



Ratooning Sugarcane in Madras.

By R. VASUDEVARAO NAIDU, L. Ag., Assoc., I.A.R.I.

and

M. LAKSHMIKANTHAM, B. Sc. (Agri.),

Agricultural Research Station, Anakapalle.

Introduction. A 'ratoon' can be defined as a crop allowed to grow in the same field from the roots of the previous cane crop without planting seed sets anew. That which immediately succeeds a planted crop is called the first ratoon and these following in subsequent years are designated as 2nd, 3rd or 4th ratoon etc.

Ratooning is an age-old practice in vogue in most of the sugarcane growing countries of the world. (11) Decreased cost of cultivation and early maturity are two of the most important causes that influence a cultivator to ratoon cane. In some countries like Cuba, West Indies and British Guiana, it is reported that even five to six ratoon crops are taken from the same field. (12) According to the Indian Sugar Committee report (1920) ratooning cane was not common in this province except in the Cumbur tank area of the Kurnool district. (16) But the position is now changed and almost all the cane-growing districts of this presidency grow ratoons.

This paper reviews the experiments conducted in the province on this practice, and discusses its effects on the physiology and economics of sugarcane cultivation. We have also indicated the future lines of work that is desirable to follow in ratooning cane.

2. **Extent and importance of ratoons.** The normal area under sugarcane in this province is 125,320 acres. This is about 3% of the total cane area in India. During the past fifteen years the area under improved varieties has increased steadily till it is about 90% of the total sugarcane area in this province.

The varieties from Mauritius and Java which predominated during the earlier years, did not ratoon well and fell easy victims to pests and disease and there were instances of the entire crop being devastated. The introduction of hardy seedling canes from Coimbatore, however, revolutionised the position and has led to the gradual increase in the area under ratoons. Figures presented in the following table illustrate this point.

TABLE I.

Year.	Total area in acres.	Percent area under ratoon (from statistics gathered departmentally)
1931-32	116,105	1.90
1932-33	120,921	2.13
1933-34	121,650	2.22
1934-35	125,310	2.40
1935-36	123,361	3.08
1936-37	119,650	4.28
1937-38	97,965	7.29

1938-39	98,262	10.45		
1939-40	137,633	12.25		
1940-41	161,716	16.47		
1941-42	109,527	8.59	From season and crop report.	
1942-43	121,691	12.48	Do.	Do.
1943-44	154,650	5.83	Do.	Do.

There was a progressive increase till 1939-40 followed by some fluctuations later on in the ratoon area. Nevertheless this practice has come to stay and the usefulness of ratoons is being demonstrated by experiments conducted at Research Stations like Anakapalle.

3. Review of experiments on ratooning. A review was made of all the experiments that had been conducted from 1931 onwards on the ratooning of sugarcane at Anakapalle, Samalkot, Palur and Gudiyattam.

It was evident from this review that experiments on ratoons were not many and that only those conducted in recent years were up to the modern standards of experimentation. Nevertheless the following indications of economic importance can be drawn from these experiments.

(a) *Economics of ratooning* :—

- (i) The popular prejudice that thin canes ratoon better than thick canes was proved to be untenable. Co. 419, a thick cane, was found to be the best ratooner.
- (ii) The actual cost of cultivation was less in the case of ratoons but the cost of production per unit weight of heavy yielding varieties like Co. 419 was almost the same in the case of plant crops as well as first ratoons. What was gained in the cost of cultivation was lost in the outturn per acre and hence the production costs were the same. The cost of production of second ratoons was definitely high and hence it is economical to ratoon cane only for one season.

There are varieties like Co. 421 which are more profitable as ratoons than as plant crops. But taking into consideration both plant crops and ratoons with regard to cost of production as well as yields, Co. 419 is unrivalled by any other variety. Therefore Co. 419 should be preferred for ratooning and this practice should be limited to only one year (first ratoon)

(b) *Physiological effects of ratooning on Sugarcane*

- (i) *Growth* :— Ratoons have an initial advantage over the plant crops, in that they have an established root system and are able to draw sustenance from the soil before plant crops establish well. Hence they show early vigour. But with the break of the South-west monsoon plant crops forge ahead rapidly and outgrow ratoons. The following figures from Anakapalle illustrate this point.

TABLE II. Average Height in inches. Co. 419

Months.	Plant crop.	1940-41		1941-42		1942-43	
		1st Ratoon.	p. c.	1R	2R	p. c.	1R
June	29	30	33	35	34	24	20
July	53	52	56	54	50	48	39
August	75	71	77	73	64	74	63
September	92	88	96	90	78	99	86
October	108	104	113	105	88	105	106
November	-	-	124	117	96	130	114
December	-	-	133	124	104	136	120
January	-	-	-	-	-	141	129

The disparity in heights is also reflected in the millable lengths of canes, as is evidenced by the figures below. There is a progressive decline in the length with the increase in the number of ratoons.

TABLE III. Average length of millable cane in inches. (Anakapalle)

Variety.	1940-41		1941-42		
	P. C.	1R	P. C.	1R	2R
Co. 419	122	122	121	114	112
Co. 421	129	122	118	117	124
Co. 508	108	104	93	82	79
PoJ. 2878	113	109	109	102	101

These results are in conformity with those recorded at Mauritius where ratoons are reported to be "as a rule shorter" than plant crops. (5).

(ii) *Number of canes harvested per acre*:— There is an increase in the number of canes harvested per acre from a ratoon crop, especially, in the case of first ratoons. Varieties which are inherently poor in tillering like Co. 419 and POJ. 2878 will be exceptions to this rule at times. Some of the cane clumps die out in second ratoons. Hence a smaller number of canes are harvested per acre than in first ratoons or plant crops. But even when the canes are more numerous they are shorter than those in plant crops, as mentioned already, and hence lower yields are realised from ratoons.

(iii) *Arrowing*:— Arrowing commences earlier in ratoons than in plant crops. The extent of arrowing is generally more in ratoons. The following results support this conclusion.

Arrowing limits vegetative development and hence must have been a contributory cause for the lower yields registered by ratoons.

(iv) *Juice Quality*:— It is a well-known fact that ratoons mature earlier than plant crops. (11) As mentioned already it is one of the two main causes that induce the cultivator to ratoon cane. Results which are furnished in the following tables confirm this finding.

TABLE IV. Results of chemical analysis of Sugarcane juice.
(Variety Co. 419)

	12th October 1941		10th November 1941		11th December 1941		12th January 1942		26th January 1942						
	Plant crop.	First Ratoon	2nd Ratoon	P.C.	1R	2R	P.c.	1R	2R	P.c.	1R	2R			
Corrected Brix	12.88	13.68	14.18	14.16	16.16	14.18	17.06	16.96	16.56	17.89	19.39	19.09	19.99	20.19	21.09
% Sucrose	8.55	10.16	10.48	11.12	13.09	10.48	14.74	14.89	14.18	15.33	16.83	16.46	17.85	17.84	18.69
% Glucose	-	-	-	-	-	-	-	-	-	0.90	0.87	0.69	0.58	0.71	0.57
Coefficient of Purity	66.37	74.25	73.91	78.54	80.98	73.91	86.42	87.80	85.61	85.69	86.80	86.22	89.06	88.37	88.63

	8th November 1944		5th December 1944		20th January 1945				
	P.c.	1R	2R	P.c.	1R	2R	P.c.	1R	2R
Corrected Brix	16.16	16.56	17.44	19.22	19.45	18.42	18.72	19.42	19.62
% Sucrose	12.96	14.00	14.70	16.70	16.97	16.00	16.04	17.22	17.13
% Glucose	-	-	-	-	-	-	0.98	1.05	1.05
Coefficient of Purity	80.23	84.53	84.29	86.90	87.26	86.86	85.69	88.69	87.30

TABLE V. Percent jaggery recovery on cane weight and yield of Jaggery per Acre.

	1941-42				1943-44			
	Co. 419	Co. 421	Co. 508	PoJ. 2878	Co. 419	Co. 421	Co. 523	Co. 527
	<i>Percent jaggery recovery.</i>							
Plant crop	11.22	11.31	12.00	11.72	11.85	10.98	12.05	11.96
First ratoon	11.78	11.66	14.51	13.31	14.33	11.29	13.42	14.20
Second ratoon	12.22	11.15	12.40	13.06	-	-	-	-
	<i>Yield of jaggery in tons per acre.</i>							
Plant crop.	5.395	4.172	3.659	3.462	6.220	4.209	4.897	5.343
First ratoon	4.591	4.458	3.349	3.477	6.098	4.142	3.886	5.087
Second ratoon	3.684	4.236	2.563	2.426	-	-	-	-

It is seen from table IV that ratoons recorded one to one and half percent more sucrose and 3 to 7% more of coefficient of purity than plant crops. The January analysis figures disclose a tendency for plant crops to register lower glucose percentages. This is in consonance with the results obtained elsewhere. (13) Excessive glucose content in cane juice affects cr. stallisation adversely and to that extent ratooning cane is a disadvantage. The jaggery recovery per cent on cane weight (table IX) was always more in ratoons than in plant crops although the acre yields in terms of jaggery were less.

(v) *Fibre percent cane and recovery of sugar* :— Fibre is defined as the water-insoluble dry matter in cane. This is influenced by the variety of cane, "Seasonal influences under which the crop was produced, class of cane (stand over, plant or ratoons) and the immediate history of the crop (whether green or burnt, period which has elapsed since burning and/or cutting)" (10). The accurate determination of this factor is of fundamental importance to all concerned with the sugar industry since in the sugar recovery formulae, the commercial cane sugar value is influenced by the accuracy of the fibre figure.

Estimation of fibre in plant and ratoon canes was not done separately till now in this province in any of the research stations except at Anakapalle. Even here a beginning was made only during the previous year, but due to the unfortunate break down of the cane shredder, the work had to be given up. Results of experiments done in other places however, point out that ratoons contain more fibre than plant crops. (8)

In the matter of sugar recovery, ratoons are said to be inferior in quality to plant crops (15). This is borne out by the figures of sugar recovery derived while milling on a large scale by four of the sugar factories in this province, and kindly supplied to us. The results are presented below :—

TABLE VI.

Mill.	Variety or varieties.	Months.	Fibre %	Sugar recovery %	
Vuyyur Sugar Factory (1943-44)	Co. 419 and Co. 421 were mixed in about 9:1 ratio	Ratoon	13.34	9.64	
		Plant cane	13.03	9.84	
Indian Sugars & Refineries Ltd. Hospet (1943-44)	Mostly Co. 290.	Ratoon.	November	13.24	9.91
		Plant cane	December	13.44	11.07
			January	12.66	11.28
			February	13.52	11.04

The Etikoppaka Agricultural & Industrial Society Limited (Etikoppaka Sugar factory)	About 80% Co. 419. Ratoon. (100%) .. 83% Co. 419. Ratoon. (94%)	December January	- -	8.9 10.135
Etikoppaka Sugar Factory (Etikoppaka) Vizag District. (1944-45 season)	29% Co. 419 Plant cane 96% Co. 419 .. 100% Co. 419 .. do. ..	February March April May		10.779 9.65 9.00 7.922
The Vizagapatam Sugars & Refinery Limited Thummapala Sugar Factory Thummapala (1944-45)	Co. 419 Ratoon. .. Plant cane			10.11 10.12

(vi) *Susceptibility to pests and diseases.* One of the reasons for discouraging ratooning in sugarcane is the supposed (greater) susceptibility of ratoons to pests and diseases. The susceptibility is ascribed to the lower vigour and the scope for an uninterrupted continuance of the life-cycle of a pest or disease at the same place.

Termites, Mealy bugs, Pyrilla and Moth borers among insects and Red rot, Smut and Mosaic among diseases are most important in this Presidency. Even though the incidence of a particular pest or disease may not kill a plant outright it causes enough damage to the canes to appreciably lower the yield, in terms of cane as well as sugar (18).

Termites (*Odontotermis obesus* R. and *Eutermes hoemi*) attack planted cane sets and eat away the buds and at times the entire inner portion of the setts leaving only the outer rind. Germination will be seriously affected if the infestation is severe (14). Seed sets taken from a crop infected with mealy bugs are reported to record lower germination and produce plants whose subsequent growth is stunted (6).

Pyrilla attack results in the premature yellowing of leaves which affects adversely the normal photosynthetic activity of the plants (14). Even the sound part of a cane infected by borers is said to yield juice four to six units lower in purity than that from healthy canes (9). According to Dr. J. H. Haldane of Messrs. Begg, Sutherland and Company the loss in sucrose due to pests and diseases ranged from 17.3 to 50% in cane supplied to ten of the sugar factories for which figures were furnished. This loss was estimated to amount to Rs. 17,80,000 for a season of five months (15). Among diseases, red-rot is known to have devastated entire plantations. Smut kills the plants outright, as ryots growing second and third ratoons know to their cost. Mosaic is reported to affect thick canes of the *Officinatum* type more adversely than the thin canes. When cent percent of the plants are infected by mosaic a loss in yield amounting to a maximum of 20% (in

thick canes) is reported to occur (4). The quality of the juice, however, is said to remain unaffected. Hence under ordinary conditions where hundred percent infection rarely occurs, Coimbatore varieties, even though susceptible to mosaic, seem to be highly tolerant."

At the Agricultural Research Station, Anakapalle, it was observed that the mealy bug (*Trionymus sacchari*, G.) attack was more severe on ratoons than in plant crops. But the incidence of cane leaf hoppers (*Pyrilla purpusilla*, W.) was greater on plant crops

Argyria sticticrasis, H., *Diatroea venosata*, W. and *Scirpophaga* Sp. F. are the chief borer pests noted in this province. But the first two borers are prevalent on a more extensive scale than the latter. The damage caused by these was estimated at Anakapalle by examining the canes at harvest time and the results are furnished below. (Separate records were not maintained with regard to the extent of attack by each borer.)

Except during 1943-44 plant crops showed a decidedly higher percentage of borer attack both in cane stalks and internodes. This is contrary to the general belief and to the results of some of the experiments (15). Ratoons are more fibrous than plant crops. In this experiment since ratoons and plant crops were randomised and were in close proximity to each other the borers must have preferred less fibrous plant canes to the ratoons. As mentioned already smut, red-rot and the virus disease, mosaic, are the most important diseases that affect sugarcane. No experiments were conducted to determine the comparative resistance or otherwise of plant and ratoon crops to these diseases in this province. But observations go to show that ratoons have a heavier infestation of these diseases. Ratoons are the principal sources of smut infection in this province.

4. Future lines of work. According to Earle "under good average conditions (of crop growth) it costs twice as much or more to produce a ton of plant crop than a ratoon" (7). For achieving the same results here also the cost of production per ton of cane must be considerably lowered. As per the data we have at present, the production costs per ton of plant crop and first ratoon of Co. 419, the most popular cane in this province, are practically equal. This is due to the low outturn (of canes) recorded by ratoons. Hence the yields of ratoons have to be improved by the adoption of proper manurial and cultural practices. Then it may be possible to raise successfully and economically second, third or fourth ratoons as in other countries.

(ii) Properly designed experiments on manuring ratoons giving information on the optimum dose and the economic limit for each locality in the province have yet to be conducted.

(iii) Fibre and C. C. S. estimation of all the important cane varieties have to be made both at the research stations and factory farms to determine the relative merits of ratoons and plant crop in each case.

TABLE VII. Borer attack in plant and ratoon cane.

		1941-42			1943-44			1944-45					
		Co. 419	Co. 421	Co. 508	Po.J. 2878	Co. 419	Co. 421	Co. 523	Co. 419	Co. 421	Co. 523	Co. 527	
		<i>Percentage of canes attacked.</i>											
Plant crop		85.00	82.33	44.67	81.67	73.00	41.67	54.00	38.00	43.00	46.70	46.70	37.70
First ratoon		86.33	62.00	26.33	79.33	57.33	44.33	52.00	42.67	37.70	26.00	39.00	21.70
Second ratoon		82.33	73.00	27.00	72.67	-	-	-	-	38.00	23.00	28.34	22.71
		<i>Percentage of internodes attacked.</i>											
Plant crop		12.87	11.05	3.81	12.00	6.73	3.65	3.81	2.91	5.89	4.37	5.63	5.157
First ratoon		10.69	7.99	1.86	10.20	5.47	3.96	4.70	3.20	3.456	2.434	4.834	1.07
Second ratoon		12.53	7.48	1.49	10.01	-	-	-	-	3.472	2.145	2.472	1.923

(iv) More intensive research on the control of sugarcane pests and diseases is urgently needed. On the practical and successful application of the results of such research depends the future of the sugar industry to a great extent. For instance, liberation of *Trichogramma*, an egg parasite of the moth borers (at the rate of 8000 parasites per acre) was reported to have resulted in an increased yield of $7\frac{1}{2}$ tons of cane in some trials (3). The applicability of this finding on a province wide scale has to be studied in detail.

(v) Indiscriminate burning of cane stubble and trash 'in situ' on the fields is resorted to, at times, by the ryots partly to save the cost of clearing the trash etc. and partly to destroy the pest and disease organisms and thus put a break in the continuity of their life cycle. But, whether the advantage that accrues by the destruction of pests and diseases is real and whether it may not be counter-balanced by the loss not only of valuable humus from the surface soil but also of trash that can be converted into compost for utilisation later on, has to be thoroughly investigated.

(vi) A reliable method for fixation of cane prices (plant and ratoon) has to be worked out in consultation with all the interested elements in the sugar industry. There need be practically no difference in prices paid to plant and first ratoon crops of varieties like Co. 419 and Co. 527; for the cost of production is almost the same and what is lost in sugar recovery is gained by the facilities a ratoon crop offers, for starting crushings earlier.

(vii) The usefulness of selecting seedlings in the first ratoon stage, as is being tried in Mauritius (11) is well worth investigating in this country also.

5. **Acknowledgements.** Our sincere thanks are due to the Government Entomologist and Mycologist who readily supplied us with their reports. Our thanks are also due to the four sugar factories whose figures we have utilised in this publication. Part of the work done at Anakapalle and Gudiyattam and reviewed here was subsidised by the Imperial Council of Agricultural Research, and we take this opportunity to gratefully acknowledge the Council's assistance.

Literature Cited.

1. Annual reports of the Agricultural Research Stations in the Madras Presidency. 1931-32 to 1943-44.
2. Annual reports of the Government Agricultural Chemist, Entomologist and Mycologist 1931-32 to 1940-41.
3. Annual report of the Government Entomologist for the year 1944-45 (unpublished).
4. Chona B. L. (1944) Sugarcane mosaic and its control—Indian Farming Vol. V, No. 4.
5. D. E. Sornay, A. and Mazery, G (1943) Selection of Sugarcane seedlings from first ratoon Populations—*Revue Agricole Maurice*, May-June, pp. 94-101 (Extract from "Sugar", January 1944).
6. Dick, J. (1942) South African Sugar Journal—July 1942. P. 345.
7. Earle, F. S. Sugarcane and its culture (Extract, original not seen).
8. Facts about Sugar. (1939) Volume 34.
9. Haldane, J. H. (1938) Quality of cane in North India in relation to borer infestation. Agriculture and Live stock in India. Vol. 7 Part V, (Extract from Facts about Sugar, Vol. 34; 1939)

10. Korr, H. W. and Cassidy, N. G. (1937) The determination of fibre in cane. Technical communication No. 4. Bureau of Sugar Experimental Stations, Brisbane. (Extract from the *International Sugar Journal*, May 1938).
11. Maxwell, Francis. (1927) Economic aspects of cane sugar production.
12. Noel Deerr. (1911) Cane sugar.
13. Princen Geerligs. (1924) Cane sugar and its manufacture P. 89.
14. Ramakrishna Iyer, T. V. (1940) Handbook of Economic Entomology.
15. Report of the Indian Tariff Board on the Sugar Industry. (1938).
16. Report of the Indian Sugar Committee—(1920).
17. The Indian Sugar Industry Annual (Editor M. P. Gandhi) (1942) The sugar Industry at a glance, P. VIII.
18. The sugarcane Borer. (1941) Farmer's Bulletin No. 1884—U. S. Department of Agriculture.

Potato Growing in the Nilgiris.

By P. A. NATHAN, L. Ag., C. D. H. (Glas.)

and

P. N. NAIR, B. Sc., (Ag.)

Section I. Preface.

Historical. The early history of the potato is shrouded in doubt but the consensus of opinion is that its original home is in the highlands of Peru and Chili in S. America where it still grows wild. It had apparently been under cultivation for many centuries by the natives, when the Spaniards discovered the potato in the neighbourhood of Quito. The natives used the potato in place of bread and generally ate it cooked or made into flour or dried in the sun for preserving it for future use.

Potatoes were first introduced into Spain during the sixteenth century from whence it spread into the other countries of Europe. It is recorded that the colonists from Virginia, under the patronage of Sir Walter Raleigh introduced the potato into Britain in 1586 and was first cultivated on the estates of Sir Walter Raleigh near Cork. The progress of potato growing in England, however, was slow and in 1619 it was mentioned as being among the articles provided for the Royal household. During the reign of James I it was so rare as to be priced at two shillings a pound. By 1633 the Royal Society realised the valuable qualities of potato and took necessary measures to encourage its cultivation. The cultivation however became general only within the last century.

The potato probably was first brought to India from Spain during the seventeenth century. Its present distribution in India is very wide. It is grown in Bihar, Bengal, Bombay and the Punjab. In the South it has extended to Mysore and the adjoining parts of Salem district in Madras, but the Nilgiris District is the main centre of potato cultivation in the Madras Presidency. The other places in the Presidency where the potato is cultivated on an appreciable scale are the agency tracts in the Northern Circars and the hill tracts of Madura district.

It is not known when potato cultivation was started in the Nilgiris but in 1824 Sir Frederick Price recorded that a potato weighing 5 lbs. was raised that year in Mr. Sullivan's garden at Stonehouse Hill. In the Nilgiri