

Details of cost cultivation on Onion Crop raised from Bulbs.

Items.	Estimated expenditure.	Items that can be considered as positive cash expenditure.
<i>Preparatory cultivation.</i>		
Ploughing 6 times with country plough—9 pairs of cattle at 12 as. and 9 men at 4 annas. ...	9-0-0	
Levelling and forming bunds. 8 men at 4 annas. ...	2-0-0	
<i>Manure and Manuring.</i>		
Cost of Manure 20 cart loads. ...	10-0-0	
Carting Manure and spreading. 2 pairs of cattle 2 men and 4 women. ...	2-8-0	
Sheep penning. ...	15-0-0	15-0-0
<i>Seed and Sowing.</i>		
Cost of 1,500 lbs. of bulbs. ...	20-0-0	30-0-0
Planting bulbs 30 women @ 2 annas each. ...	3-12-0	
<i>After cultivation.</i>		
2 hoeings and weedings, 30 women per acre at 2 annas each. ...	3-12-0	
<i>Irrigation.</i>		
Irrigations with <i>Picotak</i> at 12 men per acre—6 irrigations at 4 as. a head per irrigation. ...	18-0-0	
<i>Harvesting.</i>		
Digging, lifting, carrying and cleaning—10 men and 60 women. ...	12-0-0	
Miscellaneous expenditure such as drying, storing etc. ...	4-0-0	
Total Rs. ...	110-0-0	45-0-0

Receipts. By sale of 9,000 lb. of bulbs at 50 lb. per rupee Rs. 180-0-0. Profits realised thereby is Rs. 70 if the labour etc. of the ryot, his family and his cattle are taken into account and Rs. 155 if only cash expenditure is taken into account.

Note. 50 lb. per rupee can be taken as normal one. But at times the price goes down to even 100 lbs. per rupee; when the ryot, can realise a net profit of Rs. 45/- per acre if only cash expenditure is taken into consideration.

Acknowledgments. My thanks are due to Messrs. V. Tirumala Rao, Entomology Assistant and K. Suryanarayana Asst. Agrl. Demonstrator, Anakapalle, for information regarding the cost of cultivation etc.

**SOME USEFUL EXPERIENCES REGARDING
SUGARCANE CULTIVATION & MANUFACTURE OF
WHITE SUGAR AT PALUR AGRICULTURAL
RESEARCH STATION**

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The only factory manufacturing white crystalline sugar south of Madras is at Nellikuppam owned by the East India Distilleries and Sugar Factories Ltd., which is managed by Messrs. Parry & Co.

Thanks to the interest taken by this firm and their efficient organisation, the cultivation of sugarcane is extending by leaps and bounds in South Arcot District. The abnormal fall in the prices of all agricultural commodities and the facilities which the factory is affording to the cane-growing ryots round about the factory, by the grant of cash advances for cultivating the sugarcane crop, have contributed in no small measure to the development of the area under this crop. The variety Badila (Fiji B) which was introduced by the Department some years ago has now entirely replaced other local varieties and the factory prefers this to any other variety because of its high sucrose content and purity.

Palur Agricultural Station which is in close proximity to the factory has been devoting its attention to proper methods of cultivation, study of varieties etc., for the last 20 years. The following lessons learnt at the station may be useful to the cane-growers in general.

Rotation. The Nellikuppam factory has taken lease of about 1,000 acres from the ryots and is cultivating canes every year in an area of about 500 acres. In those lands canes are raised once in 2 years. Attracted by the money advances and ready marketing facilities offered to them, very many ryots grow canes every other year on the same land. Sugarcane being a very exhaustive crop, standing in the field for about 12 months, it impoverishes the soil very soon and hence a study of this question was undertaken to find out if the practice of growing cane in alternate years was sound. The experiment started 10 years ago was concluded this year, and the lessons learnt are as follows:—

Rotation.	Average yield of jaggery per acre.	Net profit per acre, per rotation.
Two year.	7,590 lb.	Rs. 103.
Three year.	8,610 „	„ 106.
Four year.	9,217 „	„ 87.

Note.—The profits include net profits of all crops in the rotation.

The results indicate that the sugarcane does not pay in the long run when raised in the same field in alternate years. The three year rotation is more economical and sugarcane does better. The results indicate further that canes give the best yield when raised once in four years, though a four year rotation is uneconomical.

Preparation of the land. Many ryots have recognised the advantages of planting canes in trenches dug one foot deep and 3 to 4 feet apart. But many are still digging trenches by manual labour. Ransome's Victory plough is being used for trenching at Palur station and 2 acres are easily trenched in a day. A middle breaker or double mould board plough is used for trenching. Nearly three acres are finished in a day which reduces the cost of trenching still further. Trenching by ploughs and setting right the ends cost only Rs. 4 at

the most, while, by manual labour it costs as much as Rs. 9 to Rs. 10 per acre.

Method of seed preparation and planting. In places where canes are to be planted for the first time or any new variety is to be introduced, it is advantageous and economical to adopt the 'short crop' method. A few setts of the new variety are planted in the month of March in trenches $2\frac{1}{2}$ ft. apart, manuring them heavily—applying up to 150 lb. nitrogen per acre in 2 doses. The canes can be cut after about 6 months in August or September, and the whole canes can be cut into setts and replanted in about 5 to 6 times the area. This crop also will receive enough manure to supply 150 lb. nitrogen. By the beginning of March next, the whole crop will give as much as 30 times the original setts got from outside. Besides rapidly multiplying the setts, it is found that the germination capacity of the setts is better, the germination being quicker and more uniform than the ordinary cane tops. This method is also useful in places where the time of planting and harvesting do not synchronise. For example, in some villages round about Nellikuppam, the planting has to be delayed for a long time as the sugar factory regulates the order of cutting to ensure a steady supply of canes to the mills. The 'short crop' or the rapid propagation method obviates the necessity to wait besides getting a good and plentiful seed material.

Treatment of Setts. It pays to select the seed material for planting. Good setts from the clumps showing no signs of 'mosaic' or 'red rot' disease, may be selected and prepared with clean and sharp knives. After some practice the coolies are able to detect the diseased clumps very quickly. As a precaution, the setts may also be dipped in Bordeaux mixture for preventing smut and other diseases. These small precautions reduce the incidence of diseases to a great extent.

Seed rate. It is a false economy to reduce the seed rate in a costly and long duration crop like sugarcane. In places where trouble with white ants is anticipated, it is preferable to plant as much as 12,000 setts per acre, doubling the setts at the ends of trenches. Frequent irrigation till the end of June and application of tar emulsion of 1% strength, keep the white ants in check. It is also advisable to keep a small nursery to fill up blanks during the first two months.

Manuring. From the year 1923, experiments are in progress to study the manurial requirements of canes in regard to the three manurial constituents, nitrogen, phosphoric acid and potash. The set of experiments that was concluded in the year 1923, showed, that there is not much difference between the use of castor cake and groundnut cake; groundnut cake in combination with ammonium sulphate gave the best yield. In order to find out in what proportion the ammonium sulphate should be mixed with groundnut cake, and up to what quantities these manures could be economically given, another set of trials

started in 1928 is being continued. Five year's results are available at present.

Optimum dose of Nitrogen. Increased yields were obtained when the quantity of nitrogen applied was increased up to 400 lb. The increased yields obtained in the case of 300 lb. and 400 lb. nitrogen were not in proportion to the cost of manures applied and hence found to be uneconomical. The average yields up to 200 lb. nitrogen are as follows:—

<i>Manure.</i>		<i>Yield of cane per acre in tons.</i>
50 lb. Nitrogen as cake.		16.6 tons
do.	Plus Ammonium sulphate.	18.3 "
100 do.		22.0 "
do.	do.	23.1 "
150 do.		27.3 "
do.	do.	25.4 "
200 do.		30.5 "
do.	do.	31.7 "

The results show that sugarcane (especially Fiji B in South Arcot) responds to heavy manuring up to 200 lb. Nitrogen; further, that a mixture of cake plus ammonium sulphate mixed in the ratio of 3 : 1 in nitrogen contents, is better than cake manure alone.

Combination of cake and ammonium sulphate. Regarding the combination of cake and ammonium sulphate, the results are not steady but so far as they indicate mixing in the ratio of 3 : 2 seems to be best.

Application of manures. Increased yields are obtained by the application of nitrogenous manures in 3 doses in the proportion of 30 : 40 : 30. The first dose is to be applied before planting, the second in the third month and the third in the fifth month.

Effect of phosphates, potash and Chilean nitrate. In order to study the effect of Chilean nitrate, potash and phosphates on the yield and quality of canes, a new manurial experiment was started a year ago. The available results are as follows:—

200 lb. nitrogen as Nitrate	...	...	...	35 tons.
200 lb. do.	+ Potash	...	...	34.4 tons.
do.	+ Phosphate	...	...	35.8 "
do.	+ Potash + Phosphate			39 "
do. as cake 120 + Nitrate 80.				36.7 "
do.	+ Ammonium Sulphate 80.			37 "
do.	+ Am. Sul. + Potash + Phosphate			43 "
do. as cake + Potash + Phosphate				42.1 "

From the above it may be seen that nitrate either alone or in combination with cake is inferior to ammonium sulphate. Potash by itself has no influence on the yield, while the addition of phosphates increases the yield. The best yield is obtained when potash and phosphoric acid are added to 200 lb. nitrogen in the shape of cake and ammonium sulphate.

Effect of ammonium sulphate on the keeping qualities of jaggery. To test the popular opinion that ammonium sulphate tends to produce soft jaggery, jaggery obtained from plots manured with varying quantities of ammonium sulphate were preserved. Three years' observations go to show that the stickiness and the softness increase as the proportion of ammonium sulphate increases in the manure mixture of cake and ammonium sulphate. The sample from the pure ammonium sulphate plot was the worst while that from the pure cake plot was the best.

Interculture. Sugarcane is ordinarily weeded 4 or 5 times in the early stages. Junior hoe and H. M. Guntaka No. 2 are being used in this station to hoe the ridges in between the rows of canes. H. M. Guntaka No. 2 cultivates nearly $3\frac{1}{2}$ acres in a day and thus a lot of manual labour can be saved. This implement can also be used as an ordinary guntaka in fallow fields.

Banking. In earthing up the canes partially after the second manuring, 8 men are required if done solely by manual labour. It can be done very effectively by a Hindoostan plough. The shape of the mould board is eminently suited to throw the soil loose after complete inversion without clogging, and completely covering the manure. There was a saving of Rs. 2-5-0 per acre by using this plough for partial earthing up.

Propping. The new pitting crowbar designed by the Research Engineer is decidedly a better tool than the ordinary crowbar for making pits to fix posts in the cane fields. When the soil is sufficiently moist and is in a soft condition, the new tool does nearly $2\frac{1}{2}$ times the work of the ordinary crow bar. This small device can be adopted by all ryots to save labour. Propping the canes with galvanized iron wires has become the routine at Palur. Some of the surrounding ryots and the Superintendent of the Factory Cane-farms are also adopting this method with advantage. Some of the P. O. J. varieties require to be propped with double wires.

Trashing. It is believed by some that stripping leaves is a waste of labour. In places which are subjected to cyclonic weather it prevents lodging to some extent. During the cyclone in November 1930 it was observed that the tall grown canes in this station did not lodge so badly as the surrounding untrashed canes, as the fierce wind simply passed through the canes in the former case and caused less damage.

Disposal of trash and stubbles It is a common sight in S. Arcot to see the cane trash in fields being set fire to, after the canes are harvested. Burning these waste products is considered to be an economy as it saves the labour of removing the trash and stubbles outside the field. This seems to be a wrong notion. Attempts were

made to convert the cane trash into compost. It was found possible to do so, by the addition of 50 lb. bone meal and 200 lb. of cow dung as starters, to a ton of trash. The organisms convert this waste product into compost in 3 to 4 months. The following are the manurial contents of the trash compost so prepared, and of the loose box manure prepared at this station.

	Nitrogen, (N)	Phosphoric acid, (P ₂ O ₅)	Potash, (K ₂ O)
Loose box manure.	0.55	0.29	1.01
Trash compost.	0.36	0.45	0.76

This compost contains a little more than half the quantity of nitrogen contained by farm yard manure and compares very favourably with the cattle manure available in the villages. As some bulky manure is necessary to maintain the physical condition of the soil, and as the available farm yard manure is not sufficient to manure all the fields, trash compost can be used in the place of cattle manure. The cane cultivators who do not require trash for any other purpose may convert it into compost and use it in their fields to supplement the other manures and thus reap good crops at a small cost.

Jaggery-making. Ryots round about Nellikuppam do not mill their canes themselves but sell them to the factory. The produce from about 4,000 acres is being crushed at the factory. But since there are about 10,000 acres in South Arcot, the canes from the rest of the area are being used in the manufacture of jaggery. Sindhewabe furnace has practically replaced the local furnace. During the last four years the double Sindhewabe furnace described in Vol. XIX of the *Madras Agricultural Journal* is in extensive use. By utilising the hot air in the flue, to heat the juice in the top pan, we are able to reduce the time taken for boiling by 15 to 20 minutes for each pan. This furnace can be adopted by all to save time, fuel and labour. This furnace works satisfactorily even for the preparation of 'rab' in white sugar manufacture.

Manufacture of white sugar. In the case of ryots in the immediate vicinity of a big factory as at Nellikuppam, it may be more advantageous for them to sell their canes direct to the factory as by doing so they realise the best price. Taking current prices for jaggery, the manufacture of sugar instead of jaggery appears to be a more paying proposition, and, the information given below might be of some use to those interested in the manufacture of white sugar with the centrifugal. In order to introduce the indigenous method of white sugar manufacture as a cottage industry, the "Belprocess" or the open pan system was, at the instance of the Director of Agriculture, tried for the first time at Palur Agricultural Research Station during the last season.

Though there are about 114,000 acres under canes in this Presidency, due to the lack of communication and to scattered cultivation,

it may not be possible for many years to come to establish factories and bring the whole area under factories. In spite of the low recovery of sugar in the 'open pan system' or the 'Bel process' it has many advantages. The capital required is very small, the technical knowledge required is not very high, the whole plant can be moved from place to place if necessary and the net return per acre is more than that from the manufacture of jaggery.

Capital. The capital required for erecting a small plant to prepare white sugar by the open pan system, is only Rs. 3,000, which is within the reach of any well-to-do ryot, or a co-operative society in a village where sugarcane is cultivated. In districts like South Arcot, where a number of oil engines are used for irrigation purposes, the additional capital required for a power crusher, centrifugal machine, pans, etc., is only Rs. 1,500 at the most. As mentioned already, the double Sindhewahi furnace works very satisfactorily. The multiple Rohilkhand or Bhopal Bel with costly and thick pans seem to be unnecessary.

The process of manufacture. The process consists in crushing the freshly cut canes with power mills and boiling the juice to the consistency of a thick syrup called rab. The mucilaginous liquid got by pounding *Bhendai* (*Hibiscus esculentus*) plants in water, and a solution of bicarbonate of soda are added as clarifying agents after removing the first scum. After a series of trials, 15 lb. of clear saturated lime water were found necessary to clarify every 400 lb. of juice. The addition of lime water helps in better recovery of sugar and in the proper selling of molasses when made into jaggery. The final striking temperature is a very important factor in the manufacture of sugar. The concentrated syrup is struck at 114°C. for thick canes like Fiji B, 247 B. etc. and at 111°C. for thin canes like Co 213. The resultant syrup is poured into earthen-ware tubs and vigorously aerated till the temperature goes down to 65°C. The proper cooling also contributes to the better recovery of sugar. The rab is allowed to crystallize for a week in kerosine tins after which it is pugged with iron chisels. One or two table spoonfuls of sodium hyposulphite are added to dark coloured rab to improve the colour. 60 to 70 lb. of the above pugged rab or 'magma' which is semisolid in condition, are poured into the basket of the centrifugal machine which has perforated walls. The cage is rotated at 2,200 revolutions per minute. By centrifugal action the molasses get separated and get collected at the bottom. The white sugar which appears on the walls of the cage is washed with a syringe of water once or twice, to completely remove the molasses. After the molasses are completely drained, the sugar is scraped out and dried in the sun which serves to bleach it still further. The molasses, if boiled immediately after liming, sufficiently set well and form a second grade jaggery which fetches half the price of

the good jaggery. If on any account the normal recovery was not got from the first rah, it was found possible to get the balance as second sugar, when the first molasses is boiled and made into second rah.

Cost of production. The cost of preparing white sugar and molass jaggery from a 30 ton crop works out to Rs. 75. During the last season Fiji B cane yielded at the rate of 41 maunds of white sugar and 53 maunds of molass jaggery per acre. Valuing a maund of sugar at Rs. 10 and a maund of molass jaggery at Rs. 1-8-0 the receipts per acre less cost of making sugar is Rs. 415 while the receipts per acre when jaggery is made amounts to Rs. 240. There is thus a clear margin of Rs. 175 in favour of sugar making. Already two ryots have started this industry in North Arcot and Chingleput Districts and it is pleasing to hear that they got an extra profit of Rs. 200 per acre by making sugar instead of jaggery.

Acknowledgements. The writer acknowledges with thanks, the kind permission and help given by M. R. Ry. C. Narayana Ayyar Avl., Dy. Director of Agriculture, IV Circle for using the farm records in the preparation of this paper.

RECENT WORK ON THE GENETICS OF MILLETS IN INDIA.*

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Millets are the food crops of the poor and till recently received very little attention. Much of the work recorded herein has been done at the Millets Breeding Station, Coimbatore in collaboration with the band of young workers devoting themselves to these crops. Work reported by other workers is also summarised with suitable references.

Sorghum—The Great Millet.

Seedlings. In certain cases seedlings give an indication of pigmentation in the adult plant. The coleoptile with or without the root may be coloured. There are seedlings with no purple colour. These distinctions could be utilized to observe segregation in the seedling stage. This practice is very old and has been utilized at Coimbatore for a number of years (Rangaswami Ayyangar, 1930).

Sap Colour. There is a sap colour character, characterised by redness in the leaves, grain, dry stigma and anther. The presence of this group has proved dominant to its absence (Graham, 1916). Ramanathan (1924) records the dominance of red pedicelled spikelets to their non-pigmented condition. This latter is what is observed in

* Paper contributed to the Symposium on Recent Work on Plant Genetics in India at the Indian Science Congress, Bombay, January 1934, Dr. P. S. Hudson, Deputy Director, Imperial Bureau of Plant Genetics, Cambridge, opening the discussion.