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SUGARCANE GROWING IN THE TANJORE DELTA

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Introduction. When the price of paddy, the only staple crop of the njore delta, began to fall steeply in 1930, the Agricultural Research Station, Aduturai took up the trial of other crops than paddy in the wetlands from 1931 onwards so that the experience gained in growing them and the results obtained may be passed on in time to the *mirasdars* of the delta. Among the crops tried, sugarcane was one of the most important and it is proposed to give in this paper an idea of the methods adopted in growing this crop successfully on this station during the past six seasons. Neither the station staff nor the vast majority of the *mirasdars* of the delta had any previous experience of growing sugarcane in the paddy lands of this delta.

Choice of land. The question of choice of fields for growing sugarcane is of very vital importance in a delta tract with very poor natural facilities for surface as well as sub-soil drainage, as the absence of such facilities really precludes the possibility of growing canes successfully in a vast majority of the area in this delta. Out of a million acres of paddy land in the old delta, not more than 50,000 acres would be suitable for canes. But considering the few hundred acres that are under canes at the moment, 50,000 acres is a very large area, indeed, for future expansion of cane cultivation in the tract. If a careful search is made it should be possible for every *mirasdar* to select a few fields that are higher in level and better drained than the other fields in the holding. Such fields should invariably be selected for growing canes as canes refuse to grow normally in badly drained or water-logged soils.

Preliminary Cultivation. (1) *Ploughing*:—Soon after the harvest of the paddy crop in February the fields should be ploughed twice before the soil loses moisture and dries up too hard for working the plough. It is of course not an easy matter to plough the fields after harvest and get good tilth because of the waxy nature of the soil. But this procedure is far better than digging trenches for planting in an unploughed field as it has been found from experience that such fields are badly infested with weeds and are costly to maintain. In case it is not possible for any reason to plough the fields immediately after harvest, ploughing should be done soon after

a soaking rain if one is received before trenches are dug for planting. Ploughing in dry fields after a rain invariably produces excellent tilth in the heavy soils of the delta.

(2) *Trenching*:—Trenches for planting should be 15 inches broad and 1 foot deep when finished and 3 feet apart from centre to centre as it has been found that canes planted 3 feet apart in lines allow of the usual operations, e. g. weeding, manuring, earthing up, trashing and propping being done conveniently. In the first five years trenches were dug by hand labour and if the soil is fairly good tilth it takes from 25 to 30 men to do an acre. During 1936 and 1937 seasons, a double mould board plough was used to make the trenches and with a pair of animals this plough is capable of finishing 25 cents in a day of 8 hours. To get the trenches straight, ropes are laid 3 feet apart and the straight line marked at intervals of say, 10 feet, with twigs and the ropes removed before the plough is worked. With this device it is possible to get very straight trenches. By using a double mould-board plough it is possible to bring down the cost of trenching by 50 per-cent but this implement can be used only in previously ploughed fields. After the trenches are prepared, the bottom of each trench should be dug loose to a depth of 6 inches and left exposed for a few days before cattle manure is applied.

(3) *Manuring*:—A dose of 20 cartloads of well-rotted cattle manure or Indore compost per acre is applied to the trenches and the manure is well dug in a few days before planting. Care should be taken that undecomposed straw or other vegetable remains are not applied to a cane field, as such materials would attract white ants which later on would attack the cane setts and young canes in turn and kill them out in numbers

As it is generally believed that phosphatic manuring has influence on the setting qualities of jaggery, bonemeal at the rate of 200 lbs. per acre is dug in along with the cattle manure. No other manure is applied before planting. It is a good plan to sow a crop of sunhemp on the crest of the ridges separating the rows of young canes. It was found from experience that this crop is best sown immediately after the first weeding, say a month after planting the cane setts. Both the cane and the green manure crop get ideal conditions for growth after this first hoeing. Within 40 to 45 days the sunnhemp would have attained its maximum growth when it is pulled out and applied to the cane crop by laying the plants along and close to the cane rows. 3,000 lbs. of this green manure has been found to be a fairly good dose per acre. Before earthing up and covering the green manure a dose of 500 lbs. of groundnut cake and 100 lbs. of ammonium sulphate is applied on this as a top dressing. After this, the young cane is earthed up on either side covering the manures in the operation. No further dose of manure is given thereafter, though a second weeding and earthing up are given to the crop generally in its fourth month.

Planting. Before actually planting the setts it is found better to flood and soak the trenches 5 to 6 hours in advance to break down the hard

clods and produce a soft puddle to allow of the setts being gently pressed down. When the water in the trenches has fully soaked down, cane setts with 3 buds or eyes are laid in a line along the centre of each trench with buds pointing sideways and ends of setts touching each other. The setts are then gently pressed down to a depth of 1 to 2 inches so as to have a thin layer of soil on the top of the setts. As planting is usually done in the height of summer, it is essential that the setts should be protected by a layer of soil as otherwise the exposed setts would be affected by the direct rays of the sun and killed. This precaution is not very essential when planting is done during the rainy season. It is a good plan always to dip the setts for 5 minutes in Bordeaux mixture to kill out fungus spores and mealy bugs. The number of setts required for planting an acre varies from 11,000 to 15,000 setts, depending upon the internodal lengths of the variety used.

Besides cane setts, tops of canes also can be used for planting and, in planting tops it is better to thrust the cut ends into the soil in such a way that the planted top makes an angle of 30° with the soil surface. It may be stated as a general rule that the younger a cane or part of a cane the better it would be for use as planting material. When setts are taken from a fully mature cane, the top half of the cane yields the best setts. If whole canes are to be used for setts, it should be from a crop that is 6 or 7 months old. From the trials carried out on the station, it has been found that the best sett for use is the sett immediately below the top. Cane tops though they give good germination have certain drawbacks which setts have not. They easily carry over insect pests without a chance of detection, particularly borers from the old crop to the new. Besides, as they are planted in a slanting position, canes developing from the buds at different levels have not the same anchorage as those developing from a sett laid flat and pressed into soil. There is also a general belief that canes arising from tops are the first to flower though this point has not been experimentally tested. Another defect noticed is that some of the developing buds find it difficult to come out through the leaf sheaths and require to be released by removing the leaves. Such buds get etiolated by remaining long inside the sheath and lack vigour.

Planting season From the results obtained by planting canes during every month of the year continuously for two years, the favourable season for planting canes in this delta has been found to be from January to May, the best months being March and April. January and February are early for planting because of the difficulty of preparing the fields satisfactorily immediately after harvest, though early planting gives the crop a longer period of active growth before the North East monsoon rains begin. The general experience is that a cane should have finished at least six months of vigorous growth before fields get water-logged from the heavy rains of the North East monsoon from the middle of October and before the mild spell of cold weather begins in November, as canes slow down considerably their rate of growth from the middle of October to the middle of January,

Thereafter with the advent of the bright weather, some growth takes place though not very appreciable before the canes begin to mature fast. That it is water-logging more than the cold weather that is responsible for the slowing down of growth is evident from the fairly good growth canes planted in dry lands make even during the rainy or the cold season. So to get the best results, planting should be begun from the middle of March and finished before the middle of May at the latest.

Irrigation. The irrigation season for the Cauvery delta begins from the middle of June when water is let down from the Stanley lake at Mettur for starting the cultivation of paddy. This water is available till the end of January of the following year. So from February to the middle of June water is not available from this irrigation source for the cane crop, though unfortunately it is during this period that cane crop requires the help of artificial irrigation most as it happens to be the season of severe hot weather and of very scanty and undependable rainfall. So lift irrigation of some kind is absolutely essential both for planting a new crop or for ripening an old one from February to June. Though the water table in the delta is very high, underground or sub-artesian springs are very weak, so much so that the recuperative power of wells after pumping out a supply is very poor. To give an example a 15 feet diameter well with 15 feet of water and 2 bore holes giving 40 gallons per minute on the station is pumped dry by a 7-horse power engine and 3" pump within 1 to $1\frac{1}{2}$ hours and it takes more than 12 hours for this well to recoup the supply. But with the help of even such a poor well it should be possible to cultivate 5 acres of cane by careful adjustment of planting. Wherever conditions are more favourable with better sources of supply either from wells or tanks or rivers, it should be possible to command a much larger area. In the absense of good artesian springs, it is not known whether it would be possible to instal electrically operated bore well pumps as has been done quite successfully in the United Provinces. It is a subject worth investigation by the Industries and the Electrical Departments of the Government, as Tanjore District is already getting power from Pykara.

The number of irrigations that a cane crop should receive depends upon the quantity and distribution of rainfall. It has been found from experience that on an average 4 irrigations are essential for sprouting the crop after planting as the germination of a cane crop is not finished before the end of the third week after planting. As the stiff clay soil overlying the cane sett bakes too hard and hinders the young sprout freely emerging it is necessary and better to give more light irrigations at short intervals than heavy irrigations at longer intervals during the sprouting period as they help to keep the top soil moist for the sprout to emerge freely. Moreover there is no necessity for heavy irrigations for a crop that is just planted as the root zone is at this stage very narrow and shallow. The intervals between the sprout irrigations may roughly be as given below. The first irrigation on the 4th day after planting, second on the 10th, third on the

16th and the fourth on the 22nd day. Thereafter the irrigation may be once in 12 to 15 days in the absence of rain. Assuming that a crop is planted in the middle of March, at least half a dozen lift irrigations would be necessary before the receipt of channel water in the middle of June and allowing for summer rainfall. From the middle of June to the end of September water is plentiful in the channel and there may be necessity for 4 heavy irrigations during this period. Thereafter the crop gets the N. E. monsoon and there will be no necessity for irrigation. On the other hand the problem will be to drain the excess rain water from the fields in order to keep the crop healthy. In the case of canes like Co. 281, Co. 285, sorghum hybrids and similar ones that mature within $8\frac{1}{2}$ to $10\frac{1}{2}$ months, no further irrigations may be found necessary before the crop is harvested for milling. But canes of longer duration would require at least 3 or 4 irrigations to mature the crop from February to April the number depending upon the ripening period of the variety concerned.

Drainage. The question of drainage in a cane field should receive special attention, particularly during the continuous wet weather during the north-east monsoon rains. Cane fields should be free of stagnant water as far as possible, as otherwise the crop does not grow and becomes pale and sickly in appearance. Under such conditions fungoid diseases, particularly "red-rot" will have very favourable opportunities for development. It is better to provide drainage channels all round a cane field and connect them with the big drainage or storm water channel running through a holding so that there is no scope for rain water to remain in the cane field unduly long. These drains should be cleared of obstructions frequently to keep them always trim and serviceable.

After Cultivation. (1) *Hoeing and weeding.* When the swamp paddy fields are converted into temporary garden lands to grow other crops than paddy, weeds take advantage of the conditions to grow along with the crop and smother any young crop whether cane, soy bean, cotton or ground-nut, if early precautions are not taken to hoe out the weeds. Nut-grass is the most pernicious of these troublesome weeds and defies total extinction despite all efforts at its removal. So one ought not to neglect weeding a young cane crop early enough. During the fourth week after planting a cane crop, the first weeding should be given as by that time most of the active buds should have sent out sprouts and the period of danger of injury to the hidden buds would have almost passed. The first weeding is better done by women with the small hand hoes as mammatty hoeing by men may cover up a large number of young sprouts with earth, though it is claimed that cane borers are kept under check by earthing up a cane crop as early as possible. When the crop is 2 months old a second weeding combined with a mammatty-hoeing may be given, provided no green manure crop of sunnhemp had been intersown just after the first weeding. If a green manure crop is grown, this hoeing and weeding and first earthing up can be combined into one operation when the green manure is applied to the

crop in the third month. It is possible to intercultivate the crop with a plough like Cooper No. 11 instead of hand hoeing.

(2) *Earthing up.* In the beginning of the third month young canes can be given the first earthing up. In this operation the rings dividing the cane rows is broken up and the earth so obtained is used for filling the cane trenches and forming a sloping ridge on either side of the canerow so that the canes now occupy a ridge and the interspace between rows of canes becomes a trench to serve both as drains for storm water and furrows for irrigation. A second and final earthing up is given to the crop at the end of the fourth month or in the beginning of the fifth month. The earthing-up can be performed by a double mould-board plough after breaking up the ridges with an iron plough, the finishing touches alone being given by men with mammatties. Hardly any injury is done to the crop if the operation is done before cane formation has not progressed far.

(3) *Trashing.* The removal of old or dried up leaves from a cane crop is known as trashing. When the cane crop is in its seventh month that is just before the heavy North-east monsoon starts, a trashing can be given as it will avoid rain water stagnating inside the axils of leaves and thus prevent the sprouting of dormant buds or eyes. Insects like scales, nymphs of cane flies and mealy bugs are also removed in trashing. After trashing, a cane crop looks very neat and one is able to judge more accurately the development of millable cane and to estimate the tonnage. The whole crop gets better aerated also. Another advantage in removing the cane trash just at the start of the monsoon is that it can be immediately made into Indore compost heaps for quick decomposition into manure with the help of unfailing rains at this time of the year.

(4) *Propping.* As the Tanjore delta with the rest of the East coast of the Peninsula is subject to cyclonic weather of greater or less intensity every year, particularly during the North-east monsoon months from October to January, cane crops are liable to lodge badly. Another factor which helps the canes to lodge easily is the extremely wet nature of the soil during this period which makes soil round the cane roots loose. Lodged canes have been noted to be higher in glucose content and poorer in sucrose. Jaggery from such canes does not set well because of the high glucose content. Propping of canes is done on the station by a double strand of wire made to pass along each row of cane in a series of figures of eight enclosing a clump of cane in each half of a figure of eight and securely tying the ends of the wire to horizontal bamboo props running along the margins of the cane field and at right angles to the cane rows. If the cane rows are long, one or more rows of horizontal bamboo props will have to be erected inside the cane field to prevent the wire from sagging and giving way. Spacing the horizontal bamboo props 25 feet apart has been found to secure the canes well and prevent their lodging.

Maturity of canes. Each variety of cane has its own duration of growth and maturity. The local Nanal canes mature in 8 to 8½ months, the sorghum

hybrid canes are the next to mature, Co. 351, 352, and 357 maturing within $8\frac{1}{2}$ to $9\frac{1}{2}$ months, Co. 353 in 9 to 10 months and Co. 355 within $9\frac{1}{2}$ to $10\frac{1}{2}$ months, Co. 285 within 10 to 11 months, Co. 218, 214 and 290 within 11 to 12 months. Among the thick canes Fiji B is the earliest to mature within 10 to 11 months, while all the other canes like Co. 365, 364, 400, 402, 404, 408, 417, 419, 421 and P. O. J. 2878 take between 11 to 12 months to mature while J. 247 takes between 12 to 13 months to do so. These durations are with regard to the conditions obtaining in this delta and are only approximate. Heavy manuring, particularly nitrogenous manuring is known to delay the ripening of a cane crop. The exact time for the harvest of a cane crop to get the maximum quantity of sugar or well-set jaggery has to be found out by taking Brixometer readings of cane juice of whole canes as well as juice extracted separately from the bottom halves and top halves of canes as the bottom half of a cane matures earlier than the top half. When the ratio of readings taken of top and bottom juice is 1 : 1 or in its neighbourhood, the cane can be considered as mature for harvest. A practical method which any *mirasdar* can easily carry out is actual trial boilings of juices at weekly intervals and thus time the harvest when jaggery begins to set well. When this stage is reached the aim should be to harvest and crush the canes within the shortest possible period as delay in harvesting may again spoil the chances of getting good jaggery, by over-aging of the canes.

Flowering or 'arrowing' in canes. There are certain varieties of canes that flower freely while there are others which fail to do so. 'Arrowing' is the term more frequently used for flowering in cane. People generally believe that immediately a cane sends forth its flower it is mature and ready for harvest. It is not so. From the observations made on this station during the past six seasons, it has been found that canes planted from January to the end of April or even till the middle of May invariably come into flower during the second half of October, irrespective of the date of planting. So the flowering of canes in this tract is governed more by the season than by the age of the crop. The same varieties when planted after May fail to flower in October and may make a feeble attempt at flowering in December-January. From a series of periodical chemical analysis of flowered canes carried out by the Government Agricultural Chemist at Coimbatore during more than one season it has been found that it takes at least 2 months more for such canes to mature or to begin to deteriorate in sugar content. This period should be longer in this delta and widely varying because of the season-fixed nature of flowering in October of every year, of canes planted any day after January and before June. The canes that regularly arrow on this station are Co. 218, Co. 281, Co. 213, Co. 285, Co. 351, Co. 352, Co. 353, and Co. 355.

Harvesting. The harvesting of cane can be done either with the help of an ordinary mammatty or special cane knives. In harvesting, care should be taken to cut the cane as close to the ground as possible so that very little of the millable canes are left behind. It may be worth while even to include

2 or 3 inch lengths of cane below the ground level, if such portions can easily be cleared of adhering roots and earth. The cane is stripped of all the old leaves till the whorls of leaves at the top are reached. These leaves are not easy to strip and so the top of the cane is cut off and the cane sent to the mill for crushing. Canes should be milled and converted into jaggery or sugar immediately after harvest, as otherwise harvested canes particularly in the hot months, begin to deteriorate. So the quantity of cane to be harvested should depend upon the capacity of the mill and the boiling equiments. Four to five boilings can be conveniently taken in a day of 8 to 10 hours and would consume about 1 to 1½ tons of cane. Thus a 30 ton cane crop in an acre would take about 20 days to harvest and mill, with a bullock driven mill. If canes are sent to a factory, any area can be cut and despatched, depending upon the labour and transport facilities available each day.

Yield. The yield of cane crop depends on the variety, the soil conditions and treatment given to it. Under the treatment given and the conditions prevailing at the Aduturai Station, the following may be given as the average yields of the various canes so far grown. The maximum yield given by some of the canes are also given, so that one may be aware of the potentialities of each variety when grown under favourable weather and other conditions.

Statement showing yields of cane crops.

Variety.	Planted crop		Ratoon crop
	Average yield per acre in tons.	Maximum yield per acre in tons.	Yield per acre in tons.
Thin Canes			
Reed cane.	15·0	18·0	18·0
Co. 213	28 0	33·3	21·8
,, 214	,,	26·3	—
,, 281	30·0	37·3	23·6
,, 285	30·0	39 9	27·1
,, 290	28·0	41·7	25·3
Sorghum Hybrids.			
Co. 351	25 0	—	34·4
,, 352	28·0	—	40·9
,, 353	30·0	—	40 0
,, 355	30·0	—	36·8
,, 357	25·0	—	29·1
Thick Canes.			
Co. 363	35·0	43·8	—
,, 364	35 0	—	—
,, 400	32·0	35·1	—
,, 402	35 0	44·6	—
,, 404	30 0	40·3	—
,, 407	32·0	42·5	—
,, 408	30·0	33·1	—
,, 413	*	45·8	—
,, 416	*	45·3	—
,, 417	*	29·2	—
,, 419	*	61·6	—
,, 421	*	57·1	—
J. 247	32 0	38·3	—
POJ. 2878	35 0	40 0	—
Fiji B	30·0	—	—

* Grown for the first time in bulk.

Ratooning. Canes were ratooned on the station every year and from the results obtained, it may be stated that generally speaking, thin canes particularly Co. 281, 285, 290 and 213 and sorghum hybrids ratoon well. The yield of a ratoon crop has averaged between 20 to 25 tons while in 1936-37, ratoons of some sorghum hybrids touched 40 tons. It is not advisable to ratoon canes more than once for various reasons, particularly for fear of diseases and insects getting a firmer hold of such crops.

Canes suitable for the delta. Co. 281 has been found to be the best all round cane for the conditions of this delta. It matures fairly early, gives fair tonnage, is highly priced for both jaggery and sugar making, and withstands water stagnation remarkably well. For these reasons, this cane is the one that has been keenly taken up by the cultivators in this delta. Co. 285 also grows equally well, resists water stagnation and equals or even excels Co. 281 in tonnage but it is not in favour with the *mirasdar* or the factory as it is very hard to trash, and very difficult to crush because of the extreme hardness of the rind and consequently never gives more than 60% extraction. Fiji B (Badila) is a cane that does well under local conditions but such conditions are rather difficult to obtain. Among the sorghum canes, Co. 353 is fairly early, grows better and gives fair tonnage. Co. 351, 352 and 357 are early but the tonnage is not high. Among the thick canes Co. 419 seems to be the most promising cane, closely followed by Co. 421. Other thick canes that are of promise are Co. 363, 364, 402, 417 and POJ 2878.

Fungoid and virus diseases of Canes. Red rot *(Colletotrichum falcatum)* and Smut *(Ustilago Sacchari)* are the two fungoid diseases noted on the cane crop here. These diseases have occurred only in very mild forms so far. Smut is confined to only one variety Co. 213 while other varieties have been so far free from this disease. Rigid selection of setts from healthy clumps of canes is one method of keeping down and even freeing the cane crop of these diseases ultimately. In the case of smut it is better to uproot the affected clumps after covering the smutted tops with a gunny and burn them. Another method to avoid the spread of this disease to other varieties is the total exclusion of Co. 213 in the cropping. Of the virus diseases 'mosaic' disease of sugarcane is one. Fortunately this disease has not so far been noted on the cane crop on this station and it is believed that cane crops in this delta are also so far free from it.

Insect pests of cane. The list of insects noted on the cane crop in this delta is fairly long and in some cases the ravages of these pests have been severe particularly of the cane borers and cane flies. The more important of the pests and the methods for their control are given below :—

The Cane borers (*Diatraea stictieraspis*, H; *D. venosata*, W; and *Scirpophaga auriflua*, M.): The first two bore into the young canes and cause dead hearts. Dead hearts may be pulled out and destroyed. A Chalcid parasite—*Trichogramma minutum*—has been found in large numbers parasitising the egg-masses. The last one commonly known as the

cane white borer—is a pest of young and grown up canes. It bores into the stem from the top shoots unlike the other borers. Eggs are laid in masses and covered with brown hairs. Eggmasses may be collected and destroyed. In cases where dead hearts are prominent these may be pulled out and destroyed. Various parasites have been collected from the larvae.

The cane flies (*Pyrilla perpusilla*, Gr.) : The nymphs and adults suck the juice from the tender leaves. Light traps are effective against adults. Leaves containing eggmasses and nymphs can be clipped and burnt. A Drynid parasite - *Dryinus purilla*—has been noted on the nymphs and eggs are found attacked by Chalcid parasites.

The cane mealy bug (*Repersia Sacchari*, Gr.). The bugs suck the juice from the leaves and stem. Healthy setts may be used for planting.

Termites (*Odontotermes obesus*, R.): These bore into planted setts and kill the tender shoots. Fields showing attack of the pest have to be irrigated with water containing crude oil emulsion. The pest is often serious in virgin fields.

The cane Hespid (*Telicota augias*, L), the hairy caterpillar (*Euproctis scintillans*) and the scale insect (*Aclerda japonica*, N) have been noted on the cane occasionally.

Cost of cultivation. The cost of cane cultivation is a fairly heavy item of investment and depends on the level of wages paid to men and women and also the cost of manures applied. Cost of cultivation including cost of setts and harvesting charges per acre may vary from Rs. 150 to 175. The level of wages adopted on the station is 5 annas a man and 2 annas a woman per day. The average cost of cultivation for various items involved in growing a cane crop is given below. If the cost of setts and of propping is not taken into account, the charges would be approximately Rs. 100 to 125 per acre, as propping is hardly done by any mirasdar though it is essential while setts are taken from non-millable portions of one's own cane crop, mostly tops. This item may also be safely omitted. The net profit from a cane crop again depends upon the yield of cane, the market price of jaggery or the price paid by the sugar factory when canes are sold to a neighbouring factory. From a 30 ton yield from an acre, the net profit that may be expected is anything from Rs. 75 to Rs. 150.

Average cost of cultivation of a cane crop in Tanjore delta.

(Area : 1 acre).	Rs. a. p.
4 courses of ploughing.	10—0—0
Trenching	6—0—0
Manures and manuring.	
20 cartloads of cattle manure at 8 annas per cartload	10—0—0
200 lbs. bonemeal	6—8—0
100 lbs. ammonium sulphate	5—0—0
500 lbs. groundnut cake	15—0—0
Carting and applying the above manures	5—0—0
Sunnhemp leaves—Cost of seed, sowing, collecting and applying.	3—0—0

12,000 setts at 2—8—0 per 1,000	30—0—0
Planting setts.	6—0—0
Weeding	3—8—0
Earthing up	12—0—0
Trashing (twice)	7—0—0
Propping	18—0—0
Irrigation and drainage	8—0—0
Harvesting	30—0—0
Total	175—0—0

The cost of converting one ton of cane into jaggery comes to Rs. 3.

STUDIES IN SUGARCANE JAGGERY

IV. Some Properties of Jaggery in Relation to Moisture.*

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In an earlier communication (1) the long felt need for a systematic nvestigation into the several probable factors which govern the differential properties exhibited by jaggeries, as they are available in the market, was ndicated. In it, a preliminary review of the results of such an investigation was also given briefly. In what follows are embodied the results of the study made to understand the properties of jaggeries, in respect especially of their relations to various degrees of relative humidity.

For purposes of the present study, only two types of jaggeries, the distinctly good and the distinctly bad ones, were selected, based on the following empirical tests. It may be mentioned here that a number of samples of medium quality were also studied, but as their properties stood between those of the good and the bad ones, they are not included in this paper.

Test,	Good Jaggery.	Bad Jaggery.
1. Appearance & Consistency.	Generally dry, hard crystalline rigid solids.	Generally damp & some times sticky solids; (occasionally pastes & liquids also).
2. Grinding or crushing.	Reduced to a powder. The powder sometimes lumps up.	Soft pastes, which sometimes spread.
3. Sound produced when struck againt a hard object.	A metallic sound is produced.	Only a thud is caused.
4. A scratch made on its surface.	It is white and persists as such for a long time.	No white streak is formed at all.
5. Pin point penetration.	It does not penetrate; it sometimes bends.	Penetrates easily and quickly.

* Paper presented before the twenty-fifth session of the Indian Science Congress held at Calcutta, 1938.