. E.	Remarks
RAJADHANIKOTTAI:						
6 days	Co. 419	1-1-1963	26- 8-1963	12	} 0.34	Mean of 20 clumps
12 days	Co. 419	1-1-1963	26- 8-1963	12		
18 days	Co. 419	1-1-1963	26- 8-1963	12		
GUDIYATHAM:						
8 days	Co. 419	17-3-1963	12-11-1963	18	} 0.46	Mean of 10 clumps
16 days	Co. 419	17-3-1963	12-11-1963	18		

Differences not significant

B. Rate of Internode Formation : 1. VARIETIES :

(a) *Internodes in clumps and stalks within clumps of different varieties:* The studies reported under A *i. e.*, internode formation in different varieties, was continued at tri-weekly intervals. The number of internodes per stalk averaged over the clumps and varieties, and the number of internodes per variety, averaged over the stalks and clumps for the three dates of observation are given below.

STALKS/DATE	19—8—1963	9—9—1963	30—9—1963	
Primary	19	22	25	C. D. = 0.3
Secondary	15	18	21	C. D. for inter- action = 0.5
Tertiary	12	14	17	
Mean	15	18	21	
VARIETIES :				
Co. 419	16	19	22	C. D. = 0.3
Co. 449	15	18	21	C. D. for inter- action = 0.9
Co. 658	14	17	20	
Mean	15	18	21	

The internode formation progressed in a regular way at the rate of one internode per week. This rate was kept up in all the three kinds of stalks, as well as in all the three varieties studied.

(b) *Rate of internode formation in varieties differing in thickness and length of internodes:* This study was made with seven varieties (Co. 419, Co. 449, Co. 658, Co. 997, Co. 62010, Co. 62012, Co. 62131) differing in girth and length of internode. Observations were made on the number of internodes formed on four randomly selected clumps at fortnightly intervals during the growth period from 12—10—1964 to 2—3—1965. The mean differences in number of internodes among the intervals proved significant, while the inter-action between varieties and interval did not.

Intervals — Progress of internode formation:

Fortnightly	Date of Planting: 16—5—1964 Dates of observation: From 12—10—1964 (fortnightly)									
	1	2	3	4	5	6	7	8	9	10
Mean no. of internodes	7	9	11	12	14	16	16	18	19	21
C. D. at 5%	0.8									

There was a regular production of two internodes per fortnight except during the interval 3—4 (*i. e.*) in November, 6—7 and 8—9 (*i. e.*) in December and January. These intervals correspond with the periods of lack of sufficient sunlight and temperature due to heavy rains and winter season which probably interferred with the usual rate of one internode formation per week. The absence of interaction effect "variety x interval" clearly shows that the varieties inspite of their variations in internode length, girth, and initial vigour grow at the rate of one internode per week except during short periods of heavy rainfall and cold in winter season.

MANURES: The data on the rate of internode formation in plots treated with different levels of nitrogen are given in Table 3 (a). In an interval of three months, nine internodes have formed uniformly at all levels of N. It therefore follows that one internode for a period of 10 days is formed and that this rate is irrespective of the level of N manuring.

Discussion and Conclusion: It is evident that the number and rate of internode formation is unaffected by the variation in the varieties and methods of cultivation. In other words, the nature and rate of internode formation are practically the same for the different varieties varying in length and thickness of internodes and also under different levels of manures and frequencies of irrigation. The length and girth of internodes on the other hand, invariably get improved upon adopting the improved practices. The individual cane weight increases under the improved methods by increases in the length and thickness of internodes and not by increase in the number of internodes or by an increased rate of joint formation.

It is interesting to note that even under widely varying varietal characteristics or under different levels of nitrogen and frequencies of irrigation (1) the number of internodes formed in canes of the same age is practically same indicating thereby that the cane length and cane weight are dependant on internode length and internode weight and (2) the rate of internode formation is one for every week to ten days.

The above facts are of considerable importance to the cane breeder, to the cane agronomists, as well as the cane grower. That the internode length and girth alone influence the individual weight of cane may be made use of by the cane breeder in breeding varieties, which possess thicker and longer internodes. The cane agronomist should have an eye on the internode content of cane in making selections for high yield besides other factors, and evolve manurial and cultural schedules, which always tend to improve the length and girth of internodes.

The cane grower should always maintain proper environmental conditions which promote the free and full development of internodes which go on with constant regularity, particularly during the growing season.

Summary: Observations made on stalk and internode formation on different varieties and under different environmental conditions revealed (1) In canes of the same age, the number of internodes formed is the same on any given date irrespective of the varieties and levels of manures or frequencies of irrigation, though the length and thickness of the internode may vary according to the variety and the conditions of growth. In other words there is a fixed regularity and periodicity in the production of internode, which is not altered to any great extent irrespective of varieties or conditions of growth except during cold season, indicating thereby that the cane length and cane weight are dependant on internode length and internode weight. (2) The rate of production of internode is one per week to ten days.

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