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Sugarcane in Madras State*

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Introduction: It is proposed to review here the salient features of sugarcane research in the State in the last five years. It is not proposed to deal with the advances made elsewhere. The cane cultivators of this State are interested in new varieties, methods of manuring, irrigation, inter-culture and control of pests and diseases. While the cane cultivators of the State have proved their potential ability to achieve very high yields, it was by no means achieved by intimate knowledge of the crop in the field, nor through economic application of manure, water and pest control.

Varieties: The variety Co. 419, which was tested and released more than 15 years ago, continues to be the dominant variety in this State. Varieties Co. 449 and Co. 527, which are also recommended by the Department, for earlier harvests, have spread to a limited extent. Variety Co. 449, is particularly prefered in areas of water scarcity. This variety is hard to break and fairly resistant to smut. A good policy is one of keeping Co. 449 and Co. 527 in a part of the holding, as dependence on a single variety is neither safe nor economic (Dutt. 1954). In the case of factory areas, a fair proportion under these three varieties is recommended to raise the average sugar recovery percent.

In recent times, it has been doubted if the breeding and selection of new varieties have kept pace with the deterioration of the existing varieties of the field and the demands of the industry for higher yields and better quality in cane. (Harban Singh 1954). It is indicated that there is no genetic deterioration in cane. (Patwardhan 1951). Iyer (1951) reported on varietal deterioration by statistical study on yields in Shajahanpur. While it is true that the average yield shows a tendency to drop, it is not attributable to genetic deterioration of the variety. The average yield of the variety Co. 419 in Anakapalle Research Station, has dropped from 55 tons cane per acre to less than 40 tons only. In 1951—1952 when the crop was given 375 lb. nitrogen per acre as against the usual lower dose, the yield shot upto 63 tons cane per acre from the low yield of 40 tons. In the yield competitions, ryots have achieved yields of nearly 100 tons cane per acre with as little as 150 lb.

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nitrogen per acre. The falling yields in the Pugalur sugar factory zone was pulled up in one season by better cultural treatment to the crop. It is therefore for detailed examination what aspect in the treatment of the crop contributes to this fall in yield. Dutt (1950) pointed out that our canes are not poor in quality. The average yield of cane for the competitors in prize competitions scheme was 75·1 tons in 1951—'52 and 79·22 tons in 1952—'53. The change in the cultural practices in the cane development centres has brought about increase in yield from 27 tons to 33 tons of cane per acre and by adopting earlier planting both yield and quality improved.

One may express disappointment that no new variety was released for cultivation in the last one decade. The variety Co. 419 has set up, very high standard for yield. The data in table 1 indicate that some varieties proved to be better in yield or quality than Co. 419, but they could not be consistently better that Co. 419 in respect of both.

TABLE I.

Comparison of Co. 419 with other varieties under test.

Year	Variety	Yield in tons cane per acre	Sucrose % in juice	Purity % in juice
1943—1944	Co. 419	31·80	18·91	91·75
	Co. 449	36·64	20·06	93·78
1944—1945	Co. 419	27·75	17·30	88·67
	Co. 449	30 98	19·66	92·49
1945—1946	Co. 419	45·72	17·51	88·93
1946—1947	Co. 419	29·61	19·63	95·68
	Co. 467	48·71	18·95	91·12
1947—1948	Co. 419	20·57	17·59	91·49
	Co. 467	26·74	17·82	86·56
1948—1949	Co. 419	35·84	19·24	89·74
	Co. 467	42·63	18·50	89·21
1949—1950	Co. 419	39·21	19·21	94·34
	Co. 467	40·60	18·52	92·15
1950—1951	Co. 419	38·02	16·56	82·83
	Co. 467	42·36	17·89	86·36
1951—1952	Co. 419	37·83	14·01	78·22
	Co. 620	36·59	19·44	92·98
1952—1953	Co. 419	30·60	15 83	83·26
	Co. 630	27·90	18·09	87·22
1953—1954	Co. 419	39·30	15·48	94·38
	Co. 620	32·54	18·75	87·98

The three standard varieties Co. 419, Co. 449 and Co. 527, can still hold the field and what is needed is a proper schedule of cultivation in order to achieve maximum yields.

That yields in this State are not so poor as is generally believed to be is indicated in table 2.

TABLE 2.

Comparative yield data for different countries.

Name of the Country	Yield of cane in tons/acre	Sugar recovery %	Yield sugar tons/acre
Cuba ...	17·12	12·25	2·050
Lousiana ...	19·84	8·06	1·602
Puerto-Rico ...	24·16	12·23	2·956
Hawaii ...	62·05	10·46	6·480*
Mauritius ...	19·63	12·08	2·370
Java ...	56·20	11·49	6·440
Formosa	28·27	12·93	3·657
Australia ...	21·34	14·33	3·060
India ...	14·70	9·50	1·394
Uttar Pradesh ...	18·40	9·78	1·800
Bihar ...	16·10	10·10	1·626
Bombay ...	40·50	11·59	4·694**
Madras ...	33·50	9·39	3·146

* Duration of crop 20 to 22 months.

** Larger proportion of crop being Adsali (18 months).

Lakshmikantham (1951) reported that Co. 419, is superior even to the varieties of Hawaii in respect of nitrogen utilisation. It may therefore be stated that the variety of cane in Madras is capable of high yield consistant with quality and hence high yield of sugar per acre is yet attainable. The general average yield is low due to the small ryots not having the timely credit facilities for intensive cultivation.

Manuring: Next to variety, manure plays the largest role in increasing production. As in other countries, largest response is for nitrogenous manures and as such, this item received the largest attention in recent years (Lakshmikantham et al 1949. Lakshmikantham 1952. Parthasarathi 1952). Optimum dose of nitrogen

based on regional tests have been prescribed. Detailed studies on release of nitrogen by the soil and uptake by the plant have been carried out at Anakapalle (Mohanrao and Narasimhan 1951). These studies revealed that fertilisation at planting is not reflected in foliar nitrogen and that the initial nitrogen of the soil is high enough for the germination stage. The first half dose is recommended to be applied at forty five days after planting. These studies also revealed that after September-October the plants are not capable of utilising the applied nitrogen as efficiently as in earlier months. The late application of nitrogen which is sometimes practised by the ryots, is not fully utilised. For a normal crop the leaf nitrogen level is fixed at 2·1% while that at deficiency level is 1·7%. Studies at Anakapalle revealed the immediate possibility of applying the foliar diagnosis technique on an extended scale. Parthasarathi and Lakshmikantham (1951) have pointed out that Co. 419 is more efficient in utilising the applied nitrogen than Co. 527. Similar results have been recorded by Davidson (1953).

Detailed studies were again conducted in recent years regarding the time of application of manures, (Parthasarathi and Lakshmikantham 1953). Application in two doses is found to be preferable. If for any reason, application in one dose is necessitated, it should be done as early as possible, but not later than June. Such single application is generally necessitated in deltas where irrigation water is not available in the months immediately after planting. Application of the second dose of nitrogen late in the season, depresses juice quality particularly in early harvests. First ratoon crop requires additional manuring of about 50 lb. nitrogen per acre to pull up the yields (Seetharamiah 1952).

Form of nitrogen is an important aspect of nitrogenous manures. This is well recognised by all the ryots. A mixture of cake and Ammonium sulphate in ratios varying from 1 : 1 to 2 : 1, may be applied. An important finding in this regard is that the form of nitrogen depends upon moisture availability in the soil. Under drought conditions organic nitrogen is more suited than the inorganic. Conversely, under plentiful soil moisture, ammonium sulphate is better than cake, (Ramarao 1953). Even on equal nitrogen basis, the organic manures are better in respect of juice quality while the inorganics are better in increasing the yields. The foliar diagnosis studies indicate less uptake nitrogen from bulky organic manures like farm yard manure.

Detailed investigations were carried out at Anakapalle in respect of nitrogen nutrition in different soil types. (Ramrao 1954). Loamy soils yield more per unit of the applied nitrogen, though the clayey soil is inherently richer in nitrogen content. The nitrogen content of the plant tissues of the crop raised in clayey soils is greater than those from the loamy soils. These data indicate that both uptake from the soil and the utilisation of the stored nitrogen of the tissues are poor in clayey soils than in loamy soils. This is indicated to be due to the difficulty with which the soil moisture from heavy soils becomes available to the plant as compared to that from lighter soils.

Harvest of sugarcane at 12 months is not a correct harvest schedule (Parthasarathi 1954). Combination of correct varietal schedule and age at harvest for each month, is needed to pull up sugar recovery percent.

Irrigation: The water requirement of the crop has been again recently studied and reported (Parthasarathi and Thirumalrao, 1951, Parthasarathi et al 1951). That application of excess water is not beneficial has been emphasised. Application of excess water even in early phase leads to condition equivalent to low application of nitrogen. Profuse watering hastens maturity and increases arrowing. For Gudiyattam heavy rainfall in July-August is seen to increase arrowing in the crop. (Parthasarathi and Jagannatharao 1954). Advantages of controlled irrigation have been tested at Anakapalle and Gudiyattam and demonstrated in the liaison farms at Nellikuppam. Profuse irrigation to start the crop, limited irrigation during the growth phase and long intervals with stoppage prior to harvest are beneficial for high sugar yields per acre.

When swampiness in soils is created during active growth phase, it hastens ripening. But analysis of juice indicated high organic non-sugars, non-protein nitrogen and low phosphate content (Mohanrao and Anji Reddy 1951).

In Hawaii, soil moisture, day-degrees and moisture of young leaf, leaf sheath are taken as guide for irrigation, (Baver and Humbert 1953). Irrigation is adjusted seven months prior to harvest, even though ripening of cane does not seem to commence then. Moisture of young leaf sheath is gradually brought down to 74% at harvest. It has been shown from the studies at Anakapaalle that the tissue moisture has a basic relation to the sucrose content of the plant (Parthasarathi and Rama Rao 1951), and this was

further confirmed by Rama Rao (1954), who reported a high negative correlation of —0·96, which seems to hold good under varied conditions.

After cultivation: The most important inter-culture operation is propping of cane. This operation costs nearly Rs. 300 to 350 per acre in the Circar Districts. Both the Indian Sugar Committee (1920) and Venkataraman Committee (1950) were impressed with the increase in yield of 10–15 tons, but at the same time emphasised the need to reduce costs. Experiments on wrapping and propping were conducted in the State, bnt the local bamboo propping was found to be the best (Lakshmikantham 1950). The need for bamboo propping in the northern coastal areas was believed to be due to the soil type and periodical cyclonic winds. In the past experiments at Samalkot, trench planting was found to lessen lodging but this method of planting was not tried with less costly method of propping. The surface planting in beds and the brittle nature of the variety under cultivation are the two major causes for the ryots resorting to costly and laborious bamboo propping. Parthasarathi and Reddy (1951) reported on a cheaper method of trash propping. Recent trials at Anakapalle and Samalkot indicated that combined with trench planting and trash propping cane cultivation is feasible in these areas with greater net profit per acre and less cost of production per ton of cane. Even in Southern Districts, this cheap method of propping is found to add 3 to 5 tons of cane per acre, facilitate irrigation in late phase and also facilitate clean cultivation and quicker harvest. It is necessary to select varieties which resist and also which do not break or deteriorate on lodging. Recent investigation at Gudiyattam (Vaidyanathan 1954), indicated that loss due to lodging is very small in Co. 499 as compared to that in Co. 419. Not only this variety is hard to break, but also the deterioration of juice in lodged canes is smaller as compared to that in Co. 419.

Pests and Diseases: Accurate estimates of loss due to pests and diseases were not made up for in this country. For example, it was widely believed that the early shoot borer is beneficial in increasing tillering and the smut causes heavy depression in juice quality. Investigation at Anakapalli (Ramachandrachari 1952, Parthasarathi et al 1953), clearly indicate the complex nature of loss due to borers and that the extent of loss is not indicated by mere borer infestation. The stage of crop at which infestation occurs and the month of infestation are both important. Usually, the infestation

is the heaviest in the month of May. When the infestation occurs in the early stages of the crop though there is apparent tillering the number of tillers per clump that is harvested is 2·57 for Co. 419 infested as against 2.95 of healthy; for infested Co. 475, it is 2.94 as against 2.45 of healthy. Apart from this reduction in survival, the weight of shoots that come to harvest from infested clumps was also reduced by 35.62% in Co. 419 and 28.25% in Co. 475 and variations in weight in respect of month of infestation was also noted. Therefore it is worthwhile to spend a fourth or a fifth of the estimated crop yield in controlling early shoot borer which is a serious pest in this State. Among the diseases, smut is of foremost importance. Detailed investigations on the growth and development of smutted clumps were made. It is usually interpreted that smut whip is a floral stalk. At Anakapalli precocious flowering in about 11 weeks age and in the month of July, was recorded, due to infestion of smut. But smut whips appear even in the germinating bud. It is too early for the shoot to form even floral premordia in its terminal growing point. Subramanyam et al (1951) indicated that the habit of the fungus to sporulate profusely and piling up spores might be responsible for the production of the whip and not precocious arrowing, which latter is impossible at such early stage in the development of the bud. The losses due to smut were also carefully estimated in plant and ratoon cane (Parthasarathi et al 1952). It is true that when the smut whips appears at the top of a grown up cane, loss in weight and juice quality are heavy. Studies on apparently healthy canes of smutted clumps, indicated that loss in weight of such shoots may be of the order of 47—51% as compared to canes of healthy shoots and that less in juice quality of such shoots is practically nil. Here again, the loss in weight of shoots and total loss from the crop will depend upon the time of infection. In cases of early infestation, total loss of clumps is common and more shoots die. June, July, August are the months of heavy Infections for the main season crop.

	Smutted.	*Healthy.*
Mean number of millable canes per clump.	3.15	5.56
Mean weight of millable canes per slump. (lb)	6.38	13.11
Average weight of single cane in pound	2.25	2.07
% loss in weight.	48	...
Sucrose % in juice.	17.64	17.38

It is therefore clear that loss in yield is far more than in loss in quality and the habit of sugar factories to point their fingers to presence of smut for poor sugar recovery percent is not altogether correct.

Studies in Gur: After Varahalu (1933, 1937), very little work on qualities of gur was done in this State. Recently, the chemical composition of juice and its relation to qualities of gur was investigated at Anakapalli (Mohan Rao, Narasimhan et al 1951, Mohan Rao, Anji Reddy 1951). In respect of the two varieties Co. 419, and Co. 527, it was noted that in the juice of Co. 527, which generally yields better quality gur, organic non-sugars, total and non protein nitrogen are lower and phosphate content higher than in the juice of Co. 419. When nitrogenous fertilisers are increased, organic non-sugars, colloids and pectins are increased, and phosphate reduced in the juice. Total and non-protein nitrogen also are increased as also the proportion of non-protein nitrogen to total nitrogen. In juices of immature canes, nitrogen and glucose are predominantly great. In canes raised under swamp conditions, organic non-sugars non-protein nitrogen and low phosphate are responsible for the resulting bad gur (Mohan Rao and Narasimhan–1951).

Studies at Anakapalli and Gudiyattam were couducted to standardise the use of lime as clarificant in gur making. It is well known that immature and deteriorating juices require more lime than for the juice at peak maturity stage. When the pH., level of the juice was studied, pH. 6.1 was found to be the optimum after clarification. At higher pH. level, the gur is harder but darkened, at lower levels the colour is better, but gur softened. Addition of superphosphate as a second clarificant after lime, invariably softens gur, but improves colour.

Clarification with juice of bendi plant (Hibscus esculentus) alone is the best when the crop is in peak maturity. In earlier stages combination of lime and bendi juice appears to be preferable. Hydros (Sodium hydrogen sulphite) improve colour very much, but it imparts pungency to taste. The deterioration both in colour and consistency are quicker and greater, when it is used as clarificant. Since colour of gur commands the highest premium in the market and not consistency, the use of hydros is widespread. The cause for rapid deterioration of colour in storage is a sunject of importance for further investigation.

Special types of godowns for storing gur are in vogue in Godavari District (Parthasarathi et al 1950). Each godown is capable of storing 50 to 100 tons gur and over 12,000 tons of gur are stored every year in these districts. These godowns are smoked to warm and dry up the internal atmosphere. The gur keeps condition for over one year. The commercial utility of the godowns is already well established in practice.

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