

**THE
DECCAN SUGAR TECHNOLOGISTS'
ASSOCIATION (INDIA)**

PART ONE

Technical Papers submitted for discussions at the
TWELTH ANNUAL CONVENTION

1955

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Index to Advertisements

Name of advertiser	Opposite Page No.
1. American Spring & Pressing Works ..	185
2. Blairs Ltd. ..	40
3. Burmah-Shell ..	iv B-iv C
4. Dyer's Stone Lime Company Ltd. ..	iv
5. Elgin Mills Co. Ltd. ..	80
6. E. Green & Son (India) Ltd. ..	153
7. Greaves Cotton & Company Ltd. ..	41
8. Hind Enterprises ..	168
9. Imperial Chemical Industries (India) Ltd. ..	41
10. Imperial Chemical Industries (India) Ltd. ..	57
11. Indian Hume Pipe Co. Ltd. ..	Appendix 7-B
12. Mirrlees Watson Co. Ltd. ..	33
13. Nizam Sugar Factory Ltd. ..	Cover 3
14. Phaltan Sugar Works Ltd. ..	184
15. Premier Automobiles Ltd. ..	152
16. Ravalgaoon Sugar Farm Ltd. ..	81
17. Saswad Mali Sugar Factory Ltd. ..	Performance Sheet
18. Shaw Wallace & Co. Ltd. ..	1
19. Standard Vacuum Oil Company Ltd. ..	169
20. Tilak Sports Co. ..	94
21. United Provinces Commercial Corporation ..	32
22. Walchandnagar Industries Limited ..	56

CONTENTS

1. Separate Clarification & Application of Prof. Saha's New Technique to the Clarification of Secondary Juices	D. G. Padalkar, K. G. Gosawi, Y. R. Khedekar & P. G. Naniwadekar	1
2. Evaluation of some of the Sugar factory waste products. Press mud, spent-wash as soil reconditioners in the reclamation of Chopan Soils	P. M. Soman, V. G. Wani & C. M. Gokhale	7
3. Manufacture gur in sugar factories and increase sugar production by five lacs tons	D. G. Padalkar	10
4. Curative effect of different treatments on Sugarcane sets, from cane possibly affected by the presence of a Virus	J. A. Gumaste, P. N. Soman & B. L. Patil	13
5. Further observations on "the use of agallol" (organo-mercurial compound) as growth promotor of sugarcane	G. K. Tonapy	16
6. A new insect pest on young sugarcane crop and its control	G. K. Tonapy	17
7. Forty-Four Gunthas an Acre or Planting Maximum Area in an Acre	N. C. Kharkar & P. B. Kulkarni	19
8. Note on Lytron X-886 and Sodium Aluminate	K. A. Joshi, R. P. Chitale & M. A. Tilak	23
9. Double clarification of cane juice	R. P. Chitale	28
10. Co 678 again !	D. D. Kodre and N. B. Patwardhan	31
11. A note on the comparative study of Co 419 propogated from old and fresh seed	B. M. Pandhare	33
12. Response of Phosphate to Sugarcane	L. N. Kolhe	36
13. Ratoon Stunting and Treatment with Trace elements	D. B. Barve	39
14. Preliminary investigations into the causes of high recovery of Sugar	S. B. Kadrekar	41
15. Occurrence of Pyrilla pest in the Bombay State during the last five years and the present position regarding its control	R. M. Patel and H. R. Arakeri	47
16. Dicalcium Phosphate for Clarification of Cane Juice	S. N. Gundu Rao and B. H. Hoshing	52
17. Improving the colour of gul	V. K. Leley, S. B. Kadrekar and R. A. Kale	56
18. Foliar Sprays with Boron	D. D. Kodre	62

19. A New Variety of Interest - Co. 775	H. R. Arakeri, M. V. Divekar and D. D. Kodre	65
20. On the Utilisation of General Soil Survey Maps of the Sugarcane Areas in the Bombay Deccan-Manurial schedule according to Soil type	S. K. Patil	70
21. Influence of different manures and fertilizers on soil micro-organisms	M. J. Albuquerque and D. K. Patel	74
22. Effect of Krilium Application on the Soil Condition and its Role in Reclamation of Chopan Soil	M. A. Mirajkar and D. K. Patel	82
23. Urea Spraying-Some preliminary observations Parts I & II	M. Y. Karve, V. P. Vaidya and H. P. Mutha	88
24. Heavy Nitrogenous manuring of Sugarcane	F. S. Patel and M. Y. Karve	94
25. Application of Superphosphate through Carriers in Deccan Canal Soils	Kumari V. S. Lad and D. K. Patel	96
26. Planting Experiments	B. H. Hoshing	103
27. Webre Circulator in Vacuum Pans	P. V. S. Sastry	106
28. Padegaon findings in short (1950-55)	H. R. Arakeri	110
29. Iron Deficiency-A Cause for Chlorosis (Kewadya) in sugarcane	S. V. Patil, R. S. Patil and H. R. Arakeri	125
30. Irrigation of Sugar Cane in the Nizam Sagar Tract	G. N. Joshi	128
31. The Problem of Field Rats	K. S. Kale and I. G. Ramchandra Rao	133
32. A new and undiagnosed Disease of Sugarcane	R. V. Pant Balekundri and M. N. Shah	138
33. Laboratory Experiments on Electrical Method of Cane Juice Clarification	S. N. Gundu Rao and H. G. Kulkarni	140
34. Whither Co 419 ?	D. K. Havnoor	144
35. Germination and Seed Treatment	F. S. Patil, M. Y. Karve and M. S. Shukla	146
36. Response of Sugarcane to Phosphate Dressings under "F" Type of Soil	H. R. Arakeri and D. D. Kodre	153
37. Crops-Logs of Plots Receiving Different Nitrogen Doses	S. N. Gundu Rao and H. G. Kulkarni	160
38. A Note on Selection of the High Speed Centrifugal Machines	K. N. Mukherjee, K. B. Dandge & B. S. Vaidya	168
39. The Phenomenon of Water-Shoots	P. M. Govitrikar	170
40. Studies in the causes of High Produ- ction of Molasses at Sakarwadi	D. P. Kulkarni	18
41. Report of Prize Plot Competition	19
42. Performance of Season 1954-55	21

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Separate Clarification & Application of Prof. Saha's New Technique to the Clarification of Secondary Juices

By

D. G. PADALKAR, K. G. GOSAWI, Y. R. KHEDEKAR & P. G. NANIWADEKAR
Ugar-Khurd

It is a fact universally acknowledged that any Industrial Process to be successful, it must be more cheap and economic than the prevalent ones. It is more true in India. It is on these very grounds that the results of Prof. Saha's New Technique are watched with keen interest by the Technologists and Industrialists in India and abroad, as it claimed nearly equivalent Carbonatation Sugar and recovery. The costs of Manufacture and Capital Expenditure are, also, claimed to be comparatively low. The Factory scale trials taken uptil now, are not convincing about these claims and many doubts are expressed by Technologists. The Process, however, has some attractive features for which the process will be tried further when it is hoped that it would become an accepted Standard Process.

While carrying Laboratory trials with Saha's process, we found that there was higher rise in purity in the case of low purity juices than in the case of high purity juices. When we tried this process in our Factory, we were required to reduce the crushing rate, as our press capacity was inadequate. It occurred to us then that we may apply this new process to the secondary juices only. This would have reduced the pressure on the filter-press Station. But this suggestion of ours could not be carried out during that period, because this required some alterations in the tanks and piping. Subsequently we came across this separate clarification process carried out in one of the Raw Sugar Factories in Cuba with excellent results. This gave us a fresh impetus to work out the following modified process.

Process.

(1) Crusher and 1st Mill Juice is to be weighed together. It is to be heated to 180°F and pre-limed with 0.75% milk of lime of 15 Be on volume of juice. It is then partially neutralized with superphosphate solution and is brought to a pH of 6.8 to 7.0 with SO₂ gas. The treated juice is boiled and is then sent to the Dorr. The clarified juice from the Dorr is sent to the evaporators and the mud is mixed with Raw Secondary Juices.

(2) The secondary juice from the remaining mills is weighed and mixed with the crusher and 1st mill juice mud from the Dorr. It is heated to 180°F and is prelimed with 1% milk of lime of 15 Be. and neutralized to 7.0 pH with SO₂. A second dose of 1% milk of lime of 15 Be. is to be added and the alkaline juice

of about 10.5 to 11.0 pH is to be quickly filter-pressed. The clear filtered juice is brought to a pH of 6.8 to 7.0 with SO_2 . It is then boiled and again filter-pressed. The filtered juice which is clear, brilliant and water-white is to be taken to the evaporators along with clarified crusher and 1st mill juice. Laboratory Trials of the above Process were carried out for about 3 weeks and a continuous equipment was used for liming and sulphuring. The results are given in Table No. 1 which show that:—

- (i) Last mill juice plus settlings of crusher and first mill juice after clarification with New Technique showed a rise in purity of 4 to 6 Units.
- (ii) Clarified juice was sparkling and water-white.
- (iii) Colloids removal was about 50%.
- (iv) There was no abnormal destruction of Glucose.
- (v) Appreciable amount of P_2O_5 was removed in the clarification process.
- (vi) There was a rise of only about 150 Mg. of CaO per litre of juice over the CaO content in the original juice.
- (vii) Sulphated Ash in clarified juice remained practically the same as in the raw juice.
- (viii) The Standard process of clarification was tried with this juice, but there was no appreciable rise in purity.

Advantages and Disadvantages of this Process.

ADVANTAGES:—

- (I) High Grade Sugar, nearly equivalent to carbonation sugar, is expected to be produced as—
 - (a) Crusher juice, which is of higher purity by 2 to 2.5 units than the usual mixed juice and having less impurities, is used.
 - (b) Secondary Juices, which have higher impurities like Colloids, Bagassilo and other Non-Sugars, are preferentially treated with Prof. Saha's Process and hence are better removed, giving a rise in purity of 4 to 6 Units, are used.
 - (c) Effect of whole juice filtration will practically be obtained in this process as the secondary juices contain the major part of suspensions of fine bagasse, etc., due to the application of high pressure and heavy maceration at the secondary mills.
- (II) As thin and low purity juices are filter-pressed, the sugar loss will be less; wash-water required will be less and the load on this station will be reduced by nearly 50%.

(III) Due to less recirculation of thin juices at the mills, Bacterial Loss will be reduced.

(IV) The consumption of chemicals will not be much higher than those required for the standard process, as the total lime consumption in this process would be 1.4 to 1.5% by volume on juice, while the consumption of lime in the standard process is about 1.0 to 1.2%.

(V) Without much additional capital expenditure, it will be possible to standardize, in stages, Prof. Saha's New Technique.

(VI) It is worth noting that the Laboratory Trials were carried out towards the close of the Season, when our juices did not clarify well with the standard process. But the same juices gave consistent good clarification results with this process.

(VII) Sugar recovery is expected to be higher as more Colloids, Gums & other Non-Sugars and also fine suspensions will be removed in this process.

DISADVANTAGES.

(1) Crusher and secondary juices will have to be weighed separately for Chemical Control.

(2) Some additional equipment like Juice Heaters, Liming Tanks, Pumps, etc. would be required.

(3) There would be a slightly higher cost of Chemical & Labour.

Processing of the secondary juices, after clarification through evaporators and massecuite boiling, is a further suggestion which will help to improve the quality of sugar as well as boiling of massecuites. This would involve installation of a separate evaporator. But the total heating surface, required for a given crushing capacity, will not change. This additional investment may probably be justified as it may improve the quality of sugar and also boiling of massecuites.

References.

- (A) 'Cane Sugar Hand Book' (Eighth Edition) - By Spencer D. Sc.
Page 98, Sec. III; Page 46, Sec. 53.
- (B) 'Principles of Sugar Technology' - By Peter Honig.
Page 641 (L) Double Sulpitation.
-

Table No. 1

Date	Trial No.	Juice	Bx.	Pol.	Py.	pH	% R. S.	Glu. Ratio	Ash %	Ash Bx.	% Colloids	CaO	P ₂ O ₅	Rise in Purity
27-3-55	1	Original	8.03	5.97	74.35	—	0.9795	16.41	—	—	—	832	41.8	+ 0.75
„		Clarified	8.51	6.39	75.10	6.9	1.061	16.81	—	—	—	836	93	—
28-3-55	2	Original	5.40	4.15	76.85	—	0.6515	15.77	—	—	—	345	—	+ 1.10
„		Clarified	5.85	4.56	77.95	6.5	0.6122	13.67	—	—	—	636	—	—
„	3	Original	6.50	4.61	70.92	—	0.9475	20.55	0.282	4.30	—	363	72.5	+ 0.81
„		Clarified	6.93	4.97	71.73	6.7	1.409	21.54	0.342	5.00	—	708	82.8	—
29-3-55	4	Original	6.75	4.96	73.52	—	—	—	—	—	—	—	—	+ 2.59
„		Clarified	7.12	5.42	76.11	6.6	—	—	—	—	—	—	—	—
„	5	Original	8.66	6.53	75.41	—	—	—	—	—	—	—	—	+ 3.09
„		Clarified	8.79	6.79	78.50	—	—	—	—	—	—	—	—	—
„	6	Original	5.68	4.27	75.18	—	0.5444	12.75	—	—	—	—	—	+ 2.13
„		Clarified	5.77	4.46	77.31	7.0	0.5131	11.51	—	—	—	—	—	—
30-3-55	7	Original	8.73	6.16	70.57	—	—	—	—	—	—	—	—	+ 2.29
„		Clarified	8.60	6.26	72.80	6.6	—	—	—	—	—	—	—	—
31-3-45	8	Original	5.43	3.94	72.56	—	0.7707	19.56	—	—	—	—	—	+ 3.61
„		Clarified	5.54	4.20	76.17	6.7	0.7360	17.53	—	—	—	—	—	—
„	9	Original	5.26	4.18	79.47	—	0.7461	17.84	—	—	—	—	—	+ 2.62
„		Clarified	5.42	4.43	81.73	6.4	—	—	—	—	—	—	—	—

The above Juice was treated as follows :-

Last Mill Juice + 0.4% P₂O₅ of 15 Be heated to 100°F, 1% Lime added, Neutralised by SO₂ to 7pH, boiled, 1% Lime Added (pH 10.5) Filtered.

Filtrate was Neutralised by SO₂ to 7pH Filtered.

Table No. 1 (Contd.)

Date	Trial No.	Juice	Bx.	Pol.	Py.	pH	% R. S.	Glu Ratio	Ash %	Ash % Bx.	Collo- ids	CaO	P ₂ O ₅	Rise in Purity
5-4-55	1	Crusher Juice	20.01	16.02	80.05	—	—	—	—	—	—	818	—	+ 0.34
"	"	Clarified	21.14	16.99	80.39	7.3	—	—	—	—	—	854	46	—
"	"	LMJ+Mud	6.60	5.02	76.07	—	—	—	—	—	—	436	101	+ 2.34
"	"	Clarified	7.32	5.74	78.41	6.6	—	—	—	—	—	654	36	—
6-4-55	2	Crusher	21.35	18.69	87.54	—	1.069	5.716	—	—	—	818	—	— 0.12
"	"	Clarified	22.46	19.63	87.42	6.9	1.380	7.028	—	—	—	1036	—	—
"	"	LMJ+Mud	10.01	7.28	72.73	—	1.013	13.93	—	—	—	680	—	+ 5.28
"	"	Clarified	10.23	7.98	78.01	7.0	0.9620	12.04	—	872	—	—
"	3	Crusher	20.55	16.36	79.60	—	2.234	13.68	0.70	3.406	—	1213	53.2	— 1.40
"	"	Clarified	21.69	16.96	78.20	—	2.383	14.05	0.74	3.411	—	872.6	55.2	—
"	"	LMJ+Mud	10.86	8.32	76.60	—	1.050	12.62	0.58	5.339	8.8	...	—	+ 4.00
"	"	Clarified	11.38	9.17	80.60	—	0.9939	11.16	0.50	4.394	4.2	909	46	—
7-4-55	4	Crusher	22.17	18.55	83.68	—	2.273	12.26	0.48	2.165	3.2	545	—	+ 0.85
"	"	Clarified	22.81	19.28	84.53	6.9	2.169	11.26	0.52	2.279	1.4	690	—	—
"	"	LMJ+Mud	8.03	6.18	76.96	—	0.7261	11.75	0.54	6.724	10	581	—	0.74
"	"	Clarified	8.33	6.47	77.70	6.8	0.7104	10.97	0.36	4.321	5	890	—	—
9-4-55	5	Crusher	20.79	17.99	86.54	—	1.198	6.658	0.56	2.694	2.8	568	64.4	+ 0.02
"	"	Clarified	21.61	18.71	86.56	6.8	1.233	6.5941	0.56	2.591	2.4	1036	55.0	—
"	"	LMJ+Mud	8.73	6.44	73.77	—	0.7738	11.96	0.26	3.357	6.8	709	147.0	+ 6.10
"	"	Clarified	8.45	6.75	79.87	6.4	0.7127	10.55	0.38	4.471	2.4	836	46	—
10-4-55	6	Crusher	20.57	17.17	83.45	—	—	—	—	—	—	—	—	— 0.79
"	"	Clarified	22.34	18.47	82.66	6.9	—	—	—	—	—	—	—	—
"	"	LMJ+Mud	7.90	5.60	70.89	—	0.7674	13.71	0.54	6.835	8.4	600	92	+ 5.48
"	"	Clarified	7.70	5.88	76.37	7.0	0.7298	12.39	0.40	5.194	4.4	763	46	—

Table No. 1 (Contd.)

Date	Trial No.	Juice	Bx.	Pol.	Py.	pH	% R. S.	Gluc. Ratio	Ash %	Ash % Bx.	Colloids	CaO	P ₂ O ₅	Rise in Purity
11-4-55	7	Crusher	21.19	16.64	78.52	—	2.702	16.24	0.66	3.115	4.0	890	73.6	+ 0.20
"	"	Clarified	22.49	17.70	78.72	7.1	2.686	15.18	0.72	3.202	2.0	1073	55.20	—
"	"	LMJ+Mud	8.66	6.09	70.33	—	0.8435	13.86	0.48	5.543	14.40	690	92.0	+ 5.77
"	"	Clarified	8.41	6.40	76.40	6.7	0.7454	11.65	0.40	4.736	6.80	909	73.6	—
12-4-55	8	Crusher	19.36	16.51	85.29	—	1.388	8.405	0.52	2.686	4.20	890	55.0	— 0.33
"	"	Clarified	20.81	17.68	84.96	7.1	1.442	8.155	0.60	2.876	2.80	1127	64.0	—
"	"	LMJ+Mud	9.63	7.18	74.56	—	0.8993	12.52	0.74	7.685	9.60	818	—	+ 4.960
"	"	Clarified	9.58	7.62	79.54	6.7	0.8816	11.57	0.42	4.383	4.0	872	147	—
13-4-55	9	Crusher	20.89	16.79	80.35	—	2.087	12.44	0.64	3.063	3.6	800	184	+ 1.61
"	"	Clarified	22.72	18.62	81.96	7.3	2.256	12.12	0.74	3.257	3.0	1054	92	—
"	"	LMJ+Mud	9.88	6.90	69.82	—	0.9559	13.86	0.50	5.060	12.0	636	460	+ 5.98
"	"	Clarified	9.56	7.25	75.80	7.2	0.9270	12.77	0.46	4.811	4.4	818	92	—
14-4-55	10	Crusher	20.22	16.50	81.70	—	1.901	11.53	—	—	—	763	73	—1.72
"	"	Clarified	21.61	17.29	19.98	6.9	1.928	11.15	—	—	—	1000	64	—
"	"	LMJ+Mud	8.09	5.82	71.94	—	0.7809	13.42	—	—	—	618	460	+ 3.21
"	"	Clarified	8.73	6.56	75.15	7.2	0.7316	11.15	—	—	—	854	82	—
The above Juice was treated as follows :—														
Crusher Juice + 1% Lime, heated to 180°F and 0.33% P ₂ O ₅ 15 Be added; finally neutralised by SO ₂ to 7pH. This was boiled & settled.														
Crusher Juice Mud + L. M. J. heated to 180°F, 1% Lime added, Neutralised by SO ₂ to 7.0 pH; 1% Lime added (pH 10.5) filtered.														
Filtrate was neutralised by SO ₂ to 7.0 pH filtered.														
16-4-55	11	Crusher	20.01	16.13	76.78	—	—	—	0.62	3.98	3.6	636	73	+ 1.07
"	"	Clarified	22.19	17.28	77.85	7.1	—	—	0.74	3.334	3.3	1090	55	—
"	"	LMJ+Mud	9.06	5.45	60.16	—	—	—	0.40	4.416	12.8	800	55	+ 5.75
"	"	Clarified	8.92	5.88	65.91	6.9	—	—	0.32	3.587	4.4	963	55	—

The above Juice was treated as follows :—

Crusher Juice + 1% Milk of Lime (15°Be) added at 180°F and neutralised by SO₂ to 7 pH; Boiled and Filtered.

Crusher Juice Mud+LMJ heated to 180°F, 1% Milk of Lime (15°Be) added, neutralised by SO₂ to 7.0 pH 1% Lime added (pH 10.5) Filtered.

Filtrate was neutralized by SO₂ to 7.0 pH Filtered.

In all the above trials, filtered Triple Super-phosphate of 15 Be was used.

**Evaluation of some of the sugar factory waste products. Press mud,
spent-wash as soil reconditioners in the reclamation
of Chopan Soils**

By

P. M. SOMAN, V. G. WANI & C. M. GOKHALE
Walchandnagar

The manurial value of some of the waste products of the sugar factory, such as press mud, bagasse, spent wash has long been recognized (1, 2, 3,). Kanitkar (4) Sen (5) have recommended the use of press mud in the reclamation of usar soils in U. P. Dhar and others (7) have studied the value of molasses in reclamation of usar soils in U. P.

Presence of patches of alkali infected lands, called locally as the Chopan soils is very common in the sugar factory areas of the Bombay State. They are more or less sodiumized, and are very sticky. Their infiltration quality is very low, depending on the degree of alkalanization, depth and nature of sub-stratum. In every block of 60-80 acres, there are about 2-3 acres of such soil (3-5%). The cane crop is very poor, and the yields are not more than 5 to 10 tons of cane per acre.

Considering the yields in a block of 80 acres,

(1) 76 acres @ 65 Tons = 4940 Tons

(2) 4 ,, @ 5 Tons = 20 Tons

80 acres

4960 Tons

Average = 62.0 Tons.

If, however, the 4 acre patch is improved and yields about 40 tons, the average of the whole 80 acre block will be 64 tons instead of 62 tons. For bringing these soils to this level of productivity, we will have to bring about a permanent change in the nature of the clay particle. In other words, we will have to reclaim the soil. Before the cation exchange relationships of soils were understood, reclamation of such soils was extremely difficult. Dr. Basu and Sirur (6) have recommended an application of 1/2 ton of sulphur or 3-4 tons of gypsum. Considering the availability of sulphur in our country, it cannot be recommended, as almost all the imported sulphur, will be required by the industries-sulphuric acid, sugar etc. We have ample supplies of gypsum and can well be utilized.

It will be seen that the cost of permanently improving such small patches will not be so high as it is thought. Generally a dose of a ton of oil cake is applied to cane on such areas. Taking Rs. 160/- as the cost of 1 ton of cake, this is

surely a waste, as conditions required for making the nitrogen available to the plant do not exist in such soils. If instead the cake dose is applied after the soil is reclaimed, it will be much useful to the cane crop and will result in an increased tonnage. Its economic aspects can be considered separately.

Sugar factory waste material such as press mud and spent wash, contain such substances as can effect a permanent change in the properties of such soils, i. e. change them from sodium to calcium soils. In this experiment, an effort is made to evaluate the comparative values of such products, in bringing out this change.

Genesis of Chopan Soils:— When sodium salts accumulate as in arid regions, Na ions replace Ca ions from the clay, with the formation of sodium clay. This leads to very important alterations in the chemistry, physics and morphology of the soil, and to extremely adverse conditions for plant growth. Sodium clay tends to hydrolyze with the formation of NaOH. Thus soils high in replaceable sodium, tend to be alkaline. Sodium clay also disperses very readily. This adversely affects the permeability of the soil to air and water. Only a relatively low degree of sodium saturation of clay lowers its permeability to water. This is the chief reason why saline irrigation waters, that are relatively higher in sodium, should be avoided. By the use of such waters, the soil may acquire enough exchangeable sodium to affect its permeability seriously. This effect may be masked by the flocculation action of soluble electrolytes, but upon leaching out the soluble salts, it becomes pronounced.

An alkaline soil then is not necessarily one that merely contains an excess of soluble salts. The clay itself under certain conditions, becomes profoundly altered by the soluble salts. Therefore, the reclamation of an alkali soil is not always restricted to the removal of soluble salts. The clay itself may also need be changed. A large part of the sodium held by the clay must be replaced by calcium, before the soil will be fully reclaimed.

Methods & Material:—The soil selected was from a typical Chopan soil, from a spot where nothing can grow. The soil was dried and crushed in a wooden mortar and pestle to pass through a 2 m.m. sieve and filled in Buchner funnels dia. 7½", after giving the following treatments:—

- (1) Blank.
- (2) Dry press mud 2% on wt. of soil i. e. approximately 32 tons per acre.
- (3) Gypsum 0.25% on wt. of soil i. e. approximately 4 tons per acre.
- (4) 180 ccs. of spent wash 800 grams of soil i. e. about 4" acre.

The soils were then profusely irrigated with canal water as often as possible. The first irrigation was given on 10-9-54 and the last one on 11-10-54.

The permeability (Here recorded as drainage rate in ccs. per square meter per second) of soil to water was recorded as under, at the beginning and at the

end of the experiment. At the close of the irrigation, the soils were dried, pounded and passed through 1 m.m. sieve. Exchangeable Ca & Mg was determined and also the pH.

S. No.	Treatment	% soluble salts	pH	Permeability Drainage rate in ccs. per sq. meter per second	Permeability Taking Blank 2 as 100.	Ex. Ca. m. c. 100 gns. of soil	Ex. Mg. m. c. 100 gns. of soil
1	Blank ¹ after 1st irrigation	0.23	8.3	2.540	166.0	23.0	7.6
2	Blank ² before last irrigation	0.09	8.98	1.525	100.0		
3	Press mud	0.075	8.35	19.46	1276.0	30.2	9.2
4	Gypsum	0.085	8.70	7.56	495.7	27.1	9.0
5	Distillary slopes	0.12	8.0	11.25	737.7	25.8	10.5

Both permeability and pH. can be taken as good indicators for the changes brought about in the soil. It will be seen from the above table that as salts were removed from the soil in the blank, the infiltration rate which was 2.54 cc. came down to 1.525. That means as the concentration of the electrolytes goes down the clay particles of the chopan soil become deflocculated. The presence of fine clay particles in the drainage water, indicates the degree of dispersion. In field conditions, in these soils, there is a downward movement of fine clay particles, which accumulate in layers and hamper free drainage. In treatment No. 3 the infiltration rate was the highest followed by treatment No. 5 and 4. Thus for filtrability No. 3 < 5 < 4.

pH of the original soil sample was 8.3, which on depletion of the salts went up to nearly 9.0, bringing the soil to its worst phase. In case of press mud, the pH is 8.4. This is the normal pH of soils with abundance of calcium carbonate. In gypsum the pH was 8.7. This together with rate of infiltration indicates that a dose of 32 tons of dry press mud or 4" spent wash would be quite sufficient to effect permanent improvement in the soil.

Discussion:— The rate of infiltration both in case of filter press mud, and distillary spent wash, indicates that a substantial improvement, is brought about in the Chopan soils. The area should be under-drained with country Kumbhar tiles, so that no surface drain need be opened every time. It seems if the land is so under-drained and treated with either press mud or spent wash, the productivity of the soil is very likely to go to 30–40 tons per acre from 5–10 tons acre. Even if the cost of under-drainage etc. is taken as 400/- rupees per acre, this amount is very likely to be recovered in the first 2–3 crops under sugarcane.

Summary:- Press mud and spent wash can be used with advantage as soil reconditioners, in reclamation of Chopan soil in the sugar factory area of the Bombay Deccan.

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D. S. T. A.
12th Convention 1955

Manufacture gur in sugar factories and increase sugar production by five laes tons

By

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Ugar-Khurd

It is a well known fact that in existing process of gur manufacture, as followed by our cultivators, there is a criminal waste of juice due to low extraction. In modern sugar mills, the extraction of juice is at least 80 % while in gur manufacture, the juice extraction varies between 50-55 % on cane, which means that 25-30 % juice in cane goes as waste. Suppose the cultivators combine and put a Mill Tandum, they will avoid the waste of juice but because of the dilution of juice with maceration water and higher percentage of non-sugars in extracted juice, the quality of gur will be very poor. Moreover the capital expenditure to put a Mill Tandum will be so high that there are very remote chances of such mills being put up by the cultivators.

I have, therefore, to suggest the following process, or rather a new procedure wherein the juice going to waste at present can be made use of, for the manufacture of sugar.

Large quantities of gur are manufactured in the area surrounding the existing sugar factories. This gur, I suggest should be manufactured by the sugar factories. The cultivators should supply their cane which is used for gur to factories on weight basis. The factories should crush this cane in their mills along with their own cane and weigh separately the quantity of crusher juice equivalent to 55 % juice on cane received from the farmers. The factories should manufacture gur from this juice and hand it over to the cultivators. Reasonable manufacturing cost of gur be recovered from the cultivators. The 25 % juice that will be extracted in the subsequent mills will be used for the manufacture of sugar along with the usual mixed juice. It must be clearly noted that the factories will have their normal crushing of cane for sugar manufacture and it is presumed that there will be no reduction in normal sugar output. On the contrary there ought to be increase in sugar production due to additional recovery of sugar from the juice going waste.

At present about 30 million tons of cane is used for gur manufacture in India and if all this gur is manufactured in Sugar Factories as per my suggestion, about 5 lacs tons sugar will be produced from this juice going waste, without affecting the present production of gur in the least.

The following tables will clarify further, the positive advantage of the New Process.

Table No. 1

Cane area. 1000 acres.	Total cane 1000 tons.	Tons cane per acre.	Tons cane used for gur.	Tons cane used for sugar	Tons cane used for other purp.
4228	4,9900	11.80	28770000	13173000	7957000

Table No. 2

1. Tons of cane used for gur.	28770000	7. Pol available for sugar production	643164
2. Pol percent cane.	12.04	8. Boiling House losses.	128633
3. Total pol in cane tons.	3463900	9. Nett sugar produced.	514531
4. Milling extraction	91.28	10. Recovery percent cane.	1.79
5. Pol extracted tons.	3163847	11. Tons juice used for gur (55 %)	15823500
6. Tons pol used for gur tons.	2520683	12. Usual production of sugar.	1414488
		13. Primary juice analysis.	Bx. 19.36 Pol. 15.93 Py. 82.27

Note :—For calculations, the 1952-53 production figures in Indian Union are taken. It is presumed that the average extraction of juice in India is only 55% on cane crushed for gur manufacture.

From the above tables, it is obvious that about 5 lacs tons of sugar can be produced from the juice going as waste in the manufacture of gur. As there is no cost for cane to produce this sugar and cane worth Rs. 40/- is required per bag of sugar, the factories will get an additional gross return of Rs. 7/- per ton of cane used for gur production. The cost of gur manufacture, extra fuel, interest and depreciation on additional equipment may be taken as Rs. 2/- per ton of cane. Deducting Rs. 2/- from the gross profit of Rs. 7/-, the factories will be getting about Rs. 5/- per ton of cane as an additional profit.

The manufacture of gur is a very hard job for farmers. Hence they will feel a sort of relief if the manufacture is undertaken by the Sugar Factories. Moreover, there will be a lot of saving because:

1. The factories will bear a part of the manufacturing cost.
2. There will be uniform extraction and the quality of gur will be uniform and standard as the manufacture will be carried on under the expert supervision of the Factory Chemists.
3. As the cane will be crushed in the factories, the farmers will have a choice to make gur or to sell the cane to the factories for sugar manufacture, when the prices of gur come down.
4. As the farmers will not be required to make any capital investment for gur manufacture, they can conveniently divert their limited capital to better their cane crop.
5. This new process will be helpful to solve one of the National problems to some extent, such as:—
 - (a) There will be an increase in the Sugar Production.
 - (b) Money, by way of Income-tax, Sales-tax, Excise Duty, etc., will flow to exchequer of the Government.
 - (c) About 5 lacs acres of irrigable land which would have been required to produce 5 lacs tons of additional sugar would be saved to produce food grains and other crops.

The Deccan Tract in general is quite suitable to take trials of the New Process. Tons of gur is produced in the area surrounding many of the sugar factories. The farmers are sensible and cultured enough to adopt new methods if once they are convinced of the advantage of manufacturing gur in the factory.

The process, if found practicable, may go a long way in solving some of the problems of the Sugar and Gur Industry and hence Government may offer adequate facilities and financial help to some of the factories to give the New Process a thorough trial.

D. S. T. A.
12th Convention 1955

Curative effect of different treatments on Sugarcane sets, from cane possibly affected by the presence of a Virus

By

J. A. Gumaste, P. N. SOMAN & B. L. PATIL
Walchandnagar

Early in 1953, it was observed that ratoons, instead of giving out normal shoots behaved peculiarly. The tillering was profuse resembling grass. The tillers were very dense, grassy, and delicate, with leaves sometimes chlorotic and sometimes pale green. This shrubby condition persists, new tillers come out, the old ones die, and this phase is continuous, so that there is no cane formation. In the month of September that year, similar attack was noticed in Adsali No. 22. It was later on reported by the Virus Expert, to be due to a virus. Its heavier incidence in ratoons might have been brought about by the cane harvesting knives.

One of the characteristics of the diseased cane is that if the plant shows symptoms of the disease in the early stage of the crop, it exhibits profuse, grassy, pale green or chlorotic leaves with meagre or no cane formation. It is mostly in the ratoons that such symptoms are very common. If the plant exhibits symptoms in the late stage (6 to 8 feet cane formation) the leaves are chlorotic and the buds are scaly and many times sprouted. The sprouts are etiolate and chlorotic. Many times the chlorotic condition of the leaves is temporary giving place to pale green condition.

In Australia¹ agriculturists and geneticists have been foremost in contributing to the written and oral discussion on the subject of low yields. Suggested explanations have included, declining fertility of soils and general loss of hybrid vigour. None has been supported by investigational data. The geneticists have expressed their confident belief that under a system of vegetative reproduction the genetical make up of the variety—including its capacity to produce—would remain constant. Investigations of Queensland Bureau of Sugar Experimental Stations have now collected a volume of experimental evidence, in support of the contention that the so called varietal low yields is the result of a pathological condition, probably a virus disease and not due to any change in the genetical set-up.

Norman J. King¹ describes sugar cane ratoon stunting disease in Australia where low yields in ratoons were observed. He ascribes it to be due to the presence of a virus. Hot water treatment to the sugarcane sets has been found quite effective. It has become well established, as a regular practice in some sugarcane districts. Similar hot water treatment for sugarcane sets 50° C. for 2 hours has been reported to be very effective, against sugarcane ratoon stunting disease (2, 3, 4, 5, 6).

Martin Leake Sc. D.⁷ ascribes, monoculture to be responsible, for the increasing incidence of such diseases in sugarcane. He points out there could be an internal physiological derangement, leading to the formation of proteins alien to the natural condition of the plant. Such a plant may be envisaged as in a state of precarious balance when an injection of the wrong protein, by vector or other means, causes it to form an alien, instead of the normal protein. That view of a nature of a virus has yet to be confirmed or proved erroneous. But viruses fall under the head of nucleo-proteins. He has emphasised more on the cultural side of cane cultivation such as rotation, composting, increasing the organic matter, status of the soil, and return of field and factory refuse back to the field etc.

Experiment:—A series of treatments to the sets of diseased sugarcane, were given (1954 August). It was considered, even if the malady be due to a virus (nucleo-protein), the hot water treatment would disorganise the virus and thus remove the cause of the disease.

(1) Control, (2) 45° C. for two hours, (3) 50° C. for two hours, (4) 55° C. for two hours, (5) Exposing the diseased sets to ultraviolet radiation emitted by a 40 Watts " Sterilaire " lamp of the ultraviolet products, Losangels 27 Calif. U. S. A. for 2 hours. A similar set of treatment was given to sets of normal cane. The variety was Co. 419.

General observations on germination etc:—In treatment No. 2, 45° for 2 hours germination was 1/2 that of control. In normal cane the treatment 45° C. for 2 hours, the germination was better than control, which shows that this mortality in diseased sets is due to the scaly, drawn-out and delicate nature of the eye buds, which were moreover prematurely sprouted. In treatment No. 3, 50° C. for two hours the germination was very scanty only 5 % against 50 % in untreated (control) diseased sets. Again this increasing mortality shows the delicate condition of the eye buds. In normal seed 50° C. Water dip for 2 hours also gave better performance than no treatment. In treatment No. 4, 55° C. for 2 hours—the sets failed to germinate This was alike in normal and diseased cane. Treatment No. 5, ultraviolet light had only a very slight effect and was only slightly better than control.

Other observations:—In 45° C. treatment of the sets of diseased cane, the plants were all green and appeared like normal seedlings. The growth, vigour etc. was superior to control practically resembling normal cane. It was later on observed that, the late shoots (after 6-8 months) had pale green leaves as also chlorotic leaves. In the case of hot water dip 50° C. for two hours the plants behaved quite similar to healthy CO 419 cane. It put forth quite vigorous growth, all the late shoots were quite normal, as against 45° C. for two hours. Healthy sugarcane sets, inoculated with the extract of the diseased sets, did not produce diseased symptoms even up to 10th month. It has not been possible to ascertain the effect of the hot water treatment on the succeeding ratoon as the piece of land was utilised for building purposes. However, in the time in between, it was observed that the 50° C. water treatment did not produce white or pale leaved shoots, but normal shoots.

Discussion:—We think the problem is very serious, and other factories also try and report on their findings to this association. In recommending its trial, we may be over-emphasizing its seriousness. But we consider over emphasis, in this instance is quite desirable, even considering the meagre experience and knowledge we have, about this disease. We feel it may prove a major production problem facing the cane growers of Bombay Deccan. We may like to add that the marvellous cane variety CO 419 has withstood for a period of over 15 years, which no other variety has so far done. It is quite natural, in course of time, other varieties may come in and replace CO 419. But let us not be ungrateful to this noble variety, by allowing it to pass off in this condition. We should, therefore, give it a fair chance for its survival.

As regards the suitability, and choice of treatment, in addition to our above observations it will, we think it better to quote Mr. King^a in the discussion that ensued, “ In recommending 50° C. for two hours, we still know that we are playing reasonably safe. All the early work on this disease, was carried out on Q 28. Treatment at 50° C. for an hour and a half gave good germination and the ratoons were not stunted, compared with untreated plants. Q. 28 is not a very thick cane and we decided to standardise on 50° C. for 2 hours. This period would, it was considered, be sufficient for heat penetration in thicker canes ”.

Conclusion:—An all-out hot water treatment 49°–50° C. for two hours to sugarcane sets, may prove helpful in eradication of this dreadful disease. This may then result in increased yields in Ratoons.



Note the difference in the vigour of cane from treated diseased set.
The bushy nature of cane in untreated is very clear.

The authors are thankful to Shri. K. A. Joshi, Chief Chemist, Walchandnagar Industries Ltd. for the interest and the trouble he took, which enabled us to include the Photo Print.

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D. S. T. A.
12th Convention 1955

Further observations on " the use of agallol " (organo-mercurial compound) as growth promotor of sugarcane.

By
G. K. TONAPY
Kolhapur

This is the continuation of my article bearing the same name presented at the 11th D. S. T. A. Convention 1954.

Final observations taken on 15-12-54 (Statistical plot)

Date of Harvest :- 17-12-54.

Average of 4 replications

Treatment.	Mature height in Feet.	Girth Inches.	Canes per Acre.	Cane yield in 4 Gths. Tns. Cwt. Qrt	Cane yield per Acre. Tns. Cwt. Qrt.
Agallol.	8.5	3.5	53,512	5 - 3 - 2	51 - 15 - 0
Control.	8.25	3.25	44,824	4 - 14 - 2	47 - 5 - 0

There is a clear difference of 4 Tons 10 Cwts. 0 Qrt. per Acre in favour of the treated plot.

There is another comparative trial (not statistical) taken in the same plot. The yields obtained are as follows :

	Acres, Gths.	Yield per Acre. Tns. Cwt. Qrt.	Date of Harvest.
Agallol Plot.	1 - 25	44 - 15 - 1	19-12-54
Control Plot.	0 - 35	41 - 6 - 3 $\frac{1}{2}$	-do-

There is a difference of about Tons 3 - Cwts. 8 - Qrt. 0 per Acre in favour of the treated plot.

The conclusions arrived at in my previous article, that organo manurial compound treatment promotes the growth of cane are confirmed by the yields obtained and final observations taken by me.

D. S. T. A.
12th Convention 1955

A new insect pest on young sugarcane crop and its control

By

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Kolhapur

In the last week of September 1954, in Circle I of the Kolhapur Sugar Mills Ltd., the Rozoong crop planted in the last week of July and 3rd week of August 54, suddenly began to show death of the young shoots on a large scale. The attack was devastating. At first we thought it may be borer attack or an attack by white ants.

But after 3 to 4 days of detailed observation, we were able to find out after digging the soil to a depth of 3" to 4" around the recently affected and dead plants, an insect locally called "Ghui" or "Vinchavachi Mawshi". This insect is used as a bait for catching fish by some fishermen. Dr. Arakeri had been to Kolhapur and I gave him some samples of the said insects. Thereafter the insect was identified by the Crop Protection Officer, S. D. S. Ahmednagar as "a mole cricket the species being most probably *Gryllotalpa africana* and belonging to *Gryllidae* family. It is not known to be a pest of any significance for sugarcane crop. However it is known for having capacity to cause some danger to any

crop including sugarcane. It is an underground insect and nocturnal in habits and may cut roots ”.

The nature and extent of the damage .

The said insect has got large serrated mandibles by means of which it burrows into the rhizome of the cane plant, thus precluding any further tillering capacity of the plant. As a result the cane plant dries wholly unlike the death of the central shoot only, as in case of borers. The leaves and shoots dry up simultaneously as a result of the attack. The insect is very active and on exposure it burrows into the soil and disappears quickly.

The following is the extent of the damage in Blocks B & C

Area affected. Acres. Gths	% age of attack.
15 - 20	30 %
2 - 15	40 %
5 - 15	5 %
16 - 10	10 %

Control measures adopted:—Immediately the attacking insect was detected, the soil around each and every plant was loosened by means of a Khurpi and 10 % B. H. C. dust (Gammexane) was applied at the rate of 50 to 60 lbs. per acre and covered up with the soil.

The very next day onwards, the insect attack was effectively controlled. A few insects were found to be dead. But I think that the insecticide acted more as a deterrent than as a killing agent as no fresh attack was observed after the treatment.

Gap filling was done in the affected area by placing the setts in the grooves dusted with 10% B. H. C. As a preventive measure it is advisable to use 25 lbs. of B. H. C. 10 % per acre applied in the planting trench in plots liable to such damage by the said insect.

This treatment may prevent the attack of all soil borne insects such as white ants, grubs, etc.

D S. T. A.
12th Convention 1955

Forty-Four Gunthas an Acre or Planting Maximum Area in an Acre

By

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Harigaon

Introduction

It was in the month of July 1951, a rainy day with 2" rain, when the planting was in full swing. As usual sufficient seed was prepared the previous day. The seed hauling had become too difficult due to inaccessible roads. Then we sought to utilize the seed in a plot which was near the railway line, where only ridging had been done. Seed was hauled by trucks to this plot and planting was done dry in furrows. Beds were prepared after the soil was fairly dry and in workable condition. Germination was fine and even through the small cross-bunds built for making the zig-zag irrigation layout. (These cross bunds are locally called वरंभे or आदळे).

This gave the authors an idea to utilize the generally unplanted space in the cross bunds. Of course the contour furrowing and long furrow irrigation system which is coming in vogue now, automatically give us all the furrow length for planting, but still all the factories and especially all the cultivators have not yet taken to this new idea. Moreover, even with the contour planting, there are many local spots which are necessarily on a slope and have to be irrigated in the old way by zig-zag layout necessitating cross bunds. It is in these circumstances that the planting on cross bunds is going to give us extra dividends.

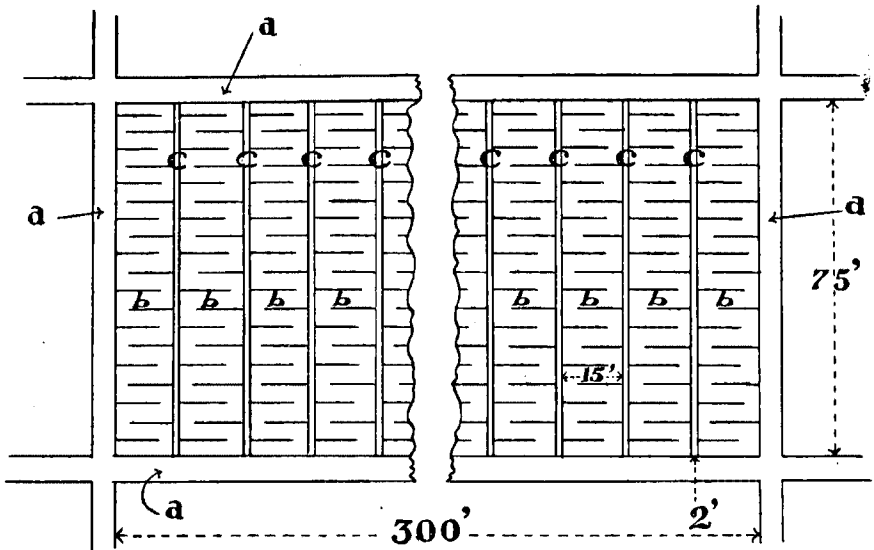
Advantages.

(1) *Extra Area Available*:— To give a clear idea of the space occupied by the cross bunds and which is generally left unplanted, the standard layout that we are following is given below

Our plots are 1200 ft. × 1200 ft. divided in 64 sub-plots of 75 ft. × 300 ft. or nearly half an acre, each with 20 to 21 rows of 300 ft. length. These sub-plots are again divided in 16 to 20 beds or "Phadkis", making a zig-zag design of 20 to 21 rows of 18 ft. or 15 ft. length according to the slope of the land.

For each cross bund a strip of at least 2 ft. is left unplanted i. e. for 20 rows of a phadki a total length of 40 ft is left unplanted. Thus for 15 or 19 cross bunds in the sub-plot of 20 rows a total running length of 40 ft. × 15 cross bunds = 600 ft. or 40 ft. × 19 cross bunds = 760 ft. is available for planting. One row of 300 ft. makes roughly one guntha. So we get an additional space of 2 to 2.5 gts. per sub-plot of half an acre or 4 to 5 gts. per acre or 10 to 12% extra area.

Following diagram will make this still clear:-



- (a) Boundry bunds of a $\frac{1}{2}$ acre sub-plot.
- (b) 20 to 21 cane rows in zig-zag layout in a phadki.
- (c) Cross bunds dividing the sub-plot in 16 to 20 phadkis according to slope. Every cross bund is a strip of 2 ft. wide & being left unplanted is available as extra area for planting.

(2) *Extra Sugar Production and Profit:-* Even making an allowance for the carelessness of the labourers, faulty germination of the setts etc. we are sure, as will be seen by actual observations given further, to get at least 6 to 7% increase in production. Considering it on the total over all production, it is obvious that it is a very lucrative proposition, especially when we know that we have to spend but very little or rather absolutely negligible for gaining so much of an advantage. The only extra cost that we have to incur is for the extra seed required and eventually for the handling of the produce. For a factory handling 150000 tons of cane or producing 18,000/- tons of sugar, the money value of the benefit derived by this small idea will work out to be 9 to 10 lacks of rupees.

(3) *Strengthening the cross-bunds:-* It is an emperical fact that the cross bunds are strengthened by rooting of the cane stools in the cross bunds. It helps a lot at the time of night irrigation when these cross bunds otherwise are generally washed off and eroded.

Objections raised.

Following are some of the objections raised against planting setts in the cross bunds:—

(1) *Faulty germination due to insufficient moisture conditions and eventual waste of seed and labour:*— This can be avoided or at least minimised by planting setts in a groove deep enough to reach the water level of the furrow and that too before letting down the water in the bed. By capilarity enough moisture conditions are maintained at the cross bunds. Even though the setts are placed 4" to 6" deep at the time of planting due to the loose texture of the soil of the cross bund, the germination is satisfactory.

(2) *Tillering may not be satisfactory due to less intertillage:*— Tillering is not at all affected. The figures given elsewhere are self-explanatory.

(3) *Obstruction to the movement in the field:*— There was initially a strong opposition to this idea from the sub-ordinate staff and the labour, as it was found difficult by them to move across the rows on the cross bunds for field operations and supervision etc. But they were slowly accustomed to the new field conditions by persistent practice. Eventually, this has become a usual routine with us and we are now-a-days ardently following the cross bund planting in The Belapur Company's Estate.

Actual Observations.

(1) *Germination Counts:*— As there was a defidence about the germination of cane planted in cross bunds, counts were taken in different places to see the comparative germination of setts on cross bunds and in the furrows. Percentages of germination at the age of 3 weeks are as follows:—

	% age Germination			
	Heavy soil	Medium soil	Light soil	Average
Eye buds on furrows	94.9	93.2	78.5	88.8
Eye buds on cross bunds	88.8	83.6	69	80.4

The figures show that the germination of cross bund setts is not very defective though a bit backward than the furrow setts.

(2) *Tillering of Cane:*— It was feared that the cross bunds are not likely to be broken at the time of intercultivation and the tillering will be affected. To observe the exact progress of tillering, counts were taken in two different plots and at different ages of the crop. The table over-leaf shows the tillers from the cane setts planted in the cross bunds in proportion to the total No. of canes in two acres at different periods and the %age increase in the number of canes at different periods both on cross bunds and that in the furrow.

Week after planting	Tillers on Cross bund		Percentage increase of tillers	
	% age of the total No. of tillers in 2 acres	Tillers on furrows	Tillers on cross bunds	
4th Week	12 %	100%	100%	Assuming the 4th week tillers as mother shoots.
7th Week	11.5%	118.6%	121.5%	
16th Week (after earthing up)	14.8%	136.4%	185.9%	

From the above figures it is seen that we can get as much as 14% more cane by planting setts in cross bunds. The counts for the percentage increase in tillers definitely show that the tillering of setts planted in cross bunds instead of being adversely affected is definitely much better. This can be attributed to the deeply laced lower eye buds in the loose and favourable soil conditions of the cross bunds.

(3) *Millable Canes*:- For the purpose of counting - the exact number of millable canes - two different plots of an acre each were selected in different circles. The plot was thoroughly cleaned of trash, late sickly and non-millable canes. The average figures per acre are as under :-

- (a) Avg. No. of canes P. A. including canes on cross bund : 49298
 (b) " " " " " only on cross bund : 3400
 (c) " " " " " excluding canes on cross bund : 45898
 (d) % age of extra cane for Mill (by planting cane on cross bund) : 7.4%

(4) *Stand of Cane on Cross bund and that of cane in the centre of the Phadki*:- Heights of cane were taken at different ages and are as under :

	At 9 months age	At 12 months age
(a) Avg. height of cane on cross bund	5'	8'-6"
(b) Avg. height of cane in the furrow	6'	2'-6"

This shows that the cane on cross bunds was backward by about a foot which may be due to the late germination and start and some portion of the cane being buried under soil due to raising & strengthening of the cross bunds. But as the progress of the cane height is observed to be the same, it can be said that there is no retardation of growth of cane on cross bunds if the setts are planted carefully.

Conclusion

It is hoped that this short note backed up by our experience, adequately proves the advisability of planting on cross bunds and getting the maximum advantage out of the area that we are to plant.

D. S. T. A.
12th Convention 1955

Note on Lytron X-886 and Sodium Aluminate

By

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Walchandnagar

The modern trend of milling is to extract the maximum amount of juice from sugarcane. To facilitate this object new types of hydraulic equipments as Edwards hydraulic or new types of cane knives and levellers are rapidly replacing the old ones. This increased extraction has created problems in the clarification station by overloading settling equipment with the increased colloidal material. These are difficult to remove by standard methods. Naturally therefore new materials are tried and put on market under various trade names. A good clarificant should produce the following results:—

(i) Maximum elimination of non-sugar (ii) Minimum time for settling with minimum mud volume, (iii) Faster filtrability of mud, (iv) Maximum clarity of juice with minimum of colour, (v) Minimum ash content of clear juice (vi) During the process there should be neither increase nor decrease in reducing sugars.

With these points in view, the trials of two new clarificants viz. Lytron X-886 and Sodium Aluminate, were carried out at Walchandnagar. The short account of the same is given below.

Monsanto Chemical Company has manufactured a resinous product named Lytron X-886. It is a white powder, which has a high molecular weight. It is a palyelectrolyte, which dissolves in water and dissociates into a number of negatively charged particles. It is claimed that these particles coagulate colloids and join hands with the flocks to settle down more quickly. Sugarcane juice at Walchandnagar is deficient in phosphate even though we give high phosphate doses to our sugarcane. We do not get clear deficated juice unless we lime to pH 8.0 to 8.4; hence we have tried Lytron X-886 only for two pH ranges i. e. 8.0 and 8.4; for defecation and typical results are given in Table I.

Further trials of Lytron X-886 were switched on to our usual liming and sulphitation process. It was observed that there was no significant change due to

the addition of Lytron X-886 immediately after liming or after liming and sulphitation.

Procedure : To one litre aliquot of limed juice Lytron (solution 0.1%) was added as 3 PPM, 6 PPM, 9 PPM and 13 PPM, respectively, subsequently juice was neutralized by sulphur dioxide to pH 7.2. It was boiled and allowed to settle. The settling rate of mud, purity rise and calcium content of clear juice was recorded (Table II). The rate of filtration of mud was recorded care being taken to see that the filtering area of each funnel was the same. The papers used were whatman No. 1, 18.5 cm. The temperature of mud was 100°C. (Table III).

Another clarificant tried was Sodium Aluminate. The following advantages are claimed by the manufacturers: (1) Lighter colour and purer juice due to the removal of coloured organic impurities and inorganic substances like silica and magnesia (2) Increased yield of sugar with less quantity of molasses (3) Lesser scale formation (4) Smoother boiling of evaporators and vacuum pans (5) Saving in steam consumption.

The Sodium Aluminate is a white amorphous deliquescent substance, soluble in water. Three percent solution was made and 25 to 100 PPM dose was added to limed juice as per following procedure.

Procedure:- Raw juice was limed (1.5% lime of 15 Bx.) and one litre aliquot was taken for every observation. Different quantities of three percent Sodium Aluminate solution was added to every litre lot as shown in Table IV. Every lot was further neutralised with sulphur dioxide keeping the final pH 7.2. The juice was further boiled and allowed to settle. The settling rate of mud, purity, calcium content, reducing sugars, ash and colour of clear decanted juices were noted (See Table IV). The rate of filtration of mud was also recorded with the usual precautions. Typical examples are shown in Table IV and V.

Conclusion:- Lytron X-886 and Sodium Aluminate do not help to hasten the clarification of cane juices which are deficient in phosphate. Lytron does not remove colour and there is no change in pH of the juice due to its addition. Sodium Aluminate removes some of the colour of clear juice but there is no substantial rise in purity. In either cases there is no extra removal of calcium from clear juice. So we think that they have little scope as a clarificant in the Deccan Sugar Factories.

Table No. I

A typical example showing the effect of Lytron X-886 on defecated juice (a) at pH 8.0 and (b) at pH 8.4

Rate of settling of defecated juice

Nos—	1	2	3	4	I	II	III	IV
	Amount of Lytron X-886 added in PPM.							
Time in minutes	(A) pH 8.0				(B) pH 8.4			
	0	9 PPM	6 PPM	3 PPM	0	9 PPM	6 PPM	3 PPM
	Mud volume in ccs.				Mud volume in ccs.			
0	1000	1000	1000	1000	1000	1000	1000	1000
1	950	900	800	840	900	850	850	800
2	700	700	600	640	750	600	640	620
3	590	500	440	500	550	400	420	440
4	450	350	320	340	400	300	300	320
5	340	280	260	280	320	260	260	270
6	290	250	250	270	290	250	240	240
7	270	240	230	250	250	230	230	230
8	260	230	220	240	240	220	210	210
9	240	210	210	230	230	210	200	200
10	230	210	210	220	220	200	200	200
15	200	180	180	190	180	180	190	190
20	180	170	170	180	170	160	160	160
25	170	160	170	170	160	160	155	150
30	160	150	150	160	150	150	150	150
All the settled juices were turbid. There was no change in pH and calcium content.								
pH	7.9	7.9	7.9	7.9	8.2	8.2	8.2	8.2
Bx	18.79	18.81			18.75	18.65		
Pol	16.12	16.14			16.14	16.05		
Py	35.79	85.81			86.08	86.06		

Table II

A typical example showing the effect of Lytron X-886 on the usual
limed and sulphited juice.
Rate of settling of mud

Sample Nos. —	1	2	3	4	5
Amount of Lytron added in PPM	0	3	6	9	13
Time in Minutes	ccs.	ccs.	ccs.	ccs.	ccs.
0	1000	1000	1000	1000	1000
1	870	860	950	1000	950
2	750	750	840	930	800
3	660	660	730	800	700
4	600	600	650	760	600
5	550	550	620	700	550
6	520	520	550	600	450
7	460	440	480	400	380
8	360	370	430	370	380
9	360	350	390	340	360
10	340	330	370	320	350
11	320	320	360	310	340
12	320	310	350	300	330
13	310	300	340	280	330
14	300	290	330	280	290
15	300	280	320	270	285
16	290	280	320	270	285
17	290	280	310	270	280
18	280	270	300	270	280
19	280	270	290	270	280
20	270	260	290	270	270
25	260	240	270	270	270
30	240	200	260	270	260
Sample Nos.—	1	2	3	4	5
Bx.	19.35	19.77	19.64	19.84	19.48
Pol.	17.00	17.34	17.27	17.40	17.07
Py.	87.85	87.71	87.93	87.70	87.63
Mgms CaO per litre.	780	780	770	770	770
pH	7.1	7.1	7.1	7.1	7.1
	Colour by electro-photometer (absorbancy).				
Red	30	27	30	33	31
Yellow	50	43	45	47	43

Table III

Rate of filtration of mud in ccs. clear filtrate obtained in minutes.

Sample Nos.	1	2	3	4	5
Lytron Added.	0 PPM.	3 PPM	6 PPM	9 PPM &	13PPM
1	35	28	30	35	40
2	55	40	43	45	50
3	72	45	52	52	65
4	80	58	62	60	74
5	90	68	70	67	82
6	98	75	79	75	90
7	102	80	85	80	94
8	110	84	90	85	100

Table IV

A typical example showing the effect of Sodium Aluminate on the rate of settling, purity rise, calcium content, ash and colour of usual limed and sulphited juice.

Rate of settling of mud

Sample Nos.—	1	2	3	4
Sodium Aluminate added	0 PPM	25 PPM	50 PPM	100 PPM
Time in minutes	ccs.	ccs.	ccs.	ccs.
0	1000	1000	1000	1000
1	1000	1000	1000	1000
2	920	960	850	1000
3	780	900	750	750
4	700	850	650	600
5	600	750	600	505
6	500	600	510	455
7	450	550	450	450
8	400	500	400	430
9	350	450	370	400
10	320	400	330	380
11	310	380	310	360
12	290	350	305	330
13	280	340	270	310
14	280	320	270	310
15	275	300	270	290
20	245	265	255	270
25	225	245	235	260
30	210	225	220	240
Bx	18.65	18.95	18.95	18.88
Pol	16.17	16.36	16.36	16.38
Purity	87.00	86.33	86.33	86.75
pH	6.7	6.7	6.8	6.8
Mgm Cao per litre	888	888	864	864
Ash per 100 Bx	3.603	3.588	3.561	3.453
Colour by electro-photometer absorbancy				
R	35	31	30	30
Y	60	55	53	52

Table V.
Rate of Filtration with Sodium Aluminate.

Sample No. —	1	2	3	4
Time in minutes	ccs. filtered in minutes.			
	ccs.	ccs.	ccs.	ccs.
1	20	19	20	15
2	32	31	28	25
3	40	38	38	31
4	48	46	45	35
5	53	49	50	40
6	58	55	53	44
7	62	59	56	50
8	65	62	59	53
9	68	65	62	55
10	71	68	63	60
11	73	71	65	62
12	74	72	67	65
13	77	74	68	68
14	—	—	—	—
15	78	75	70	69

Double clarification of cane juice

By

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In the present article, a short account of the extensive trials - on laboratory scale - of the double clarification of cane juice is described. It is based on three main points: (1) High alkalinity i. e. pH has the advantage of nearly complete precipitation of inorganic non-sugars as phosphates, sesquioxides and silicates; (2) At room temperature there is no considerable destruction of reducing sugars; (3) Separation of mud at two distinct pH values (i) alkaline (ii) neutral are carried out.

Another new aspect of this method is that the use of milk-cream separator and Sharples Super Centrifuge is made for the separation of mud from the alkaline juice.

Procedure :—Raw juice is limed with 2.5%, 2.0% and 1.5% respectively of milk of lime of 15 Brix, at room temperature. It is quickly centrifuged through

milk-cream separator or Super Centrifuge. Triple super-phosphate solution of 10 Brix is added to above alkaline clear juice so that its pH comes down to 7.4. It is further boiled and settled or filtered through a vacuum filter. The comparative results for some cases are given in table 2. Table 2 is divided into four parts a, b, c, and d; 'a' shows the effect of adding 2.5% of milk of lime of 15 Bx, 'b' shows the effect of adding 2.0% of milk of lime of 15 Bx, 'c' shows the effect of added 1.5% of milk of lime of 15 Bx, 'd' shows the average figures (for the month) of raw juice and clear juice obtained at the factory by the usual liming and sulphitation method for comparison. About hundred samples of final clear juice were tested for purity rise and it is observed that on an average of 98 samples there was about 1.8 degrees rise in purity from raw juice to final clear juice, when raw juice was limed to 2.5% or 2.0% of milk of lime. The addition of 1.5% of milk of lime gave lower rise in purity.

Discussion:—The separation of non-sugars at two different pH values removes more non-sugars and colouring matter as compared to our usual sulphitation process. It is observed that at room temperature the destruction of reducing sugars, due to high pH values, is not considerable even keeping for three hours (See Table 1). This method is tried extensively on laboratory scale and has found to be successful as regards the quality and colour of clear juice. Economical aspect is not studied as yet, but it can be said that if 'The new technique' establishes its claim as an economically sound one, the above method will be more economical provided the alkaline filtration by centrifuging is available at a reasonable cost. As the separation is carried out by centrifuging, it is presumed that more colloids and suspended matter are separated in the alkaline mud, and the second mud can safely be used as a fertilizer. The use of sulphur is eliminated which is a great saving in dollars. Further work on the rate of filtration of the alkaline juice is under progress. The author now earnestly requests the engineers to design a suitable continuous type of separator on the line of milk cream separator.

Table 1.

The rate of destruction on reducing sugars when raw juice was limed with 2.5% of milk of lime of 15 Bx at 80°F.

Time in minutes	% Reducing sugars	Reducing sugars per 100 Bx	% Destruction of R. Sugars
0	1.8814	10.1697	0.0000
60	1.8542	10.0227	0.01445
120	1.8120	9.7945	0.03633
180	1.7868	9.6583	0.05028
0	1.4070	7.3587	0.0000
60	1.3924	7.2824	0.01016
120	1.3734	7.1830	0.02388
180	1.3544	7.0836	0.03738

Table 2.

No.	Juice	pH	Bx.	Pol	Purity	Purity Rise	Reducing sugars per 100 Bx.	Mgms CaO per litre.	Ash per 100 Bx.	Colour by Photometer	Remarks
<i>(a):—2.5% Lime dose.</i>											
1.	Raw	5.1	17.65	15.29	86.63	—	3.3824	—	2.2590	—	
	Final clear	7.0	17.73	15.54	87.65	1.02	3.2069	600	2.3960	R-8, Y-17	
2.	Raw	5.0	18.43	16.27	88.28	—	3.9461	360	1.9330	—	
	Final clear	7.0	18.21	16.43	90.22	1.94	3.8627	600	1.9970	R-7, Y-18.	
3.	Raw	—	19.46	17.35	88.16	—	2.742	—	—	—	
	Final clear	7.1	19.19	17.57	91.56	3.40	2.638	750	—	R-9, Y-16.5	
<i>(b):—2% Lime dose.</i>											
4.	Raw	—	17.81	14.97	84.05	—	4.9713	370	—	—	
	Final clear	7.1	18.15	15.71	86.56	2.51	4.8573	810	—	R-15, Y-30	
5.	Raw	—	18.59	16.05	86.34	—	3.8789	—	2.4807	—	
	Final clear	7.0	18.24	16.14	88.49	2.15	3.7730	570	2.5180	R-7, Y-16	
6.	Raw	—	18.62	15.64	83.99	—	2.5945	—	4.153	—	
	Final clear	7.0	18.29	15.83	86.55	2.56	2.5587	540	4.249	R-10, Y-19	
<i>(c):—1.5% Lime dose.</i>											
7.	Raw	—	20.25	17.47	86.27	—	—	—	—	—	
	Final clear	7.0	21.00	18.43	87.30	1.03	—	700	—	R-22, Y-38	
8.	Raw	—	19.46	17.35	88.16	—	2.742	—	—	—	
	Final clear	—	19.40	17.40	89.69	1.53	2.693	660	—	R-8, Y-14.5	
9.	Raw	—	19.64	17.03	86.71	—	3.7376	—	—	—	
	Final clear	7.0	19.87	17.59	88.52	1.81	3.6288	—	—	—	
<i>(d):—Factory results.</i>											
10.	Raw	—	18.80	—	85.90	—	4.6989	—	2.4049	—	
	Factory clear	6.9	18.35	—	86.35	0.45	4.6748	—	2.5409	R-28 to 39, Y-46 to 62	

D. S. T. A.
12th Convention 1955.

Co 678 again !

By

D. D. KODRE & N. B. PATWARDHAN
Padegaon

There is a hue and cry for the so-called "running out" or deterioration of Co. 419—the wonder variety of Coimbatore—which now occupies an area of more than 85 per cent of the total sugarcane acreage of the Bombay State and which helped tremendously in the progress of the sugar industry in the Bombay-Deccan during the last twenty years. A good deal of discussion has taken place in the Annual Proceedings of the Deccan Sugar Technologists' Association from the year 1947, on this important item at issue with which the sugar industry is threatened. Patwardhan (3, 4, 5 & 6) presented a series of papers on this topic and concluded from the data on the performance of Co. 419 at the Sugarcane Research Station, Padegaon, during the years from 1936 to 1949 that there are no signs of deterioration in Co. 419 and the running down in yield may be attributed to other causes such as soil exhaustion, incidence of insect-pests and diseases, environmental conditions, etc., which should be investigated in detail. Even then the nervous fear about the running out of this variety is dominating the minds of the sugarcane growers.

Due to this fear in view, attention of all those interested in sugarcane culture is diverted to new promising varieties which may give better and more economic cane and sugar yields per acre and which may serve as "stand by" varieties in case Co. 419 completely deteriorates. Barve (1) reported the good performance of Co. 678 from the trials on this variety in comparison with Co. 419 under the adsali plantation on the estates of Walchandnagar Industries, Ltd. Divekar (2) presented the data regarding the performance of Co. 678 during the three years of 'Final Trials' at the Sugarcane Research Station, Padegaon; under the pre-seasonal (October-November) planting. As a very small percentage of area is under plant or pre-seasonal planting on the factory estates, it was felt essential to test this variety under adsali plantation.

Materials and Methods.

With a view to test the performance of the new varieties of seedling canes, recently released for trials at the factory estates and Sugarcane Development Sub-stations, under the adsali planting, an experiment was laid out at the Central Sugarcane Research Station, Padegaon, on the varieties of Cos. 658, 678, 683 and 685 with Co. 419 as control. The experiment was planted in the second week of July 1953. The nitrogenous top-dressing applied was 450 lbs. N in the form of sulphate of ammonia and ground-nut cake in 1:2 ratio of N, with 30,000 lbs. of farm yard manure applied at the time of planting. Also 100 lbs. of P_2O_5 in the form of super-phosphate was applied at the time of planting. The size of each plot was 1.6 gts. The system of layout was the randomised block design replicated

four times. The crop was harvested in the first week of January 1955. The harvest data is presented in Table No. 1.

Table 1
Post Seasonal (*Adsali*) Trial on Sugarcane Varieties
1953-55

Particulars	Co. 658	Co. 678	Co. 683	Co. 685	Co. 419	C. D. for significance
1. Cane in tons per acre	75.61	85.18	59.46	57.67	50.30	13.07
2. Per cent increase over Control-Co. 419	150.3	169.3	118.2	114.7	100.0	
3. Brix	17.67	17.83	19.73	17.85	19.11	
4. Sucrose in juice (%)	14.97	15.41	17.78	14.91	16.59	
5. Purity per cent	83.30	86.46	90.14	85.96	85.29	
6. Per cent Sucrose in cane	12.77	12.27	14.50	12.27	12.93	
7. Fibre per cent	12.61	13.16	14.28	12.01	11.45	
8. C. C. S. per cent	10.07	10.55	12.33	10.33	11.70	
9. C. C. S. tons per acre	7.61	8.96	7.33	5.95	5.90	
10. Per cent increase over Control-Co. 419	129.0	151.8	124.3	100.8	100.0	
11. No. of canes per acre	44,520	45,520	44,340	45,340	40,980	
12. Wt. per cane in lbs.	3.80	4.19	3.03	2.86	2.75	

The varieties Cos. 658 and 678 significantly out-yielded Co. 419 by 50 and 69 per cent more cane respectively than Co. 419, in which case there was a good deal of damage by lodging and drying of canes. From stand point of C. C. Sugar, Co. 678 has yielded 52% more than Co. 419 (5.90 tons sugar per acre). Co. 683, though yielded less than Co. 678 & 658, has shown good quality of cane. All the varieties have lodged, but it was severe in case of Cos. 685, 419 and 683.

Thus the performance shown by Co. 678 is highly encouraging, and it is quite likely that Co. 678 may replace Co. 419, if it shows consistent performance every year.

The data, being for one year, requires further confirmation.

Acknowledgement.

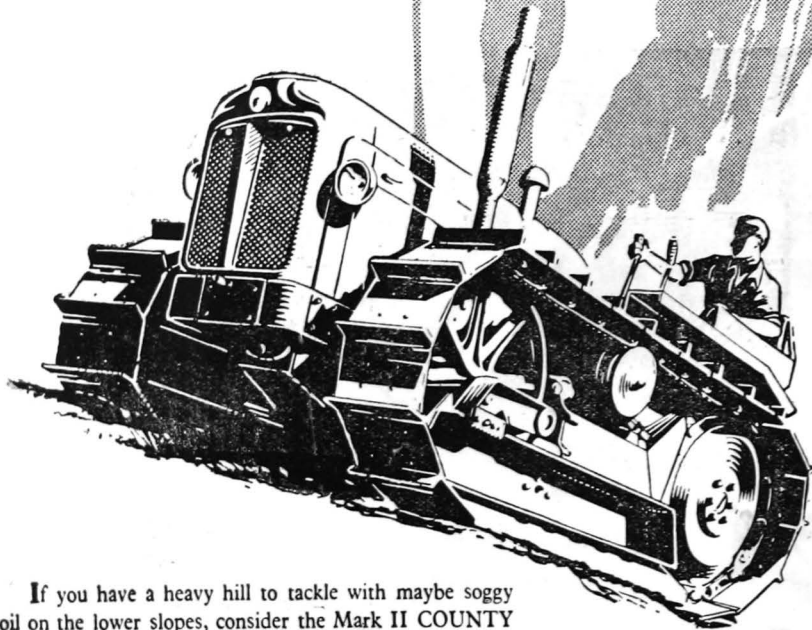
Thanks are due to Shri S. V. Mankar and E. B. Baviskar for their co-operation in carrying out the trial.

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1. Barve D. B. 10th Annual Convention, D. S. T. A. 1953
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3. Patwardhan N. B. First Biennial Conference of Sugarcane Research and Development Workers in Indian Union, Coimbatore 1951
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6. —do— 11th Annual Convention of D. S. T. A. 1954

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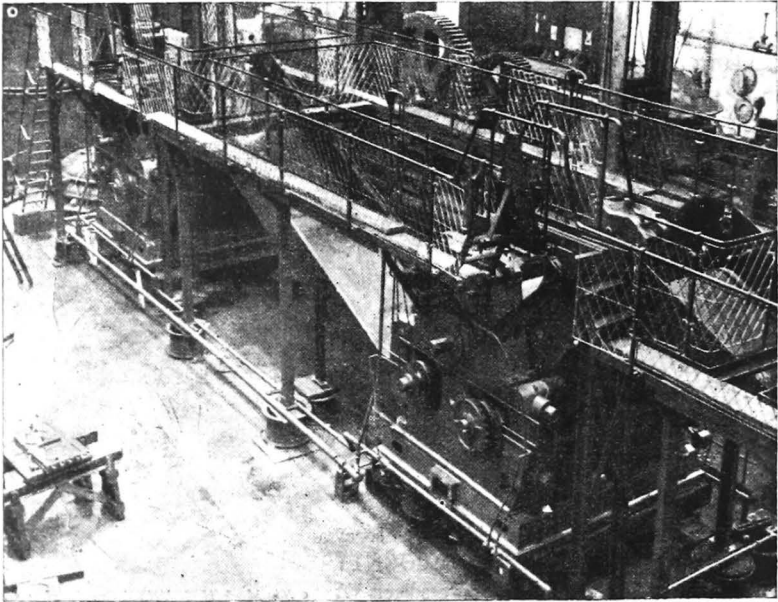
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A note on the comparative study of Co 419 propagated from old and fresh seed

By

B. M. PANDHARE
Kopargaon

1. General

Co 419 is a cross between P. O. J. 2878 and Co 290, in which the developed characters of these crossed canes are found. This variety was first released from Coimbatore to the Provincial stations in India in the year 1933. This variety enjoys an almost universal popularity in tropical India. It is a noble variety among all the varieties of sugarcane bred at Coimbatore, due to its wonderful performance. It is now the dominant cane both for gur and sugar factories all over this part of India. This variety is little under cultivation in Northern India where there are extreme climatic conditions and rainfall is more. In the states of Bombay and Madras, the climate is of tropical type and hence thick variety is grown in these states. Thick variety thrives well in the tropical climate. Co. 419 occupies nearly 80% of sugarcane area under cultivation in tropical India.

2. Introduction in Bombay State

This variety was first introduced for trials at Padegaon Research Station (Dist. North Satara) in 1933. Different trials were carried out at this station and after good findings in its performance and yield, this variety was released to the sugar factories and Bagaitdars for further multiplication. Padegaon Research Station sent this variety to the Government Kopargaon Farm in 1936. I had one acre under this variety for crushing in 1937.

3. Agriculture

I found this variety growing vigorously on my farm from 1937 upto 1945. Germination was good, leaves were broad, long and dark green in colour; internodes long and canes thick in girth. Tillering was fairly good. It had a lodging tendency due to its profuse growth. It was late in maturity. It was giving better yields with optimum doses of fertilizers. In the beginning the quality of gur was soft and a little inferior in colour due to its vigorous growth upto the crushing time. Later on the quality of gur was on the way of improvement as the variety acclimatized itself to the climatic conditions of the Bombay Deccan. I had obtained 275 maunds of gur from one acre of sugarcane (Co. 419) with a moderate quantity of oil-cake and other fertilizers in 1937.

4. Deterioration

Since 1945, this variety began to fall in yield, year after year. It is said that the variety is deteriorating. "Deterioration" means the phenomenon of the falling off in yields of a variety after prolonged period of cultivation, in the same class of soils, under the same atmospheric conditions, with the application of optimum quantity of fertilizers and with the same agricultural treatment. Crop-affectation by pests and diseases is one of the causes to a certain extent for the deterioration in yields. The deterioration in variety is not of cytogenetical type but morphological, which can be proved by the change of seed from one locality to another. I quote here a proof for no change in cytogenetics. On my farm this variety was falling in yield. The girth of internodes was small, the length of internodes was short and the general appearance of cane was thin. Padegaon Research Station took 2000 setts from my farm for plantation in 1954 for a trial to see whether this variety was really deteriorating. It has been observed at Padegaon that the crop propagated from this cane seed was growing vigorously.

Table No. 1.

Statement showing the fall in yields of Adsali propagated from old seed year after year.

Year	Area		Average yield per acre in Bengali Maunds	Remarks.
	A.	G.		
1950-51	16	20	210 Mds.	Optimum Climatic conditions
1951-52	16	20	204 "	- do -
1952-53	16	20	192 "	- do -
1953-54	16	20	180 "	Scarcity of water, unfavourable climatic conditions.
1954-55	2	20	195 "	Favourable climatic conditions.

5. Observations and Performance of Co 419.

In the year 1953, I had 15 gunthas of Adsali cane propagated from fresh seed brought from Kopargaon Government Farm. I used these fifteen gunthas for further Adsali plantation in 1954. I found the canes propagated from fresh seed, growing vigorously right from germination upto arrowing. General appearance and stand of the crop was uniform. In support to my above general observations a table is given below.

Table No. 2.

Comparative study of Botanical observations of Co 419 propagated from old and fresh seed under the same treatment of culture and manurial doses.

Kind of seed	Date of Planting	Germination	Tillering	Average girth	Average length of internode	Average height of cane	Percentage of top-shoot Borer	No. of cane population per acre	Average yield in maunds
1	2	3	4	5	6	7	8	9	10
Old seed.	16th July 52.	70	220	3.34"	5.3"	11.4'	10%	42000	Old seed..... 195.
Fresh seed.	20th July 53.	80	230	4.5"	5.75"	12.5'	5%	48000	Fresh seed..... 240.

6. Conclusion

From the above figures, one comes to the conclusion that the deterioration of Co 419 is not genotypic but it may be due to the environmental factors governing the performance of a cane variety. Deterioration is caused by climatic changes and soil exhaustion. No other promising variety is yet evolved at Coimbatore, which will surpass this variety in yield. This variety is a boon to the agriculturists as well as to sugar factories for establishing sugarcane enterprise on a sound footing. Every sugarcane grower must try to maintain this variety in proper vigour by all ways and means till the evolution of a new variety which will surpass this in all aspects of performance and yields. Change in seed after every 3 to 4 years and periodical increased nitrogenous doses will maintain the variety at a standard level of yield.

References.

- (1) Coimbatore canes in cultivation by Dutta and Rao
- (2) Proceedings of First Biennial Conference of Sugarcane Research Workers at Coimbatore 1951.
- (3) Proceedings of The Deccan Sugar Technologists' Association Conventions 1951 and 1954.

D. S. T. A.
12th Convention 1955

Response of Phosphate to Sugarcane

By

L. N. KOLHE
Malinagar

Introduction

Soils in Bombay Deccan, as they are deficient in nitrogen, respond very readily to application of nitrogenous manures. This, however, is not the case with phosphatic manures. The practice of application of phosphate is comparatively recent. All the same, on account of its tremendous potential influence on plant growth, it has attracted the attention of technologists.

A vast number of experiments conducted in Java have proved that sugarcane responds readily to phosphate application when its concentration in the soil is very low. Experimental work carried out in the Bombay Deccan at the various research stations, as well as at the different sugar factory farms in the past few years, presents a very interesting picture. It has not been possible, as yet, to arrive at any definite conclusion regarding the application of this most important element. The problem becomes all the more complicated in as much as phosphoric acid is readily fixed in the soil. Thus, the phosphate fixed is almost finally lost to the crop.

Every sugarcane grower wants to find out the optimum manurial treatment for his field. A number of experiments have been and are being conducted in the farms of the S. M. S. F. Ltd., Malinagar, with the above object. The data obtained from these appears very interesting.

Discussion.

Regularly laid out experiments were conducted in two types of soils, D and G. Nitrogenous doses ranged from 450 lbs. to 900 lbs. per acre with varying applications of P_2O_5 . The experiments were conducted on Adsali plantings in all cases with only CO 419 cane. In all cases, a basal dose of 30 cart-loads of F. Y. M. was applied prior to planting. P_2O_5 was given in the form of single superphosphate.

Application of P_2O_5 seems to have affected the germination only to a small degree (vide Table I). Effect of P_2O_5 on tillers shows diverse effect in the two types of soils. In D type of soil, population at 20 weeks shows an appreciable increase in tillers with the application of P_2O_5 . In G type soil, however, P_2O_5 treatments show no increase whatsoever in tillering. It is peculiar, however, to note that a very large number of these tillers does not survive till harvest. This is marked more in G type of soil (vide Table I). Phosphate treated plots in D types soil

have, however, shown on an average larger number of canes per acre at harvest. The number of canes observed at harvest in phosphate treated plots of G type of soil show a peculiar reduction and no explanation can be offered for this.

Table II shows the comparative figures of cane and sugar yields, as well as of primary juice analysis. Application of P_2O_5 , as can be seen from analysis figures, seems to have affected the maturing in no way. Hundreds of experiments conducted in Java have indicated that phosphate did not affect the quality of juice, nor the sugar production to any marked degree.

Phosphate application to D type of soil produced higher cane yield with little increase in sugar per acre. In G type soil, however, the application of P_2O_5 seems to have affected the crop very peculiarly. The cane yield per acre instead of showing any increase, shows slight reduction. The sugar yield per acre, however, is practically unaffected.

Research workers at Padegaon state that percentage of phosphate fixation decreases with increasing doses of phosphate applied. Largely increased applications of P_2O_5 are, therefore, likely to afford higher available quantities to the crop. An experiment conducted with this view point in G type of soil, gave results as tabulated in Table III. From these results, it may be inferred that higher application of P_2O_5 with increased nitrogen application tends to increase sugarcane yield. The optimum treatment appears to be 750 lbs. N+300 lbs. P_2O_5 . Figures of the yield of sugar, however, are not consistent.

Conclusion.

Phosphate application to sugarcane crop in D type of soil tends to produce higher yield of cane. This, however, is not the case with sugar yields which show no marked variation.

In case of phosphate application to sugarcane crop in G type soil, higher doses of P_2O_5 have produced improved cane yields. Yield of sugar is not proportionately increased. It, however, appears that higher application of nitrogen and phosphate may tend to delay maturity of sugarcane. Such plots yielding higher quantities of sugarcane may also be able to produce higher quantities of sugar with the harvesting sufficiently delayed.

The modern tendency is to produce maximum crop from a given area. This sort of intensive cultivation makes it further necessary to conduct experiments regarding different levels of P_2O_5 and other ingredients. The three most important elements NPK must, therefore, be applied in varying combinations and ratios to arrive at the optimum economic application.

References.

1. C. Van Dillewijn — Botany of Sugarcane Page 243.
2. K. S. Raghawan & D. K. Patel — D. S. T. A's Ninth Convention Part I.

Table I

Observation	SOIL TYPE D		SOIL TYPE G		
	Control 450 lbs. N	100 Lbs. P ₂ O ₅	Control 500 lbs. N	100 lbs. P ₂ O ₅	150 Lbs. P ₂ O ₅
(1) Germination:					
(a) 3 Weeks-plant population per acre	24,426	25,506	23,554	24,750	26,690
Percentage	67.85	70.85	65.43	68.75	74.14
(b) 6 Weeks-plant population per acre	28,537	29,750	27,525	28,249	29,415
Percentage	79.27	82.64	76.46	78.47	81.71
(2) Plant population per acre:					
(a) at 8 Weeks	28,774	30,348	—	—	—
(b) at 20 Weeks	69,496	74,336	80,592	79,522	79,358
(c) at Harvest	48,520	54,568	43,397	41,104	36,896

Table II

Particulars	SOIL TYPE D		SOIL TYPE G		
	Control 450 lbs. N	100 lbs. P ₂ O ₅	Control 500 lbs. N	100 lbs. P ₂ O ₅	150 lbs. P ₂ O ₅
(1) Average yield of cane tons per acre.	85.00	91.00	69.00	67.30	65.95
(2) Primary juice					
Brix	18.64	18.12	18.14	18.04	17.76
Pol	16.32	16.15	15.18	15.29	15.13
Pty.	87.55	89.30	83.68	84.74	85.19
(3) Average estimated yield of sugar-tons per acre.	7.70	7.84	7.07	6.82	7.08

Table III.
Soil Type - G

Treatment per acre	Average yield of cane Tons per Acre	Average estimated yield of sugar Tons per acre
A 1 - 600 lbs. N + 300 lbs. P ₂ O ₅	81.22	8.69
A 2 - 600 lbs. N + 150 lbs. P ₂ O ₅	79.88	8.64
B 1 - 750 lbs. N + 375 lbs. P ₂ O ₅	88.34	9.23
B 2 - 750 lbs. N + 187½ lbs. P ₂ O ₅	80.70	8.72
C 1 - 900 lbs. N + 450 lbs. P ₂ O ₅	85.96	9.12
C 2 - 900 lbs. N + 225 lbs. P ₂ O ₅	82.33	8.80

D. S. T. A.
12th Convention 1955

Ratoon Stunting & Treatment with Trace elements

1. Boron, 2. Manganese, 3. Cobalt, 4. Copper, 5. Zinc.

By

D. B. BARVE
Walchandnagar

For the last few years, the ratoon crops are showing poorer yields. Observations in the ratoon crops show profuse tillering. Some of these stools show yellow or albino coloured foliage. This feature is increasing every year. In order to see whether the yellow or albino leaves are due to deficiency of trace elements in plant nutrition an experiment was taken wherein five different trace elements (i) Boron, (ii) Manganese, (iii) Cobalt, (iv) Copper and (v) Zinc were tried. Each treatment was tried in two different sections where 20 stools or clumps were selected in March 1954, for each treatment. Out of these 20 clumps, 10 were kept for observation, without receiving any treatment of trace element. The trace elements were first dissolved separately in water and diluted in about two gallons of water and applied by thorough spraying on the foliage and irrigating round the clumps. Applications of trace elements were done twice at the interval of about fifteen days. Initial counts of total shoots, healthy or green shoots, yellow shoots and developed shoots were taken and were again recorded after each treatment for three times. The results are given in the table attached.

It will be clearly seen that none of the trace elements proved useful either for eliminating the trouble or for developing the number of successful canes. It is therefore necessary to tackle the problem in some other way which would lessen the harm.

Observations at Walchandnagar regarding effect of treating sugarcane ratoon crops showing grassy and stunting growth-crop 22.

	Initial Observations 22-4-1954.						Devp. shoots.		4-5-1954					Devp. shoots.		24-5-1954					Devp. shoots.		10-6-1954					Devp. shoots.																				
	Number of Clumps	Total shoots	Healthy Green shoots	Yellow Albino shoots	Green shoots	Yellow shoots	Number of Clumps	Total shoots	Yellow Albino shoots	Healthy Green shoots	Green shoots	Yellow shoots	Number of Clumps	Total shoots	Healthy Green shoots	Yellow Albino shoots	Green shoots	Yellow shoots	Number of Clumps	Total shoots	Healthy Green shoots	Yellow Albino shoots	Green shoots	Yellow shoots	Number of Clumps	Total shoots	Healthy Green shoots	Yellow Albino shoots	Green shoots	Yellow shoots																		
1. <i>Boron</i>																																																
A.	10	582	—	582	—	—	10	582	582	—	—	74	10	582	—	582	71	17	10	407	3	407	18	147	10	500	—	500	—	—	10	500	500	—	98	—	10	500	—	500	94	—	—	239	—	239	—	138
B.	10	500	—	500	—	—	10	500	500	—	98	—	10	500	—	500	94	—	—	239	—	239	—	138	10	500	—	500	—	—	10	500	500	—	98	—	10	500	—	500	94	—	—	239	—	239	—	138
2. <i>Manganese</i>																																																
A.	20	1140	18	1130	2	—	20	1224	1194	30	16	233	20	1321	53	1258	23	143	20	1123	104	413	31	567	20	978	18	216	—	—	20	1023	1015	19	5	207	20	1092	38	1047	170	88	20	751	109	662	87	486
B.	20	1140	18	1130	2	—	20	1224	1194	30	16	233	20	1321	53	1258	23	143	20	1123	104	413	31	567	20	978	18	216	—	—	20	1023	1015	19	5	207	20	1092	38	1047	170	88	20	751	109	662	87	486
3. <i>Cobalt</i>																																																
A.	20	916	426	333	45	20	20	1039	410	567	82	44	10	1312	513	656	84	104	10	1347	731	599	73	50	20	811	188	514	48	75	20	819	377	372	77	33	20	1015	349	567	76	90	10	941	677	399	67	44
B.	20	916	426	333	45	20	20	1039	410	567	82	44	10	1312	513	656	84	104	10	1347	731	599	73	50	20	811	188	514	48	75	20	819	377	372	77	33	20	1015	349	567	76	90	10	941	677	399	67	44
4. <i>Copper</i>																																																
A.	20	1029	125	731	98	52	20	1208	785	152	195	84	20	1028	78	787	225	82	10	394	49	84	239	—	20	853	150	555	108	40	20	936	549	156	157	74	20	945	118	534	239	84	20	373	14	119	207	33
B.	20	1029	125	731	98	52	20	1208	785	152	195	84	20	1028	78	787	225	82	10	394	49	84	239	—	20	853	150	555	108	40	20	936	549	156	157	74	20	945	118	534	239	84	20	373	14	119	207	33
5. <i>Zinc</i>																																																
A.	20	1177	312	758	75	27	20	1197	547	591	47	24	20	1374	506	843	38	89	20	951	689	269	22	19	20	1123	292	685	80	73	20	1198	592	459	114	53	20	1355	339	780	119	122	10	789	514	195	41	39
B.	20	1177	312	758	75	27	20	1197	547	591	47	24	20	1374	506	843	38	89	20	951	689	269	22	19	20	1123	292	685	80	73	20	1198	592	459	114	53	20	1355	339	780	119	122	10	789	514	195	41	39

A—Treated with trace elements.

B—Control. Not treated.



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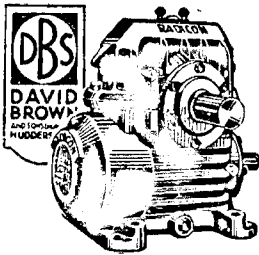
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Preliminary investigations into the causes of high recovery of Sugar

By

S. B. KADREKAR
Padegaon

Introduction

It is a well-known fact that Bombay State leads in sugar recovery in India. For the year 1952-53, the average recovery of the Bombay State was 11.51 compared with all India recovery of 9.97 (5). But within the Bombay State there is a large variation in recovery percent amongst the various sugar factories. The Kolhapur Sugar Mills is having strikingly higher recovery as compared to other factories in the Deccan Canal Area. The relevant data is presented below.

Table 1.

Recovery percentage of sugar of the Kolhapur Sugar Mills and average of the Deccan Canal Factories.

Year	The Kolhapur Sugar Mills.	Deccan Canal Factories.
1947-48	11.57	10.92
1948-49	12.53	10.74
1949-50	13.10	11.69
1950-51	13.34	11.47
1951-52	12.25	11.09
1952-53	12.79	11.29
Average.	12.59	11.20

The climatic and soil conditions of these two factories representing the two distinct tracts are given below.

Climate :—The sugarcane estate of Kolhapur Sugar Mills is situated in the "Transition Tract" of the Bombay State. Amount of rainfall varies from 25-45" and is concentrated in the months of June to September being the heaviest in July and August. The maximum temperature seldom goes above 100°F and below 50°F.

The Phaltan Sugar Works estate is situated in the "Dry Tract" of the Bombay State, the rainfall is hardly 15-20" with its extremely precarious distribution. Heavy showers in September and October are not uncommon. The maximum temperature reaches upto 104° to 107°F and minimum upto 45°F.

Soils :—The estate of the Kolhapur Sugar Mills is situated on either side of the Panchaganga river within a belt extending upto a mile from the banks. Thus the soils are mostly alluvial in nature and are of considerable depths near the bank. About 70% of this area get flood water which brings lot of silt, due to which the soils are rich in clay (3).

The soils of Phaltan Sugar Works are undulated and major portion of it falls under the soil types B, F and D of the Deccan Canal Soils (2).

Preliminary investigations into the causes for differences in recovery of sugar in two factories forms the content of this paper. Detailed investigations as regards the quality of juice in the Kolhapur Sugar Mills and the Phaltan Sugar Works—a representative factory of the Deccan Canal Area—have been reported here.

Material and Methods

A detailed study of crusher juice from the Kolhapur Sugar Mills and the Phaltan Sugar Works was undertaken in the crushing seasons of 1951-52 and 1952-53. About 15 trials were taken at each factory in two lots at an interval of about a month or so in the first season. The cane crushed for each trial varied from 20 to 50 tons. During the first sampling of the first season, Adsali crop was harvested, while during the second sampling Ratoon crop was crushed. In the second season, juice analysis from Prize plot—plot representing cane with heavy nitrogenous manuring—was undertaken from these factories. Manuring and cultural practices, however, varied according to the factory. The juice was analysed for Brix, Sucrose, Ash, Total Nitrogen, Albuminoid Nitrogen, Total P_2O_5 , K_2O and CaO according to the standard methods (1, 10 and 12). The fibre in cane was also estimated for all trials.

Results and Discussions

The juice analysis data of these two factories is presented in Table 2-A, 2-B and 2-C for Adsali, Ratoon and Prize plot cane respectively.

Referring to Table 2-A (Adsali crop) it is observed that the ash % in juice in case of the Phaltan Sugar Works is higher than that of Kolhapur Sugar Mills. This high % of ash may be attributed to the high content of K_2O in juice, which is due to high available K_2O (0.023 %) in soils of Phaltan Sugar Works as compared to low available K_2O (0.013 %) in soils of Kolhapur Sugar Mills (9). This higher percentage of ash seems to have reflected adversely on the recovery %. Similar conclusions have been arrived at by Lander and Ramji Narain (3) who report that it is the greater amount of ash in the cane juice, rather than its slightly lower sucrose content, which is responsible for low recovery.

Table 2-A

43

Juice analysis data of first sampling - Season 1951-52.

Variety - Co. 419

Factory	Crop	Nitrogenous manuring.	Brix at 17.5°C	Sucrose %	Purity %	Ash % mgs	Total Nitrogen % Juice mgs.	Albuminoid Nitrogen % Juice mgs.	Total P ₂ O ₅ % Ash mgs.	K ₂ O % Ash mgs.	CaO % Ash mgs.	Fibre % cane	Recovery
The Phaltan Sugar Works.	Adsali	550.0 lbs.	19.55	17.07	87.31	349.4	51.40	33.30	16.25	47.82	34.97	12.89	12.30
The Kolhapur Sugar Mills.	-do-	300.0 „	22.13	19.61	88.61	290.8	26.60	18.10	14.37	36.34	32.35	11.62	14.17

Table 2-B

Juice analysis data of second sampling-season 1951-52

Variety - Co. 419

The Phaltan Sugar Works.	Ratoon	350.5 lbs.	19.71	15.71	79.71	353.0	21.80	15.50	8.13	41.95	18.58	14.78	9.98
The Kolhapur Sugar Mills.	-do-	300.0 „	19.82	15.76	79.52	273.0	22.30	12.60	8.02	29.26	37.72	12.59	9.71

Table 2-C

Juice analysis data of harvest sample from Prize Plot 1952-53

Variety - Co. 419

The Phaltan Sugar Works.	Adsali	1570.00 lbs.	18.98	16.87	88.88	340.0	51.12	21.70	4.91	47.73	22.40	12.37	12.53
The Kolhapur Sugar Mills.	-do-	1612.00 „	19.39	17.27	89.02	256.0	49.80	18.60	1.25	20.23	25.37	9.77	12.35

Total Nitrogen in juice in case of Phaltan Sugar Works is double than that of Kolhapur Sugar Mills. The high content of total Nitrogen has also reflected in giving low recovery in case of Phaltan Sugar Works. Similar observations have been recorded by Lander and Chopra, (7) while finding the causes of inferior quality of Punjab canes as compared with U. P. for sugar production. The high total Nitrogen is due to the heavy nitrogenous manuring adopted by the Phaltan Sugar Works, which is about double than that of Kolhapur Sugar Mills. Nitrogenous manuring increases the growth (the yield) but at the same time tends to increase the percentage of impurities in the juice and consequently lowers the recovery.

In case of Ratoon cane juice (Table 2-B), the brix and purity are low and almost equal with similar recovery percent in both the factories. The nitrogenous manuring applied in both the factories is practically equal and as such the total nitrogen in juice is more or less the same. The low ash content observed in case of Kolhapur Sugar Mills juice is due to low K_2O content in the juice.

For further confirmation of this data, juice analysis from Prize Plot-plot receiving high nitrogenous top dressing-was undertaken in case of Phaltan Sugar Works and the Kolhapur Sugar Mills in the following year. The analytical data of the juice is presented in Table 2-C. It will be seen from the table that high total nitrogen content in the juice is responsible to some extent for the low recovery in case of Kolhapur Sugar Mills. It is worthwhile to note that in case of normal Adsali Crop of Kolhapur Sugar Mills (Table 2-A) the total nitrogen content in juice is 26.60 mgs. which has risen to 49.80 mgs. in case of Prize Plot juice lowering down the recovery from 14.17 to 12.35 %. The P_2O_5 content in the juice of Prize Plot has been tremendously reduced due to heavy nitrogenous manuring, thus disturbing the N/P ratio. The nitrogen content in case of Phaltan Sugar Works Prize Plot juice did not show any further increase over the Normal Adsali crop probably due to the fact that about 51.12 mgs. was practically the limit of Nitrogen content in juice. This is also supported by Nitrogen content in Prize Plot juice of Kolhapur Sugar Mills where it reached up to 49.80 mgs. indicating that higher dose of nitrogenous manure can increase Nitrogen content of juice only upto a limiting level.

The P_2O_5 content in the juice of Phaltan Sugar Works is somewhat higher than in case of Kolhapur Sugar Mills (Table 2-A, 2-B and 2-C). Though there is a vast evidence that higher P_2O_5 content in the juice improves its quality as regards clariability and recovery (11), this fact is not brought out clearly from these results probably due to the masking of other factors such as high % of ash, K_2O and total nitrogen content in the juice.

It is likely that the periodical availability of N, P, K in soils throughout the growth period of cane as well as weekly detailed analysis of juice throughout the crushing season for ash, Total and Albuminoid Nitrogen, Total and Inorganic

P_2O_5 , K_2O , CaO and Fibre content in cane, may throw some light on the various factors affecting the recovery.

Various ratios of the mineral as well as organic constituents present in the juice were worked out and are presented below in Table 3.

Table 3.

Various ratios of mineral and organic constituents present in the juice.

Factory	Crop	N/ P_2O_5	N/ K_2O	N/ CaO	$\frac{\text{Organic N}}{\text{inorganic N}}$
1. Phaltan Sugar Works.	Adsali.	3.16 (—)	1.07 (+)	1.47 (+)	1.86 (—)
2. Kolhapur Sugar Mills.	-do-	1.85 (+)	0.73 (+)	0.82 (+)	2.12 (+)
3. Phaltan Sugar Works.	Ratoon.	2.68 (—)	0.51 (+)	1.17 (+)	2.46 (+)
4. Kolhapur Sugar Mills.	-do-	2.78 (—)	0.76 (+)	0.59 (+)	1.29 (—)
5. Phaltan Sugar Works.	Prizeplot	10.40 (—)	1.07 (+)	2.28 (—)	0.73 (—)
6. Kolhapur Sugar Mills.	-do-	39.84 (—)	2.46 (—)	1.96 (+)	0.59 (—)

(+) Ratio beneficial for recovery. (—) Ratio not beneficial for recovery.

It is tentatively taken that the ratio values less than 2 of N/ P_2O_5 , N/ K_2O and N/ CaO and more than 2 of Organic N/Inorganic N are beneficial for higher recovery. Spencer and Meade (11) have observed that Nitrogen compounds which are coagulated by heat and lime (albuminoids or protein materials) are beneficial, as they aid in clarification. Amongst these ratios it is noticed that N/ P_2O_5 ratio has high influence on recovery percent. This, however, requires further confirmation.

The fibre, which is nothing but dry water insoluble matter of sugarcane which greatly influences the milling house efficiency and recovery has been found lower in case of Kolhapur Sugar Mills. This fact is interesting since the variety at both places was the same viz. Co. 419. Hartt (6) while finding differences in anatomy occurring in plants when supplied with different amounts of potassium has observed that potassium increases cutinization. This fact might be responsible for high fibre content in case of Phaltan Sugar Works where there is a greater absorption of K_2O as compared with that of Kolhapur Sugar Mills.

It may be added that the peculiar nature of soils and flooding during monsoon causes leaching away of soluble salts and surplus nutrients especially nitrates in case of Kolhapur Sugar Mills. This probably maintains optimum availability of major plant nutrients which is partly responsible for the good quality of cane obtained at this factory. Dutt and Iyer (4) while working at Coimbatore have found that in wet lands where the soil is deep & heavy and is subject to flood irrigation, the canes mature early and the sucrose content is

higher than in garden lands. So also due to the variation in precipitation at these two factories the total soluble salts in the soils of Kolhapur Sugar Mills are lower than in soils of Phaltan Sugar Works.

Summary and Conclusions.

1. To study the probable causes of high recovery usually obtained by Kolhapur Sugar Mills compared with the sugar factories of the Deccan Canal Area, preliminary investigations were carried out in the years 1951-52 and 1952-53. The Phaltan Sugar Works was selected to represent the Deccan Canal factories.

2. The low ash content and low total nitrogen in juice from the Kolhapur Sugar Mills is partly responsible for high recovery. The high ash content in case of Phaltan Sugar Works juice is due to more K_2O absorption and high N content due to heavy nitrogenous manuring followed in that factory.

3. The N/P_2O_5 ratio in the juice was found to have greater influence on recovery per cent amongst the different ratios of mineral constituents present in the juice.

4. The Fibre % in cane was found to be low in case of Kolhapur Sugar Mills as compared with that of Phaltan Sugar Works with the same variety Co. 419, which seem to be related with K_2O uptake.

5. The climatic and the peculiar nature of flooding of cane fields in monsoon in case of Kolhapur Sugar Mills seem to be responsible to a certain extent in improving the quality of cane due to the maintenance of low soluble salts in soil and flushing of surplus plant nutrients, thus maintaining optimum availability of major plant nutrients.

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D. S. T. A.
12th Convention 1955

Occurrence of Pyrilla pest in the Bombay State during the last five years and the present position regarding its control

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Introduction.

The Pyrilla pest has been appearing in epidemic form on the Deccan Canals since 1950-51 and has caused much anxiety to both cultivators and sugar factory owners. However the pest was more serious and widespread on Pravara and Godavari Canals than at other places. It has remained surprisingly absent uptil now in the regions of both Kolhapur and Karnatak.

It is not necessary to give the historical account, the life history, the seriousness of the damage and the control measures of the Pyrilla pest as the same have been dealt with by Wagle, P. V. (1951) in his paper entitled "The Pyrilla problem in Bombay Deccan". Further the account regarding the difficulties met in applying control measures has been given by Raja Rao, S. A. (1954) in his paper entitled "Fight against Pyrilla". This being however the sixth year since the pest has been appearing in the epidemic form in the Bombay State, an attempt is made here to give the account of the fluctuations that have occurred in the incidence of the pest at various places during the last five years and also to explain the present position regarding its control.

Fluctuations occurred in the incidence of the pest and the position of the control work.

Although the pest had been making its appearance in the mild form since 1946, it was in 1950-51 that for the first time, it multiplied considerably on Girna, Godavari, Pravara and Nira Canals in the Bombay Deccan. The area affected by the pest along with the severity of its incidence and the area treated with control measures during the last five years on various canals in the Bombay State, for both the cultivators and the factories combined, are given in Tables 1 and 2.

Table 1.

Area (in acres) affected by *Pyrilla* along with the type of its attack in different years.

Canal	1950-51		1951-52		1952-53		1953-54		1954-55	
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Girna.	194	Mild.	2105	Severe	1203	Mild.	419	Mild.	1309	Mild but severe at some places.
Godavari	68	Medium	4620	Severe	3632	Severe	4674	Very Severe	648	Mild.
Pravara.	400	Severe	6316	Severe	6135	Severe	8573	-do-	2514	Mild.
Nira L. B.	646	Mild.	2515	Mild & severe at some places	30	Mild.	483	Mild.	275	Medium.
Nira R. B.					242	Mild.	655	Mild.	258	Mild.

(A - Area affected in acre; B - Type of attack.)

Table 2.

Area (in acres) treated with control measures in different years.

Canal	1950-51	1951-52	1952-53	1953-54	1954-55
Girna	22	1512	749	263	1048
Godavari	53	3606	903	2721	54
Pravara	278	3114	2848	3663	1068
Nira L. B. }	162	197	26	305	47
Nira R. B. }			7	294	—

Discussion.

From Table 1 it is evident that the pest had multiplied itself considerably in the year 1950-51, spreading more or less on the uniform scale on all the canals. The attack was comparatively more severe on Pravara canal. The area affected by the pest increased in 1951-52 when about 15000 acres were infested on canals. Along with the spread, the severity of incidence also increased. The pest was serious on almost all canals, but the attack was particularly more severe on Godavari and Pravara canals, which may be due to the more concentrations of cane that are found there. The dusting of 5% and 10% BHC was tried and proved effective, but it could not be carried out on Adsali cane because

of its tall growth and the lodging occurred. It was experienced during this year that the egg parasite (*Testatrichus pyrillae*) and the fungus parasite (*Metarrhizium anisoplae*) the presence of which also was noticed in nature, played a very important role in putting down the pest. This occurred at the end of monsoon. It may be noted however that as per the life history studied in Punjab and U. P., the pest is not active, as a rule, during cold weather from November to February.

Both the attack and the spread of the pest were as severe in intensity (if not more) in 1952-53 as in 1951-52. The area affected was about 11000 acres. The infestation was particularly more severe in the fields of cultivators on Pravara canal and on the estates of Godavari Sugar Mills both at Sakarwadi and Laxmiwadi on Godavari canal. The infestation was considerably reduced on both the Nira canals from both the area and the intensity points of view. During this year, the parasitism by *Testatrichus pyrillae* was found to be very high (but varying from month to month) during the monsoon. It was 33.3% in June, 78.3% in August and 19.8% in December. The fungus parasite was also reported to be effectively working in nature.

In the monsoon of 1953, the attack of the pest was severe-most in Ahmednagar district, especially on the estates of Godavari Sugar Mills on Godavari canal, and on the fields of Maharashtra, Belapur and Pravaranagar canal. Out of 15000 acres of cane affected by the pest, about 7000 acres were reported to have been treated with the dusting of 5 to 10% BHC. The attack had suddenly subsided by the end of monsoon and the causes were attributed to the appearance of the fungus parasite. Since cane growers thought that it was not necessary to take up any control measures as the pest would be automatically controlled by the fungus, a note was presented by Patel, R. M. (1954) at the 11th Conference of the D. S. T. A. in which the attempts were made to explain the correct position regarding that parasite. It was pointed out that the fungus could be depended upon for the control of the pest only when its artificial multiplication was possible and practical. Some sugar factories had attempted to multiply the fungus artificially in field but with no success. Further it multiplies in nature only under certain environmental conditions which are yet not studied and known. Even when it is able to multiply in nature so as to be capable to control the pest it does so generally by the end of the monsoon only i. e. after the severe attack of the pest and the full damage done by it. Further observations also show that it is not always true that once the fungus appears in nature the pest is immediately controlled as was usually believed by certain cane growers. It is therefore necessary that the insecticidal measures are resorted to as soon as the pest is found to be multiplying.

Further, from the Tables 1 and 2, it will also be noticed that in no year and at no place was the affected area completely treated with any control measures. The Bombay Agricultural Pests and Diseases Act was therefore applied against *Pyrilla* to the Sugarcane growing talukas of the Ahmednagar District where the

infestation of *Pyrilla* was always severe. The Act, to begin with, was applied for one year from 1st October 1953 and was extended for a further period of one year from 15th October 1954. As a result of this work, it was found that cane growers, especially cultivators, became more pest control conscious than they were before. The account regarding the application of the Act has been given by Patel, R. M. and Arakeri, H. R. (1955) elsewhere.

During the monsoon of 1954, the attack of *Pyrilla* was much less in both the spread and severity on Pravara and Godavari canals where the Pest Act was applied, but it became comparatively more serious on Girna canal. On the Nira left bank canal also the attack which remained mild in previous years became medium in severity, although the area attacked was not increased.

From May 1955, the pest has again been noticeable in patches on Pravara and Godavari Canals and also on Girna canal. It is completely absent however on Nira Left Bank Canal. As for the attack on Pravara and Godavari canals, it is much more on the former than on the latter.

Stocking of Spraying and Dusting Equipment

Under the scheme for the control of *pyrilla* in the Ahmednagar district, Government has purchased five power dusters, two power sprayers, forty hand dusters and fifteen sprayers and stocked them at Shrirampur and Kopergaon.

The power dusters are of the New Agricola field-cum-portable type, with 2/2.25 H. P., Petrol start/Kerosene running Engine and 40/85 lbs. capacity powder hopper. The power sprayers are of 'Patra-Z' transportable type with 2/2.25 H. P., Petrol start/Kerosene running Engine and 18 gallons capacity steel tank.

Aerial Spraying.

It is experienced by all that ground spraying or dusting operation is difficult to be carried out in the grown up cane, especially in the case of Adsali. It is more difficult when the cane is lodged. Although it has not been possible to try proposed helicopter dusting in the Bombay State, the results of the aerial spraying successfully done in Bhopal by Govt. of India against *Pyrilla* are available. The insecticide used was Endrine. The application rate was 1 lb. of 19.5% Endrine emulsification concentrate in 2 gals. of water per acre. A Piperoute aircraft belonging to Hind Flying Club to which a special spraying equipment was attached was used for the purpose. The height of the sugarcane crop was 15 ft. The tank of the spraying equipment attached to the aircraft carried 34 gallons of spray (which was sufficient for 17 acres of crop) in one flight, which took 20 minutes to be finished. The base for landing the aircraft was 20 miles away from the spot of operation, and the pilot took one hour in finishing one trip which included tank filling, spraying and returning to the base. Between 7 A. M. and 1 P. M. only six such trips could be made. All the nymphs and adults died in 24 hours. The cost came to Rs. 10/- per acre including the price of insecticide when calculated on the basis of 650 acres that were sprayed during the operation.

The cost could have been further brought down if half the rate of insecticide (i. e. 8 oz. per acre) were used and the landing ground were available nearer to the place of operation.

Summary.

An account of the area affected by the Pyrilla pest, the severity of its incidence and also the area treated with control measures during the last five years on various canals in the Bombay State is discussed and the fluctuations that appeared to have occurred in the infestation explained. The attack of the pest was more concentrated on Godavari and Pravara Canals and was entirely absent in the regions of Kolhapur and Karnatak throughout the period. The pest was very severe in 1952-53 and 1953-54.

It was observed that the fungus control alone is not enough to solve the Pyrilla problem.

The Bombay Agricultural Pests and Diseases Act was applied to the Ahmednagar district for one year from 1st October 1953 and was extended for the further period of one year from 15th October 1954. The advantages of the Act were definitely noticeable in that it made cane growers pest control conscious. Power dusters and power sprayers have been recently purchased by Government for the control of Pyrilla and are stocked at Shirampur and Kopergaon.

The account of the aerial spraying with Endrine, which was successfully carried out by Government of India against Pyrilla in Bhopal, is given.

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Dicalcium Phosphate for Clarification of Cane Juice

By

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The important role phosphate plays along with lime in the clarification of cane juice is long known. The precipitate of calcium phosphate formed during clarification removes, while settling, coloring matter, colloids, iron-polyphenol compounds and other suspended impurities. It has been established that a certain minimum of phosphate content in juices (depending upon the nature of juice) is necessary for getting good clarification results. This minimum has been roughly placed at 300 mgms of P_2O_5 per litre of juice. There have, however, been cases where small P_2O_5 contents (200 mgms P_2O_5 per litre of juice) have given good clarification while in others much high P_2O_5 contents (400 mgms P_2O_5 per litre of juice) have failed to give the desired results. The minimum requirement of P_2O_5 in juice appears to depend upon the content of those colloidal impurities, for removing, which we depend upon the calcium phosphate precipitate.

It is general practice to make up the deficiency of P_2O_5 content in juice by adding externally to the juice, phosphate in some form or the other. The types of phosphates generally used for this purpose are:—

- (1) Single, Double or Triple super-phosphate containing water soluble mono calcium phosphate.
- (2) Phosphoric Paste containing about 40–42% water soluble phosphate prepared from rock phosphate and phosphoric acid.
- (3) Phosphoric acid.
- (4) Dicalcium phosphate.

Objections are raised against the use of single or double super-phosphate due to their high content of calcium sulphate. Triple super-phosphate is now being extensively used either in the form of a thick slurry or aqueous extract prepared by decantation or filtration. While decantation involves labour and inefficient extraction, if too much dilution is to be avoided, filtration involves acid resisting pumps and presses with all the attendant difficulties. The price of phosphoric acid prohibits its general use though good results are obtained with it.

When the advantages of using dicalcium phosphate as phosphatic manure were being discussed, investigations as to its possible use for clarification purposes also was suggested by our Director Seth Govindji Raoji. Results of preliminary experiments done at Ravalgaon were published.(1)

Dicalcium phosphate contains 35 to 42% P_2O_5 . It is insoluble in water but soluble in citric acid. Its use in juice clarification was advocated by Adam (2) who has pointed out that dicalcium phosphate is capable of eliminating gums and colloids without scaling the evaporator. Attempts made for its use in juice clarification have so far been not satisfactory because of its insolubility in water, and where it was used, huge quantities of the order of 6 Kgms. per ton of cane were required while the triple super-phosphate required is of the order of only 350-400 gms. per ton of cane.

For getting good clarification results it is necessary that the calcium phosphate precipitate must take place in situ. For achieving this with the use of dicalcium phosphate successfully it should first be brought into solution.

Solubility of dicalcium phosphate in buffer solutions of different pH (prepared from sodium acetate and hydrochloric acid) at 60°C was studied and the following results were obtained.

pH	Concentration of P_2O_5
3.95	413 mgms per litre
4.19	399
4.49	355 " " "
5.20	249 " " "

It will be seen from the results that at a pH of 5 we will have in solution more than 250 mgms of P_2O_5 per litre, quantity generally required to be externally added. Good clarification results were obtained if the juice after the addition of dicalcium phosphate is presulphited to the desired pH. But best results were obtained when di-calcium phosphate was added in solution. As sulphurous acid is necessarily available in sugar factories, attempts were made to use the same for solubilising di-calcium phosphate.

A small sulphur furnace of the usual type was prepared for these experiments and the concentrations of SO_2 in sulphurous acid prepared by bubbling SO_2 from (i) this furnace and (ii) laboratory cylinder were determined.

(A) Water saturated with SO_2 from cylinder at room temperature	4.4 gms SO_2 /100 c. c.
(B) —do— at 15°C	9.6 gms SO_2 /100 c. c.
(C) Water in which SO_2 from sulphur furnace was bubbled	2.1 gms SO_2 /100 c. c.

Sulphur dioxide from this furnace and from cylinder were separately passed through a slurry of dicalcium phosphate and the amount of P_2O_5 in solution was determined.

SO_2 from cylinder at room temperature	1.28 gms P_2O_5 /100 c. c.
SO_2 from cylinder at 15°C	1.334 " " "
SO_2 from furnace	0.900 " " "
	0.977 " " "
	0.986 " " "

It was thought the concentration of SO_2 in gas from this small furnace was insufficient and so gas from factory furnace (Acme burner) was used. A slurry was made by adding 7 gms of dicalcium phosphate in 100 c. c. distilled water. SO_2 from the cylinder and factory furnace was passed separately through the slurry. Most of the sample went into solution. Concentration of P_2O_5 in resultant solutions was determined.

	Conc. of P_2O_5	Time
SO_2 from cylinder	2.556 %	
SO_2 from factory furnace (Solution at room temperature)	2.662 %	1 hour
SO_2 from factory furnace (Solution at 50–60°C)	2.648 %	1 hour

SO_2 gas from Acme-burner was passed through a slurry of dicalcium phosphate in water (15 gms/100 c. c.) for 20, 40 and 60 mts. The concentration of P_2O_5 in solution in the three cases was found out to be:-

Time	Concentration of P_2O_5 in solution
20 minutes	4.63 % P_2O_5
40 "	4.32 % "
60 "	4.56 % "

From the above tables it will be seen that major portion of P_2O_5 goes into solution even in 20 mts.

Preliminary experiments of clarification of Lab.-crusher juices were done using solubilised di-calcium phosphate and the results obtained were very encouraging.

Use of solubilised dicalcium phosphate brings out another advantage namely, further addition of SO_2 and with it large quantities of air are minimised or altogether eliminated.

Encouraged by these results, experiments were done in laboratory on mixed juice obtained from factory. The results obtained are given in Tables No. 2 & 3. The results clearly show that rate of settling is fast, mud volume is low and the CaO and Ash contents in clarified juice are comparatively less.

Factory Trial.

As the results of our laboratory experiments were promising, a factory trial was given for use of solubilised dicalcium phosphate. Di-calcium phosphate was obtained from D. C. M. Ltd. Delhi, analysis of which is given in Table No. 1. A small copper vessel with a perforated SO_2 coil in it was fabricated locally to prepare sulphurous acid, and this sulphurous acid was used to solubilise dicalcium phosphate, which was added to mixed juice in the required proportion.

The results obtained were far beyond our expectations. Mud volume was low, clear juices were brilliant, and further processing on the pan-floor and at

centrifugals was greatly facilitated. In our factory, during the high brix period, Dorr used to vomit mud, as it were, because of high mud volume. But with the use of dicalcium phosphate, not only was this conspicuously absent but the use of filter presses which was a constant feature under these circumstances could be done away with. Consequently the load on the Oliver was less and its working satisfactory.

Because of the good results obtained, its use was continued till the end of the season. The sugar quality also greatly improved.

Other advantages.

If di-calcium phosphate can replace triple super-phosphate (as it promises to), the following advantages can be derived:-

(1) Sulphuric acid required for the manufacture of Triple Super-phosphate can be diverted to other important purposes.

(2) The bye-products Hydrogen and Chlorine of caustic soda industry can be profitably used in the manufacturing of HCl required for the preparation of di-calcium phosphate from rock phosphate.

Table No. 1

Analysis of Di-calcium phosphate from D. C. M. Co., Delhi.

(1)	P ₂ O ₅ soluble in 2% citric acid	..	30.40%
(2)	P ₂ O ₅ soluble in water	..	4.21%
(3)	P ₂ O ₅ total	..	41.20%
(4)	Chloride	..	0.50%

Table No. 2

Clarification Results

	A Dicalcium phosphate	B Triple super phosphate	C Triple super- phosphate & presulphitation
(1) <i>Settling rate</i>			
Original volume	1000 c. c.	1000 c. c.	1000 c. c.
Mud volume in first 40 minutes	300 c. c.	350 c. c.	325 c. c.
(2) <i>CaO</i>	952.0 mgms per litre	963.20 mgms per litre	968.80 mgms per litre
(3) <i>Ash</i>	3.57 % 3.383% Bx.	0.56% 3.386% Bx	0.56% 3.421% Bx.

Table No. 3

	Di-calcium phosphate	Triple super phosphate	Triple super phosphate & presulphitation
(1) <i>Settling rate</i>			
Original volume	1000 c. c.	1000 c. c.	1000 c.c.
Mud volume in first 40 mts.	240 c. c.	330 c. c.	260 c. c.
(2) <i>CaO</i>	952.0 mgms per 1000 c. c.	968.8 mgms per 1000 c. c.	974.4 mgms per 100 c. c.
(3) <i>Ash</i>	0.644 % 3.52 % Bx.	0.639 % 3.54 % Bx.	0.660 % 3.68 % Bx.

Acknowledgement

The authors are grateful to our Director, Seth Govindji Raoji for his initiative, keen interest and encouragement in the work.

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D. S. T. A.
12th Convention 1955

Improving the colour of gul

By

V. K. LELEY, S. B. KADREKAR & R. A. KALE
Padegaon

Introduction

It is a common observation in a gural that, freshly prepared gul usually has an attractive orange yellow colour, but after a few days the colour generally changes and acquires a dark green shade. This goes on increasing and in many cases the gul block becomes dark tan within a couple of months. The colour problem became more critical with the introduction of the new sugarcane variety Co. 419 and excepting only a few cultivation centres like Kolhapur and Sangli the general colour of the gul in this tract was spoiled.

A number of studies on improving gul colour have been published. Many of them were aimed at the clarification of the juice (2,5,6) and a few at the colour improvement. Gadgil (3) has shown that addition of superphosphate to the juice, changed the gul colour to golden yellow and improved its grade. Since

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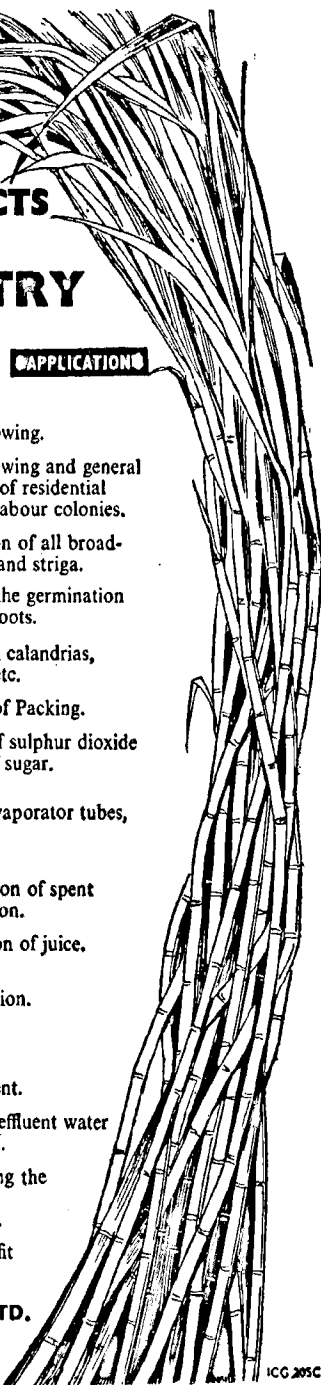
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then, use of superphosphate or phosphoric acid has become almost a common practice in gul boiling. However, the addition is found not to work in many cases and the problem was further persuaded. It has been suggested (1) that the reaction between reducing sugars and Nitrogen compounds was responsible for colour and quality of gul. It was also found that high phosphate content of the juice was associated with good colour (12). Concentration of different nitrogen fractions and of ash constituents have also been found to decide the quality of gul or sugar (8, 9, 7). Zerban (10, 11) studied the tannin content of sugarcane juices and showed that they form blue green pigments with iron. Biswanath (1) did not find any relation with tannin content of the juice and the colour of gul. Jabkan (4) reviewed the effect of iron on sugar colours and concluded that, colouration of gul was more due to iron content and the formation of deeply coloured compounds with tannins than to caramelization. This paper presents further observations on the effect of phenolic bodies and discusses a method for eliminating this trouble.

Material and methods

Sugarcane juice samples were from the various manurial treatments at the Padegaon Farm. Phenolic bodies from the juice samples were estimated with the Mitchell's colorimetric method using 'Eel-photoelectric colorimeter' for measuring optical density of the colour. Green filter (Eel. tricolour No. 404) was found to be complimentary to the iron phenol colour and gave a linear relation between optical density and gallic acid concentration. Effect of original juice colour on the optical density was found to be negligible when 2 mls. of juice were diluted to 10 mls. It was found that addition of a soluble Citrate at pH 5.5 completely discharged the iron phenol colour. This was used to measure the phenol free colour of juice or gul solutions by adding 0.2 mls. of 20 per cent neutral ammonium citrate solution and adjusting the pH to 5.5 with a drop of 1:4 Sulphuric acid. Comparative gul colours were read in 20 per cent solution with the same green filter, using optical density of the solution as a measure of colour.

Results

Phenolic bodies per 100 mls. of some typical juice samples and the effect of phosphate fertiliser on their concentration are shown in Table 1. The juice samples were of Co. 419 variety. Juice was extracted on a bullock crusher and after boiling, it was filtered hot on whatman No. 42 paper. 2 mls. of juice sample was treated with 2 mls. of the Mitchell's reagent and diluted to 10 mls. with distilled water. Optical density of the solution was read after 10 minutes.

Table No. 1.

Concentration of phenolic bodies in juice samples.
(Expressed as mg. gallic acid per 100 mls. juice)

Sample No.	Juice	Gul solution
1.	20.50	21.00
2.	19.25	21.00
3.	20.00	18.25
4.	21.00	20.00
5.	20.50	20.00
6.	20.25	18.75
7.	17.00	15.00
8.	19.25	17.75
9.	17.00	15.75
10.	16.50	15.00
11.	17.00	16.00
12.	15.50	15.00
13.	6.50	—
14.	2.50	—

The first six juice samples were from canes, wherein phosphate deficiency was clearly shown, while sample Nos. 8 to 12 were from phosphate fertilized canes. Phosphate (P_2O_5) content of the first samples was of the order of 5 mg. per 100 mls. of juice. It was increased to about 25 mg. per 100 mls. after phosphate fertilization. This however did not decrease the phenol content of the juice appreciably. Sample Nos. 13 and 14 were extracted on hand mill before and after removing the rind. Evidently the cane rind contributed the major quantity of phenols and increased crusher helped to extract them. The third column of the table shows the phenol content of solutions of gul, prepared from the above juice samples and dissolved in water to contain the same per cent solids as in the corresponding juice samples. No juice clarificants were used in preparing gul. The figures show that in normal boiling and scumming, phenolic bodies were not removed to any appreciable extent.

These phenolic bodies when combined with iron in the juice form blue green pigments and impart dark colour to gul. Table 2 gives optical densities of 20 per cent solution of a few gul samples when prepared in an iron pan and in a porcelain dish. Cane samples were from different blocks and were crushed on power crusher for a large scale gul boiling.

Table No. 2

Optical densities of 20 per cent solution of a few gul samples.

No.	Particulars of gul samples	Optical Density		
		Prepared in an Iron pan	Prepared in a porcelain dish	Solutions from Col. 3 after treatment with Citrate
1	2	3	4	5
1.	Boiled in Laboratory pan.	100.0	35.5	—
2.	Boiled in large pan.	83.0	44.0	—
3.	Boiled in large pan.	70.0	44.0	—
4.	Boiled in large pan.	67.0	34.0	35.0
5.	Boiled in large pan.	85.0	38.0	50.0
6.	Boiled in Laboratory pan.	56.0	38.0	36.0
7.	Boiled in large pan.	58.0	—	33.0
8.	Kolhapur gul.	31.0	—	26.0
9.	Kolhapur juice boiled in Laboratory pan.	50.0	36.0	31.0
10.	Kolhapur gul again evaporated in the Laboratory pan.	78.0	—	31.0

When boiled under identical conditions with respect to temperature etc. the large difference in optical densities of gul solutions prepared in an iron pan and in a porcelain dish was obviously due to the formation of iron-phenol pigments in the former. This was further confirmed when the solution was treated with ammonium citrate of pH 5.5. The optical density was reduced almost to the value obtained for the corresponding porcelain dish. Gul No. 5 was an exception where along with iron phenol colour, excessive caramelization was also indicated. Evidently, therefore, there was nothing intrinsically wrong with the juice samples and they could have given bright coloured gul, comparable to Kolhapur (Sample No. 8), had they been boiled in iron free condition. As all the juice samples, re-evaporated in porcelain dish were extracted on a power crusher, the major contamination of iron was from the boiling pan where hot juice remained in contact with iron for over 3 hours. Sample No. 9 was prepared from juice which was brought from Kolhapur. When it was evaporated in the Laboratory iron pan, it gave a dark colour gul, mainly due to iron contamination. Similarly when the golden yellow Kolhapur gul (No. 8) was dissolved in water and again evaporated in the iron pan (Sample No. 10) its optical density increased from 31 to 78 which was again mainly due to iron phenol pigments as the increased colour could be completely discharged by addition of the citrate (Col. 5).

Table No. 3.
Optical densities of 20 per cent gul solutions prepared in Galvanised Iron Pan

Gul sample No.	Galvanised Iron Pan		Iron Pan.	
	Original solution.	After addition of the Citrate.	Original solution.	After addition of the Citrate.
1	2	3	4	5
<i>Laboratory trials</i>				
1.	25.0	—	40.0	—
2.	31.0	21.5	—	—
3.	43.0	24.0	66.0	30.5
4.	25.0	18.0	52.0	30.0
<i>Commercial Scale trials</i>				
5.	45.0	39.5	56.0	40.5
6.	32.0	24.5	55.0	38.0
7.	41.0	30.5	58.0	32.0
8.	32.0	23.0	53.0	32.0
9.	34.5	24.0	51.0	29.5
10.	38.0	34.5	56.0	34.0

Three methods suggest themselves for obtaining good yellow coloured gul (1) the advantage can be taken of the suppressing effect of Citrates on the iron phenol colours. (2) Removal of the phenolic bodies or (3) juice can be evaporated in non-ferrous pans. The former was however not practicable as due to the presence of calcium in cane juice, a large quantity of a soluble citrate was required to effectively suppress the iron pigments. Besides its high cost, such a large quantity of citrate imparted a saltish taste to gul and was likely to impair its keeping quality. No suitable method could be found to remove phenolic bodies from the juice. Precipitation of phenols from the juice was rendered difficult by the presence of organic acid salts. The only alternative left was to reduce the contamination with iron to a minimum. It was found that contamination from the crusher was not appreciable. Storage tanks and pipe lines when used added sufficient quantities of iron, but the major quantity came from the boiling pan. This could be reduced to a minimum if galvanized ware was used for storing, piping and boiling of the juice. Optical densities of a few gul samples prepared in the laboratory, as well as on commercial scale in Galvanised Iron pans are shown in Table 3. It also gives figures for gul samples prepared simultaneously in an iron pan, using the same juice. No clarification treatment, excepting bhendi plant extract was used in either case. Optical density of gul solutions (20 %) was considerably less in the case of galvanised iron pan samples. In the case of iron pan samples, the darker colour was due to iron phenol pigments, as it could be reduced by addition of citrate (Col. 5). Optical density of Galvanised Iron pan samples was also a little reduced by the citrate addition, indicating a slight iron contamination from the crusher. It was however not marked and the gul colours were comparable with the Kolhapur sample given in Table 2. In sample No. 3, 5 and 7 a greater contamination with iron was apparent.

The use of galvanised iron ware thus effectively prevented formation of iron pigments and produced a marked improvement in gul colour. A similar improvement in gul colour is also produced by addition or reducing agents like sodium hydrosulphide, which bleaches these iron pigments. But its effect is only temporary and the dark colour reappears on oxidation with air. By using Galvanised Iron pan the source of colour itself is eliminated which made the effect permanent. No significant quantities of Zinc were dissolved from the pan. An analysis of gul samples prepared in Galvanised Iron pan and iron pan showed respectively 5.40 and 5.10 mgm, of Zinc per 100 gms, of dry gul samples. Considering the comparative prices of Galvanised Iron and block iron sheets, the difference in the cost of Galvanised Iron pan will not be material. Only a few boiling trials in the Galvanised Iron pan could be taken during this year and that too at the end of the crushing season. More exhaustive tests are proposed for the next season.

Summary

1. Phenolic bodies were found in cane juice samples which produced blue green colours with soluble iron salts. Concentration of these bodies was not affected by applying phosphate fertilizer. They were also not eliminated in the normal gul boiling process.

2. Dark gul colour was found mainly due to iron phenol pigments. It could be discharged by the addition of citrate iron at pH 5.5.

3. Avoiding iron contamination by using Galvanised Iron pan for juice boiling, gul with bright yellow colour could be prepared.

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D. S. T. A.
12th Convention 1955

Foliar Sprays with Boron

By

D. D. KODRE
North Bihar

Introduction

The importance of micro-nutrients in sugarcane culture is an accepted fact. The minor and trace elements, viz. Manganese, Molybdenum, Boron, Copper, Zinc, etc. play an important role and are essential for the normal development of crops. Barnes (1) states that the application of farm yard manure kept the land supplied with adequate amounts of the minor and trace elements, as F. Y. M. contains some of these elements and that after the adoption of mechanized cultivation of cane, the use of farm yard manure became very rare, which might have led to the deficiencies of these elements in the soil.

Samuels, et al (4) in Puerto-Rico made detailed investigations on the application of these nutrients and studied their effect on the Sucrose content of sugarcane. They concluded from the results of over 150 field experiments with sugarcane on wide range of varieties and soils in Puerto-Rico that the minor elements Cu, Mg, Zn, B, Mn, etc. had no significant response on sucrose content of sugarcane. In recent years, foliar sprays of these micro-nutrients are commonly used for the correction of specific deficiency symptoms in plants, and it is claimed that sprays can be used for fertilizing purposes as an alternative to the usual practice of applying solid fertilizers to the soil and that the losses due to non-availability and leaching would be avoided by sprays, than when these are supplied to the land, thus reaching the plant indirectly. Rege, et al (4) concluded from their preliminary studies with the trace elements that Boron enhances the maturity and sugar formation, as compared to other minor elements. Divekar (2) conducted a trial to study the effect of foliar sprays of Boron on the sucrose content of sugarcane and reported from one year's data an increase in sugar content of sugarcane with sprays of 10 and 20 parts of Boron per 100,000 parts of water and that an addition of 4 lbs. B per acre as soil application to the sprays showed even better response.

With a view to confirm the efficacy of foliar sprays of Boron in increasing the sucrose content of cane, trials were conducted with slight modifications in the year 1954-55 at the Sugarcane Research Station, Padegaon.

Experimental details

The spraying trials were carried out on Co. 419 under January planting grown on light as well as medium ("B") type of soil.

Light type of Soil

The treatments of different sprays on Co. 419 grown on this type of soil were as under:—

1. Spray of 10 parts of Boron per 100,000 parts of water.
2. Spray of 20 parts of Boron per 100,000 parts of water.
3. Ordinary Water Spray.
4. No spray as Control.

The treatments were replicated thrice in a randomised fashion. The sprayings were carried out with the help of a bucket spray pump. In all five sprays were given at an interval of a fortnight from Mid-November to Mid-January. The crop was finally sampled by Mid-March.

Medium type of Soil

In another trial on the same variety grown on medium type or "B" type of soil, the method was similar to the above one, the only difference being that the concentrations were increased upto 100 parts of Boron per 100,000 parts of water; the water-spray treatment was dropped. The treatments were, thus, as under:—

1. Control - No spray.
2. Spray of 10 parts of B per 100,000 parts of water.
3. Spray of 20 parts of B per 100,000 parts of water.
4. Spray of 40 parts of B per 100,000 parts of water.
5. Spray of 100 parts of B per 100,000 parts of water.

In this case also five sprays from Mid-November to Mid-January were given at an interval of a fortnight. Here also the crop was sampled by Mid-March 1955.

Presentation of Data

The data for the two trials is summarised in Table No. 1 and 2 respectively.

Table No. 1
Foliar Sprays with Boron
 (1954-55)
 Light type of soil

Particulars	Parts of B per 100,000 parts of water		Water Spray	Control i. e. No Spray
	10	20		
1. Brix	21.55	22.65	21.33	22.05
2. Sucrose in Juice	20.39	20.73	20.01	20.33
3. Purity	94.62	91.52	93.80	92.21
4. Sucrose in cane	16.82	16.44	17.12	17.01
5. Fibre per-cent	10.75	12.04	10.86	11.88
6. C. C. Sugar per-cent	15.27	14.96	14.87	14.78

Table No. 2
Foliar Sprays with Boron
 (1954-55)
 Medium type of soil

Particulars	Parts of B per 100,000 parts of water				No Spray (Control)
	10	20	40	100	
1. Brix	19.84	19.79	20.03	20.66	19.54
2. Sucrose in juice	17.69	17.68	17.19	17.04	18.28
3. Purity	89.19	89.32	84.37	82.47	94.21
4. Sucrose in cane	15.45	14.85	14.24	14.29	16.11
5. Fibre per-cent	10.33	10.97	10.92	11.63	10.95
6. C. C. Sugar per-cent	12.83	12.73	11.92	11.53	13.71

From Table No. 1 it will be seen that on light type of soil, 10 parts of B has shown very slight superiority as regards sucrose per-cent juice over control. The increase was only 0.06% more than the control. But 20 parts of B has indicated 0.40 % increase in sucrose per-cent in juice than the control. As regards the C. C. S. per-cents, 10 parts of B is leading the other treatments. On the whole, the quality of cane obtained after the sprays of 10 and 20 parts of Boron per 100,000 parts of water is slightly better than that of control.

In case of medium type of soil, it will be observed from Table No. 2, that with increasing concentrations of Boron sprays, the quality of cane is deteriorated than the control, as regards sucrose in cane and C. C. S. per-cents. The advantage, however slight it may be, obtained on light type of soil from 10 and 20 parts of Boron per 100,000 parts of water was not observed on the medium type of soil.

Conclusions

1. A very slight benefit is observed from the spray of 10 parts of B, but 20 parts of B has shown better result, on light type of soil.
2. On medium type of soil, even the sprays of 10 and 20 parts of Boron have not shown beneficial response.
3. With increasing concentrations of Boron sprays, the quality of cane was impaired on medium type of soil.
4. The data, being for one year, requires further confirmation and an exhaustive study from physiological, agronomical and economical point of view is necessary.

Acknowledgements.

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D. S. T. A.
12th Convention 1955

A New Variety of Interest -- Co. 775

By

H. R. ARAKERI, M. V. DIVEKAR & D. D. KODRE
Padegaon

Since Co. 475 which was just gaining popularity among the cultivators for its golden yellow gul and equally good yields, as that of Co. 419 was found to be susceptible to rust, the Sugarcane Research Station, Padegaon, has been working hard to find a suitable variety to replace Co. 475. During the investigations a new variety, Co. 775, a cross between POJ. 2878 and Co. 371, was found to be equally promising. Thus it was fast multiplied and was promoted to the final trials to confirm the results. This variety was received from Coimbatore in the year 1950 and was given out for field trials in the year 1953. The performance of Co. 775 is compared with Co. 419 and Co. 475 in this note.

Though, this variety Co. 775, gave good gul it was necessary to find how far the chemical constituents of the juice are responsible as per the findings of Sirur et al (1) and Tembhekar and Divekar (2). Thus the juice was analysed at the time of harvest to study the mineral constituents contained in it. It was also necessary to study the keeping quality of this variety and separate plots were maintained to study the rise and fall of Brix, Sucrose in juice and Purity, till the month of April. The cane was also subjected to mill test at the Phaltan Sugar Works Ltd, and the mill performance of this variety was recorded. In order to get a clear idea about the good qualities of this variety a comparison is made with Co. 475 in particular and Co. 419 in general. This variety has finished two years of trial in plant cane and one year under ratoon. In the former case the data of both years have been averaged.

Presentation of Data.

The yield data and cane and juice quality at the time of harvest is given in Table No. 1.

Table No. 1.

Harvest data of Co. 775, Co. 475 and Co. 419. (Average of two years)

Name of variety	Brix	Purity %	Pol in cane %	C. C. S. %	Yield in tons per acre	C. C. S. tons per acre	Gul in tons per acre
Co. 775	22.1	93.52	16.61	14.94	57.82	8.63	6.59
Co. 475	22.19	93.37	16.95	15.48	53.68	8.32	6.03
Co. 419	22.09	90.04	16.38	14.37	55.68	8.00	6.37

From the Table 1 it can be seen that Co. 775 is either equal or superior to Co. 419 and Co. 475. From the point of view of yields also Co. 775 is better than of Co. 419 and Co. 475. The Table 2, makes our findings more clear.

Table No. 2.

Mill test report of Co. 775, Co. 475 and Co. 419

Name of variety	Brix	Purity %	Pol in cane %	C. C. S. %	C. C. S. tons per acre
Co. 775	21.17	92.47	16.09	13.28	7.25
Co. 475	22.61	91.45	16.36	13.32	7.35
Co. 419	22.25	89.40	16.00	13.25	7.38

In the mill test Co. 775 has given similar performance as Co. 419 and Co. 475.

In order to know the ratooning capacity of the variety, the plant cane of the 1953-54 season was ratooned, in the year 1954-55 and the data is given in Table 3.

Table No. 3.

Harvest data of ratoon crop.

Name of the variety	Brix	Pol in cane %	C. C. S. %	Yield in tons per acre	C. C. S. tons per acre
Co. 775	23.05	18.29	15.91	37.36	8.63
Co. 475	22.45	16.55	14.59	35.46	8.32
Co. 419	22.37	17.00	14.78	31.48	8.00

It is seen that even in the ratoon crop Co. 775 has kept up its richness of juice, cane quality and the high yielding characters. This proves its capacity to be a good ratooner.

Keeping quality of the variety is an important commercial aspect in the Sugarcane Industry. Juice quality was studied periodically from the month of November to the 3rd week of April. Results for 1954-55 are presented in Table 4.

Table No. 4.
Periodical maturity tests (Average of 2 years)

Month Date	Co. 419		Co. 475		Co. 775	
	Brix	Purity	Brix	Purity	Brix	Purity
2nd Nov.	17.83	82.28	16.96	87.81	17.21	84.00
6th Dec.	19.56	89.29	20.61	91.15	19.79	89.63
4th Jan.	21.27	90.67	21.56	92.62	21.71	92.35
20th Jan.	21.51	94.37	22.02	92.42	21.90	93.81
5th Feb.	21.42	90.88	22.29	92.80	22.26	91.60
19th Feb.	21.30	90.93	21.90	92.87	22.18	90.87
4th Mar.	21.70	89.69	22.58	89.21	22.08	90.73
19th Mar.	21.36	91.66	22.12	89.62	21.28	91.13
4th April.	21.06	90.30	22.31	88.89	21.06	91.06
19th April.	20.76	89.14	21.21	87.90	20.68	89.49

From Table 4, it is seen that Co. 775 and Co. 475 are first to mature. All the three varieties reach the peak in the month of January and maintain till the beginning of April with slight fall in case of Co. 775 in the month of February and March. It is very interesting to note that Co. 775, Co. 475 and Co. 419 behave more or less in a similar manner.

Table 5 describes the chemical features of the juices of the three varieties under study. The quality of the end product in the Nira Market was also studied. Results are given in the same table.

Table No. 5.

Mineral constituents in the juice of Co. 775, Co. 475 and Co. 419.
(Percent mgms in 100 c. c. of juice)

Name of variety	Total Nitrogen	P ₂ O ₅	K ₂ O	CaO	Market grade
Co. 775	14.80	15.09	160.0	24.08	II
Co. 475	12.60	12.12	168.0	31.92	II
Co. 419	19.60	11.43	239.72	33.00	III

Here the influence of different chemical constituents can very well be observed. The total nitrogen in case of Co. 775 is lower than that of Co. 419 but bit higher than that of Co. 475. The P₂O₅ content is highest in case of Co. 775

which goes to prove its better juice claribility. The K_2O and the CaO contents are also lower in case of Co. 775 as compared to those of Co. 419 and Co. 475. An over-all estimate of these results hold good with the previous finding of Sirur et al (1) and Tembhekar and Divekar (2).

Summary and Conclusions

A new promising variety Co. 775 was studied along with Co. 475 and Co. 419.

It was observed that Co. 775 shows more or less similar performance in respect of yields, keeping quality and juice characteristics. It also gives equally good gul and it is a good ratooner.

With the confirmations of these results on factory estates and the cultivators' fields where the particular variety is undergoing trials, we can very well expect to replace Co. 475 with Co. 775.

Acknowledgements

1. Thanks are due to Shri S. V. Mankar and Shri E. S. Baviskar, the Agricultural Assistants, who have assisted in carrying out the above trials.

2. Thanks are also due to Phaltan Sugar Works Ltd., for carrying out the Mill test in spite of their busy season.

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D. S. T. A.
12th Convention 1955

**On the Utilisation of General Soil Survey Maps of the Sugarcane
Areas in the Bombay Deccan-Manurial schedule
according to Soil type.**

By
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Padegaon

The soils of the Deccan Canal tract have been classified into 12 distinct types named chronologically from 'A' to 'L' by the Genetic method which takes into consideration the soil profile as a unit of study. Out of these types A to G excluding 'E' are considered to be of importance owing to their vast expanse (covering about 90% of the area). Accordingly their response and behaviour under manuring, irrigation, cultural operations etc. were studied both in lysimeters under uniform climatic conditions and one uniform manuring at Padegaon and also on sub-stations established on these types at different centres. A number of trials were conducted both on the estates of Sugar factories and cultivators' fields. As a result of these findings tentative commendations according to soil types have been presented in the paper and these recommendations, though general without considering the variations within a soil type, will be of great use as a step towards scientific agriculture.

Outlines of General Survey:—The soil profiles were examined at every 1320' apart (or one in 20 acres) in a grid pattern in the Sugarcane block areas allotted on each of the Distributaries and the soil type maps are prepared for these areas. In these maps additional information like 'Maturity' of the soil in the case of shallow and medium depth soils (M_0 , M_1 , M_2 and so on) and degree of sodium saturation (Na_0 , Na_1 , Na_2 and so on) and total salt content in the case of deep soils are shown within these soil types which show the productive capacities and the methods of reclamations to be followed. These maps are kept with the Agricultural Officers, Sugarcane Development Scheme at Malegaon, Kopergaon, Shrirampur, Baramati and Malsiras.

Description of these six important soil types (Typical) with their chemical characteristics are given below.

Out of these six types G and F are shallow types, A and D are medium depth soils and B and C are deep ones.

Soil type 'A' :— It is a black soil with reddish tinge with good crumb structure. Depth of soil over murum usually varies from 1' to 4'. It overlies a well weathered murum and is well drained. Clay 49%, $CaCO_3$ 5%, pH 8.5, Exchangeable Ca 60, Ca/Mg ratio > 10 m. e. %

Total N 0.04%, Av. P_2O_5 0.006%, Av. K_2O 0.027%.

Soil type 'B' :— Possesses a greyish brown surface soil and a permeable sub-soil which is reddish brown in colour with plenty of lime Kankars and gypsum particles. In between these layers is found a mottled horizon. The depth of soil is never less than 4'. Drainage condition is fair to poor giving rise to different phases (i) with 2nd horizon compact and impervious, (ii) Alkalinization on the surface in spite of a fairly porous sub stratum. (iii) With salt crust on surface due to the nearness of saline sub-soil. Sometimes 4th phase viz. Eroded phase is also met with on the banks of the river where the reddish brown horizon is exposed. The chemical analyses of the normal 'B' type are :—

Clay 50%, CaCO_3 8%, pH 8.8

Ex. Ca. 35, m. e.%, Ca/Mg ratio < 3

Total N 0.048%, Av. P_2O_5 0.005%, Av. K_2O 0.048%.

Soil type 'C' :— It is a deep black soil, extremely sticky under wet conditions and forms hard clods when dry. Sub-soil water table is very near (3' to 4'). The depth of soil varies from 3' to 12'.

Clay 56%, CaCO_3 4%, pH 8.5

Ex. Ca. 45, m. e.%, Ca/Mg ratio < 3

Total N 0.046%, Av. P_2O_5 0.005%, Av. K_2O 0.02%.

Soil type 'D' :— It is of greyish brown colour with a depth from 1' to 3' overlying a lime band. Free lime content usually increases with depth. The depth of lime band from the surface is very important in deciding the manurial schedule.

Clay 55%, CaCO_3 9.4%, pH 8.8

Ex. Ca. 40 m. e.%, Ca/Mg < 3

Total N 0.042%, Av. P_2O_5 0.005%, Av. K_2O 0.04%.

Soil type 'F' :— It is a very shallow soil 12" to 18" deep with light brown colour in extremely shallow phase. In matured phase it shows 2 distinct horizon, top loose and single-grained; second compact with granular to crumb structure. It is characterised by hard murum below.

Clay 46%, CaCO_3 1.0%; pH 8.1

Ex. Ca. 45 m. e.%, Ca/Mg > 10

Total N 0.058%, Av. P_2O_5 0.01%, Av. K_2O 0.021%.

Soil type ' G ' :— It is a dark brown soil with more or less uniform texture and colour throughout its depth (1' to 2').

Clay 52%, CaCO_3 4%, pH 8.3

Ex. Ca. m. e. 55,%, Ca/Mg < 10

Total N 0.053%, Av. P_2O_5 0.006%, Av. K_2O 0.024%.

Recommendations according to soil types.

Based on the findings of the Experiments in lysimeters, sub-stations and large scale trials the following are the recommendations on the manuring according to soil type. The recommendations are applicable in general for the areas in which normal yields were taken by the cultivator. Further these recommendations are based on the production capacities, efficiency per unit of fertilizer applied and maintenance of soil fertility in general for adsali crop.

I. Nitrogen Fertilisation.

Type	Compost	Oil cake	Sulphate of Ammonia
A	20 cart loads.	300 lbs. N	150 lbs. N
B	Normal (NaO) 30 " "	225 " "	225 " "
	Eroded 40 " "	300 " "	150 " "
C	Normal 40 " "	225 " "	225 " "
D	Normal 20 " "	400 " "	200 " "
	Limy 30 " "	400 " "	200 " "
F	M ₁ 40 " "	225 " "	75 " "
	M ₂ , M ₃ 30 " "	300 " "	150 " "
G	M ₁ 40 " "	225 " "	75 " "
	M ₂ , M ₃ 30 " "	300 " "	150 " "

N. B.—Top dressing is to be applied in 4 doses.

Compost addition (at least 20 cart loads per acre) is found essential and its main function is that of maintaining a good physical condition of the soil which is found to deteriorate otherwise. Another good feature of compost application is that when humus status is built up the proportion of oil cake can be reduced. In the absence of compost or shortage higher proportion of oil cake is found beneficial in all soil types.

II. Phosphatic Fertilisation.

The quantity of superphosphate to be applied depends on the available P_2O_5 and total nitrogen status of the soil. The following recommendations are applicable where the soil has the total nitrogen status approximate 0.05% which is the average figure for this tract.

Type	Superphosphate as P_2O_5	Method of application at the time of planting.
A	100 lbs.	Halfway down the ridge.
B	150 lbs.	6" below in the furrow.
C	100 lbs.	6" below in the furrow.
D	150 lbs.	6" below in the furrow.
F	No Need	—
G	50 lbs.	Half way down the ridge.

It is observed to be more beneficial to apply the superphosphate in two doses—one at the planting time and the other at earthing. As superphosphate becomes fixed in the soil due to the high $CaCO_3$ content in these soils it is advisable to apply it mixed with compost or dung especially in 'B' and 'D' types as their lime content is comparatively high. The second dose of superphosphate at the time of final earthing up is to be applied by taking a small trench by the side before breaking the ridges to ensure application near the root zone.

III. Potassic Fertilisation.

Our soils except 'C' type are fairly rich in available potash and again regular use of compost at the rate of 20 cart loads per acre practically meets the demand of sugarcane crop. However in the case of 'C' type 50 to 100 lbs. of K_2O in the form of Sulphate of Potash may be applied. Whenever sufficient compost is not added, application of 50 to 100 lbs. of K_2O per acre may be followed as a safeguard.

Soil type 'G' :— It is a dark brown soil with more or less uniform texture and colour throughout its depth (1' to 2').

Clay 52%, CaCO_3 4%, pH 8.3

Ex. Ca. m. e. 55,%, Ca/Mg < 10

Total N 0.053%, Av. P_2O_5 0.006%, Av. K_2O 0.024%.

Recommendations according to soil types.

Based on the findings of the Experiments in lysimeters, sub-stations and large scale trials the following are the recommendations on the manuring according to soil type. The recommendations are applicable in general for the areas in which normal yields were taken by the cultivator. Further these recommendations are based on the production capacities, efficiency per unit of fertilizer applied and maintenance of soil fertility in general for adsali crop.

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Type	Compost	Oil cake	Sulphate of Ammonia
A	20 cart loads.	300 lbs. N	150 lbs. N
B	{ Normal 30 " "	225 " "	225 " "
	{ (NaO) Eroded 40 " "	300 " "	150 " "
C	Normal 40 " "	225 " "	225 " "
D	{ Normal 20 " "	400 " "	200 " "
	{ Limy 30 " "	400 " "	200 " "
F	{ M_1 40 " "	225 " "	75 " "
	{ M_2, M_3 30 " "	300 " "	150 " "
G	{ M_1 40 " "	225 " "	75 " "
	{ M_2, M_3 30 " "	300 " "	150 " "

N. B.—Top dressing is to be applied in 4 doses.

Compost addition (at least 20 cart loads per acre) is found essential and its main function is that of maintaining a good physical condition of the soil which is found to deteriorate otherwise. Another good feature of compost application is that when humus status is built up the proportion of oil cake can be reduced. In the absence of compost or shortage higher proportion of oil cake is found beneficial in all soil types.

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The quantity of superphosphate to be applied depends on the available P_2O_5 and total nitrogen status of the soil. The following recommendations are applicable where the soil has the total nitrogen status approximate 0.05% which is the average figure for this tract.

Type	Superphosphate as P_2O_5	Method of application at the time of planting.
A	100 lbs.	Halfway down the ridge.
B	150 lbs.	6" below in the furrow.
C	100 lbs.	6" below in the furrow.
D	150 lbs.	6" below in the furrow.
F	No Need	—
G	50 lbs.	Half way down the ridge.

It is observed to be more beneficial to apply the superphosphate in two doses—one at the planting time and the other at earthing. As superphosphate becomes fixed in the soil due to the high $CaCO_3$ content in these soils it is advisable to apply it mixed with compost or dung especially in 'B' and 'D' types as their lime content is comparatively high. The second dose of superphosphate at the time of final earthing up is to be applied by taking a small trench by the side before breaking the ridges to ensure application near the root zone.

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D. S. T. A.
12th Convention 1955

Influence of different manures and fertilizers on soil micro-organisms

By

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Introduction.

Soil is not a mass of dead debris merely resulting from physical and chemical weathering of rocks, it is more or less a homogenous system which also contains the products resulted from the decomposition of plant and animal remains. It is teeming with life. The extensive microbiological population, made up of great number of species of bacteria and of genera of fungii, actinomycetes and algae as well as numerous families of protozoa, nematodes and other invertebrates. Some of the organisms have relatively specific effects as in the fixation of nitrogen and the conversion of ammonia into nitrite or of nitrite into nitrate but frequently a large number of organisms can attack a single substrate. Thus the decomposition of cellulose can be brought about by many kind of bacteria having different morphological and physiological characteristics, by fungii belonging to widely different genera and by many actinomycetes and other organisms. Thus the living microscopic population exert a variety of associative and antagonistic effects upon one another. Their activities markedly influence the fertility of the soil and the growth of cultivated and uncultivated plants. Among other factors, the origin and nature of soil, the prevailing climate and vegetation, soil reaction, moisture content and aeration have a marked effect on the qualitative and quantitative composition of the soil microflora. Soil science is of recent origin and during its early period soil fertility was evaluated in terms of the status of plant nutrients. That physical condition of the soil is equally important was recognised later on. The present day trend indicates that soil fertility should be evaluated in terms of chemical, physical and microbiological conditions of the soil.

Waksman (7) has surveyed the nature and abundance of micro-organisms in the soil and reviewed the important role that they play in soil processes. Lad, Raghavan and Patel (4), in their studies for chemical constituents of the medium soils of series I and II, have reported that the losses in nitrogen have been more in plots treated with organic manures than when artificials were used. They have also observed that there has been an accumulation of nitrogen in the phosphate treated plots. Similar trend was noticed by Pramanik and Misra (5) in their studies with *Azotobacter*. A preliminary study was, therefore, undertaken with a view to find out the relative abundance of bacteria, actinomycetes, fungii and the non-symbiotic nitrogen fixing micro-organisms as influenced by continuous application of different organic and mineral fertilizers in the medium soils of series I and II.

Methods and materials

Microbiological examination was carried out from freshly collected, composite surface samples from each treatment of series I and II. This is an uncropped series laid out in 1932 in the medium soils and consists of three irrigational treatments without any manurial dose and eleven manurial treatments under one irrigational dose of 95 A" only. The manurial treatments include nitrogenous (both organic and inorganic) phosphatic and potassic fertilisers given at the rate of 300 lbs. N, 600 lbs. P_2O_5 and 600 lbs. K_2O per acre basis. A plot was maintained as dry control and it received only the cultural operations carried out in others. The size of each plot was 12' x 18.2'. These plots were replicated twice and were randomized. This experimental series was situated in the ' B ' type of soils at the Sugarcane Research Station, Padegaon.

Periodical microbiological examinations of the soils were done in January, April and September by the dilution-plate culture method outlined by Waksman (7). The population of bacteria, actinomycetes and fungi developing on nutrient agar medium and that of non-symbiotic nitrogen fixing micro-organisms occurring on Ashby's medium were recorded seven days after incubation at room temperature. These methods of enumerating the viable micro-organisms are based on the development of the living cells in the form of colonies on the agar plate or upon their growth in specific culture media. These numbers may represent only a small fraction of the total soil population. However, with the limitations that these methods of microbial analysis are subjected to, only broad inferences on the growth and activities of micro-organisms could be arrived at.

Results and Discussion

Preliminary studies conducted on the effect of different manurial treatments in the medium soils of the Padegaon Farm, demonstrated that the microbial population in the different treatments is far from constant and that it undergoes a number of variation and changes which may be seasonal or even more frequent. In general, however, the bacteria and actinomycetes predominated but the fungi population was found to be negligible in all the treatments of this series. This may be, in part, due to the alkaline nature of the soils (pH about 8.3). This reaction is not the optimum for the growth of fungi which lies rather at pH 4.5 to 5.5.

In the untreated control plot (not receiving manure and irrigation) as well as in the plots receiving only irrigation, the population of micro-organisms have been observed to be comparatively lower than those treated with manure and irrigation (Table 1).

Among the nitrogenous manures, organic manures like farm yard manure and safflower cake have on the whole induced greater activity of micro-organisms as compared to sann. Bone meal, which is partly a nitrogenous manure

has shown the same response to micro-organisms which is probably due to the fact that it contains phosphate as well. The higher specific losses in nitrogen in the case of farm yard manure, safflower cake and sann may be attributed to the respective population of the nitrifying and the denitrifying micro-organisms, their activities proceeding simultaneously or alternatively. The nitrifying organisms converting the nitrogenous compounds into nitrates which are likely to be leached off and / or the denitrifying organisms transforming the nitrogenous compounds into free ammonia or elemental nitrogen which escape off into the atmosphere.

The nitrogenous fertilizers—sulphate of ammonia and sodium nitrate—have depressed microbial activities and this is in accordance with the findings of several workers. Waksman (7) has observed that in alkaline soils which are deficient in organic matter, CaCO_3 may tend to liberate from the ammonium salts free ammonia which retards nitrification. Lad and Patel (3) have concluded that continuous application of sulphate of ammonia only in the compost–no-compost experiments, have depressed the rate of nitrification. Similar results have been obtained by Pramanik and Misra (5). Calcium cyanamide on the other hand was found to have no depressing effect on micro-organisms.

Superphosphate among the phosphatic fertilisers exhibit a definite beneficial influence on the growth of total number of bacteria, actinomycetes and particularly the non-symbiotic nitrogen fixing organisms than either bonemeal or basic slag. The latter giving the least response to microbial activities. These findings explain why superphosphate is better suited to this tract. The rise in nitrogen status of the soil may be attributed to the non-symbiotic nitrogen fixing organisms.

Among the potassic fertilizers potassium chloride and potassium sulphate no definite trend of their influence on micro-organisms is noticed. Chemical findings have also indicated that there is nothing to choose between the two. Both these fertilizers have activated the general population of micro-organisms and to a certain extent the non-symbiotic nitrogen fixing micro-organisms.

Summary

In the medium soils of series I and II (uncropped series receiving different nitrogenous, phosphatic and potassic fertilizers) it has been observed that the fungii population is negligible and that bacteria and actinomycetes predominate.

Farm-yard manure and safflower cake have induced greater activities of micro-organisms as compared to other nitrogenous manures and fertilizers.

Sulphate of ammonia and sodium nitrate have depressed microbiological population to a certain extent.

Superphosphates have shown a beneficial influence on the total population and especially the non-symbiotic nitrogen fixing micro-organisms. The rise in nitrogen percentage under this treatment may be explained to this latter fact.

Potassic fertilisers have activated the general microbiological activities and there seems to be no specific difference between the sulphate of potash and chloride of potash.

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Table No. 1. Series I and II.
Microbiological population in 10,000 per gram of soil.

Sr. No.	Soil treatment	Date of Analysis	Depth	pH	Organic Carbon	Nutrient Agar Medium for total population of micro-organisms.			Ashby's medium for non symbiotic N ₂ fixing organisms		
						Bacteria	Actino-mycetes	Fungii	Bacteria	Actino-mycetes	Fungii
<i>I Control</i>											
1.	Untreated	January 1954	0-6"	8.2	0.74	273	30	2	150	—	—
		April 1954	0-6"			47	5	—	24	8	—
		Sept. 1954	0-6"			44	32	5	76	20	—
		January 1955	0-6"			58	18	1	27	11	—
		April 1955	0-6"			78	22	—	111	48	—
<i>II Irrigational doses</i>											
2.	70 A"	January 1954	0-6"	8.5	0.88	102	9	3	23	—	—
		April 1954	0-6"			17	5	—	54	12	6
		Sept. 1954	0-6"			7	5	—	9	3	3
		January 1955	0-6"			82	10	1	20	—	—
		April 1955	0-6"			46	6	—	29	23	—
3.	95 A"	January 1954	0-6"	8.4	0.90	140	6	1	124	—	—
		April 1954	0-6"			28	9	—	40	3	—
		Sept. 1954	0-6"			37	10	1	11	3	—
		January 1955	0-6"			68	14	1	66	14	2
		April 1955	0-6"			50	18	—	26	29	—
4.	120 A"	January 1954	0-6"	8.1	0.76	37	20	1	44	—	—
		April 1954	0-6"			50	3	—	72	12	6
		Sept. 1954	0-6"			27	8	—	77	5	—
		January 1955	0-6"			52	13	—	16	8	1
		April 1955	0-6"			119	18	—	114	26	—

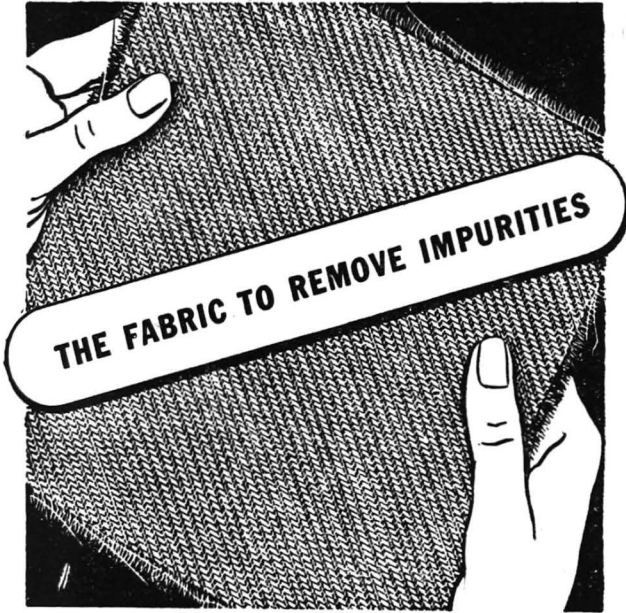
Table 1. (Contd.)

Sr. No.	Soil treatment	Date of Analysis	Depth	pH	Organic Carbon	Nutrient Agar Medium for total population of micro-organisms			Ashby's medium for non symbiotic N ₂ fixing organisms		
						Bacteria	Actino-mycetes	Fungii	Bacteria	Actino-mycetes	Fungii
<i>III Nitrogenous</i>											
(a) ORGANIC MANURES.											
5. Farm Yard Manure	January 1954	0-6"				73	5	3	66	—	—
	April 1954	0-6"				184	24	2	50	2	—
	Sept. 1954	0-6"	8.2	0.94		152	48	6	303	55	—
6. Safflower cake	January 1955	0-6"				216	66	6	103	38	—
	April 1955	0-6"				370	85	8	299	90	—
	January 1954	0-6"				141	21	1	90	—	—
	April 1954	0-6"				104	5	—	39	17	—
	Sept. 1954	0-6"	8.2	0.86		124	83	—	95	48	—
	January 1955	0-6"				136	8	2	51	11	2
7. Sann	April 1955	0-6"				193	44	—	195	45	—
	January 1954	0-6"				78	—	8	118	—	—
	April 1954	0-6"				92	29	—	61	8	11
	Sept. 1954	0-6"	8.2	0.90		98	16	—	55	6	1
	January 1955	0-6"				42	46	9	33	19	1
8. Bone meal	April 1955	0-6"				111	28	—	153	27	—
	January 1954	0-6"				31	9	—	6	—	—
	April 1954	0-6"				15	6	—	28	27	3
	Sept. 1954	0-6"	8.3	0.71		53	29	—	64	11	—
	January 1955	0-6"				156	32	4	177	45	—
April 1955	0-6"				235	37	—	194	38	—	

Table 1. (Contd.)

Sr. No.	Soil treatment	Date of Analysis	Depth	pH	Organic Carbon	Nutrient Agar Medium for total population of micro-organisms.			Ashby's medium for non symbiotic N ₂ fixing organisms		
						Bacteria	Actino-mycetes	Fungii	Bacteria	Actino-mycetes	Fungii
(b) INORGANIC FERTILIZERS											
9.	Sulphate of Ammonia	January 1954	0-6"	7.6	0.69	35	7	5	25	—	—
		April 1954	0-6"			2	—	—	15	3	—
		Sept. 1954	0-6"			13	6	—	12	—	—
		January 1955	0-6"			46	17	3	39	16	—
		April 1955	0-6"			93	30	—	56	20	—
10.	Sodium Nitrate	January 1954	0-6"	8.6	0.73	92	11	—	61	—	—
		April 1954	0-6"			20	8	2	8	—	—
		Sept. 1954	0-6"			31	13	—	60	12	—
		January 1955	0-6"			64	16	5	35	15	—
		April 1955	0-6"			116	11	—	90	18	—
11.	Calcium Cyanamide	January 1954	0-6"	8.6	0.74	74	20	—	103	—	—
		April 1954	0-6"			23	—	2	10	3	—
		Sept. 1954	0-6"			34	15	7	93	17	2
		January 1955	0-6"			230	28	4	159	49	2
		April 1955	0-6"			139	24	—	183	58	—
<i>IV Phosphatic Fertilizers</i>											
12.	Superphosphate	January 1954	0-6"	8.2	0.72	226	33	2	180	—	—
		April 1954	0-6"			157	13	14	20	1	1
		Sept. 1954	0-6"			145	39	3	599	65	—
		January 1955	0-6"			91	20	4	78	32	—
		April 1955	0-6"			321	62	—	159	52	—

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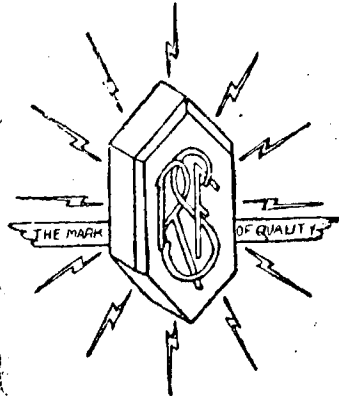
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Table 1 (Contd.)

Sr. No.	Soil treatment	Date of Analysis	Depth	pH	Organic Carbon	Nutrient Agar Medium for total population of micro-organisms			Ashby's medium for non symbiotic N ₂ fixing organisms		
						Bacteria	Actino-mycetes	Fungii	Bacteria	Actino-mycetes	Fungii
13.	Bone meal	January 1954	0-6"	8.3	0.71	31	9	—	6	—	—
		April 1954	0-6"			15	6	—	28	27	3
		Sept. 1954	0-6"			53	29	—	64	11	—
		January 1955	0-6"			156	32	4	177	45	—
		April 1955	0-6"			235	37	—	194	38	—
14.	Basic slag	January 1954	0-6"	8.6	0.76	125	9	1	178	—	—
		April 1954	0-6"			12	—	—	18	—	2
		Sept. 1954	0-6"			29	19	—	57	11	—
		January 1955	0-6"			54	25	—	27	14	—
		April 1955	0-6"			12	14	—	9	3	—
<i>V Potassic Fertilizers</i>											
15.	Potassium chloride	January 1954	0-6"	7.9	0.79	—	—	—	—	—	—
		April 1954	0-6"			30	8	—	20	2	—
		Sept. 1954	0-6"			45	19	—	155	38	—
		January 1955	0-6"			211	27	6	132	43	—
		April 1955	0-6"			100	27	—	162	52	—
16.	Potassium sulphate	January 1954	0-6"	8.2	0.75	202	16	1	140	—	—
		April 1954	0-6"			14	—	—	8	5	—
		Sept. 1954	0-6"			62	16	1	86	8	—
		January 1955	0-6"			275	37	14	161	45	—
		April 1955	0-6"			172	50	2	67	23	—

D. S. T. A.
12th Convention 1955

Effect of Krilium Application on the Soil Condition and its Role in Reclamation of Chopan Soil

By

M. A. MIRAJKAR & D. K. PATEL
Padegaon

Many investigators (3, 4, 5 and 6) have reported about the soil conditioners and their influence on structure and other physical properties of soils. The soil conditioners, now on the market, are synthetic organic compounds consisting of complex long chain molecules containing hundreds of atoms each. Most of them are salts of hydrolysed polymers of acrylonitrile. The soil conditioners are claimed to improve the physical condition of the soil.

The paper presents laboratory, pot and field studies on the effect of a soil conditioner on soil with a special reference to chopan soil (sodiumised), occurring in the Deccan Canal Area. The Chopan soil chiefly characterised by high content of exchangeable sodium in the cation exchange complex of the soil, presents problems in plant growth due to deterioration in soil structure. The product under study, is a synthetic polyelectrolyte CRD-189, the sodium salt of hydrolysed polyacrylonitrile, viz. Krilium.

Experimental details

(1) *Laboratory test*:—A preliminary laboratory test was made to study the suitability of Krilium as a soil conditioner. Five hundred grams of soil, passed through 2 mm. sieve, was treated with the soil conditioner at the rate of 0.1 per cent. The soil and the soil conditioner were mixed thoroughly and the soil moisture was made up to about 40 per cent. The soil thus treated and also the control, which received no Krilium but water alone, were kept in sun for drying. After drying, soil from both the treatments was studied for permeability (rate of percolation).

(2) *Pot experiment*:—A pot experiment with two treatments—Soil + Krilium and soil alone in six replicates—was conducted in 1953-54 to study the beneficial effects of the soil conditioner on soil. Thirtyfive pounds of chopan soil and 18.0 gms. of Krilium were mixed thoroughly and filled in six pots. Six pots without Krilium were taken as controls. The pots were irrigated at the interval of 10 days at the rate of 20 lbs. of water per pot. On the 23rd June 1953, sann seeds were sown in these pots, and the performance of crop was studied. The crop was finally harvested on the 30th October 1953. Soil samples, after the harvest of the crop, were collected and analysed. The data are given in table No. 1.

(3) *Field experiment*:- In 1954-55, a field experiment in single plots, 3'×3' each, was conducted in typical chopan soil at the Sugarcane Research Station, Padegaon, to evaluate the beneficial effects of Krilium application on soil condition. Three plots were laid out, adjacent to each other, leaving sufficient space in between, to avoid border effect. Each plot was further protected by putting a bund (1 foot), all around. Soil was worked to about 6" depth and stirred well. A fine bed was prepared by June 1954. In the first week of July 1954, these plots were treated as below.

1. **KRILIUM PLOT**:- Six ozs. of Krilium (at the rate of 2000 lbs. per acre as per company's recommendation) was added and was thoroughly incorporated with the soil to a depth of 6"
2. **CONTROL PLOT**:- Soil as such was stirred to a depth of 6".
3. **COMPOST PLOT**:- Seventyfive lbs of compost (at the rate of 160 tons per acre i. e. 200 times the Krilium application) was added and thoroughly mixed with the soil to a depth of 6".

These plots were irrigated at an interval of 10 days at the rate of 3 A", for a period of 3 months. Later, with a view to study the performance of a crop, maize seeds (local variety) were sown in these plots. Thinning of the maize plants was done twice, and the crop was finally harvested at the cob-formation stage. Plant samples at the harvest, were taken and analysed for N, P and K contents, and the data are given in table No. 4. Observations regarding germination, general growth of the crop, root development etc. were also taken and the data for the same are presented in table No. 4. Soil samples (i) initial (ii) after 10 irrigations and (iii) after the harvest of the maize crop were collected and analysed. The results are given in table No. 2 and 3.

Results and Discussion.

Preliminary laboratory test, carried out to measure the permeability by the disturbed core method, of the Krilium treated and untreated soil samples showed higher rate of percolation of water with Krilium. Increased rate of percolation with Krilium application indicated better aggregation. Since the laboratory tests gave a favourable indication of better aggregation due to Krilium application, pot studies were taken up. The data of the pot experiment are given in table No. 1.

Table 1
(*Pot experiment*)
Effect of Krilium on the plant growth and soil condition

Sr. No.	Treatment	Weight of plants(gms)	Weight of roots (gms)	Percolation rate CCS per hour	Exch. sodium M. e./ 100gms	Total soluble salts %	Exch. calcium M. e. 100 gm	Water stable aggregates 1 m. m. & above %
1.	Soil alone	66.0	6.33	14.0	11.7	0.130	33.5	54.90
2.	Soil+Krilium	60.0	6.83	22.5	11.3	0.145	32.0	62.01

The data (i) indicate that the application of Krilium to the soil has a good effect on aggregation. Water permeability measured in terms of rate of percolation is superior with Krilium application. Krilium has no effect on soluble salts content, exchangeable sodium and calcium contents of soil.

As far as the crop response to Krilium application is concerned, it will be seen from the data that the yield in terms of dry weight of sann plants does not show any beneficial effect. Moreover, there is no remarkable improvement in root weights. However, the root system, with Krilium application, showed better vertical as well as lateral expanse, compared to control.

The studies were extended to fields, wherein an additional treatment of compost was also included to test the equivalence of the Krilium to compost on aggregation. The soil samples were analysed for water stable aggregates by a modification of the Yoder's (7) wet-sieving procedure, using 50 gms. of sample, a 4 inch stroke, a washing period of 30 minutes and a nest of five sieves having opening of 2, 1, 0.5, 0.25 and 0.10 mm. Chemical analyses were carried out according to the methods used in this laboratory.

The data in table No. 2 indicate that a high degree of water-stable aggregation was attained by the Krilium application. This has also been observed by others (3, 4, 5, 6). As a consequence of greater aggregation, changes in pore-size distribution, water infiltration and soil tilth have been attained.

Table 2
(*Field experiment*)
Effect of Krilium on soil aggregation.

Treatment	Depth	Percentage water-stable aggregates					
		After 3 months			After 8 months		
		1 mm. & above	0.5 mm. & above	0.25 m.m. & above	1 mm. & above	0.5 mm. & above	0.25 mm & above
Krilium	0.12"	25.65	57.20	63.30	50.50	57.70	75.10
	12.24"	8.20	49.40	59.40	19.10	53.30	58.10
Control	0.12"	5.10	39.30	55.70	3.70	21.10	50.20
	12.24"	7.20	26.0	57.20	9.10	32.20	53.30
Compost	0.12"	10.20	21.40	59.20	12.40	21.60	59.20
	12.24"	3.35	12.0	61.70	6.10	32.30	64.90

The data presented in Table 2 also indicate that, after 3 months the water-stable aggregates (1 mm. and above) in first one foot layer of soil were 25.65 per cent with Krilium application as against 5.1 per cent in control plot and 10.2 per cent in case of compost plot. It is further interesting to note that after 8 months

the percentage increased from 25.65 to 50.50 with Krilium application whereas there was very little increase i. e. from 10.2 to 12.4 with compost. The percentage of water-stable aggregates, however, decreased from 5.1 per cent to 3.7 percent in control plot. Water-stable aggregates (0.5 mm. and above, and 0.25 mm. and above) were also much higher with Krilium application followed by compost. As far as the aggregation is concerned, Krilium is definitely superior to compost, applied at the rate of 200 times the Krilium. The equivalency claimed by the company, one pound of Krilium to 500 pounds of compost, is justifiable.

The soil analytical data are given in Table No. 3.

Table 3

(*Field experiment*)

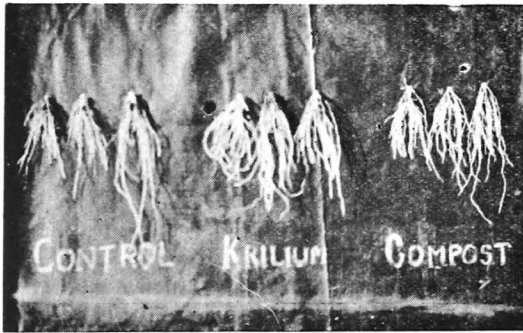
Effect of Krilium on soluble salts content, exchangeable sodium and calcium contents of soil etc.

Particulars	Initial samples			After 3 months			After 8 months		
	Krilium	Control	Compost	Krilium	Control	Compost	Krilium	Control	Compost
pH	8.87	8.87	8.87	8.91	8.91	8.61	8.99	8.98	8.76
Total soluble salts content %	0.57	0.56	0.48	0.47	0.48	0.50	0.68	0.47	0.59
Total Nitrogen %	0.055	0.055	0.050	0.053	0.049	0.181	0.056	0.050	0.114
Available P ₂ O ₅ mgms./100 gms.	2.3	2.2	1.9	3.3	5.3	21.3	4.7	5.8	10.2
Available K ₂ O mgms./1000gms.	49.9	49.9	46.7	46.2	57.0	154.0	48.7	50.0	86.8
Exchangeable calcium in m. e /100gms.	37.50	37.75	38.25	37.00	37.50	37.00	37.75	38.00	38.25
Exchangeable sodium in m. e./100gms.	6.58	6.39	6.46	6.30	6.00	4.60	6.30	6.20	4.90
Sodium saturation%	12.1	11.8	11.8	11.6	11.2	8.9	11.6	11.4	9.2

The details given in Table No. 3 indicate that Krilium has no remarkable effect on pH, the exchangeable sodium, exchangeable calcium and total soluble salts content of the soil. A slight decrease in sodium saturation, due to cultivation and irrigation is observed in Krilium treated plot as well as in control plot. There is no specific effect of Krilium on sodium saturation. Compost application

has slightly lowered the pH and considerably lowered the exchangeable sodium or sodium saturation. This fact clearly indicates that compost is superior to Krilium in dealing with the inherent characteristic of higher sodium saturation. Krilium only brings about a very good soil aggregation and hence it is necessary to study how long the aggregation will last as the soil will revert to its original soil condition as soon as the binding effect due to Krilium disappears. The data also reveal that the availability of P_2O_5 and K_2O remained much higher throughout with compost due to its manurial value. Krilium application brings about no improvement compared to control, indicating thereby that Krilium is no manure but only a soil conditioner.

Fig. 1.



At the time of the harvest of maize crop root systems from the three treatments were studied. The photos in Figure 1 show that vertical as well as lateral expanse of the root system was superior with Krilium application.

Effect of Krilium application on root system.

The data on crop (maize) response are given below:—

Table No. 4.
(Field experiment)
Botanical observations and mineral uptake

Treatment	Germination %	Botanical observations at harvest			Average weight of green plant in gms.			Total mineral uptake in grams per plot		
		Average height	Average leaf length	Average leaf breadth	1st thinning (3 weeks)	2nd thinning (7 weeks)	Harvest (14 weeks)	Nitrogen (gms.)	P_2O_5 (gms.)	K_2O (gms.)
Krilium	88.5	7.5"	11.5"	1.2"	1.276	7.57	40.41	1.71	1.33	3.66
Control	94.8	8.5"	12.5"	1.2"	1.401	9.66	49.48	1.98	1.48	4.06
Compost	93.8	11.5"	13.8"	1.4"	1.464	13.07	62.11	2.09	2.26	5.32

From the data presented in Table 4 it is seen that the crop response was the best with compost treatment due to its mineral value. Consequently, this treatment has shown higher uptake of plant nutrients. The crop response with Krilium application does not show any superiority over control. This is due to the fact that, Krilium is no manure, but only a soil conditioner. This is also supported

from the comparison of nutrients uptake between Krilium and control. The crop response with Krilium treatment is slightly inferior to control which is probably due to the limitation of available water, as high aggregation, brought about by Krilium due to gluing or cementation of soil particles into aggregates, is probably devoid of finer capillaries, storing available moisture. The Krilium treated soil, retained less water was also observed by Hagin and Bodman (3).

Summary and Conclusions

Studies on Krilium, as a soil conditioner were carried out through laboratory, pot and field experiments, crop response was also studied in the field. The studies indicate the following findings.

Krilium brings about a very high state of soil aggregation. The aggregation brought about is due to gluing or cementation of soil particles.

Krilium, as a reclaiming agent for chopan (sodiumised) soil has a limited value as it does not bring about any reduction in sodium saturation. Hence the soil is likely to revert to its original condition as soon as the binding effect of Krilium is lost.

The equivalence of Krilium to compost 500 times, as claimed by the manufacturers is justifiable as far as aggregation is concerned. Compost, however, in very high doses is superior to Krilium as it brings about reduction in sodium saturation an inherent characteristic of chopan soil. Moreover, it adds mineral nutrients.

Acknowledgements

Thanks are due to Shri K. S. Raghavan and Shri B. T. Khaladkar, (formerly Agricultural Officers with Soil Physics Section) who had undertaken the preliminary studies.

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UREA SPRAYING

Some preliminary observations.

By

Part I:—M. Y. KARVES & V. P. VAIDYA

Part II:—H. P. MUTHA

Sakarwadi & Lakshmiwadi

PART I

Manure-cost forms a very heavy item of expenses in the cost of cane production. Any reduction in this item, without affecting the yield is welcome. This economy can be effected in two ways.

A- by giving to the plants optimum requirement for the best growth and at the required time.

B- by avoiding wastage, by way of leaching etc.

The object can be best achieved by adopting a method of Nitrogen application in spray to the leaves and not in soil. Successful nitrogen application to the leaves through spray will bring about a great change in the cost of production. Selection of material for spraying depends upon its higher solubility in water, higher available percentage of nitrogen and freeness from effecting burning of plant tissues.

With this view, a feeler trial was taken in 1953 plantation at our G. R. B. Lift wadi, Lakshmiwadi. It was taken on a very small scale of 1 to 2 guntha plots. One plot was sprayed with Urea alone, 7 times, total nitrogen amounting to 202 lbs. per acre. In addition to this plantation dose of 45 lbs. of Nitrogen in soil was given. Second plot was sprayed with Urea like the first one plus 75 lbs. of P_2O_5 in form of single superphosphate. Third plot was kept as control (all nitrogen was applied in soil).

At the time of harvest, in order to avoid border effects, 3 to 4 rows were harvested as ring and then only a central row of 15 ft. length was taken for observations.

Statement showing observations at harvest: Date 28-2-55

Treatment	Wt. of cane in 15' in lbs.	Millable height in ft.	Girth in inches	No. of inter-nodes	Brix	Pol	Purity
1. Urea spray	103.62	7'-8"	3.51"	25.8	20.10	17.80	88.60
2. „ plus P_2O_5	96.25	8'-4"	3.35"	25.6	21.85	19.99	91.48
3. Control	75.12	9'-1"	3.04"	27.4	22.40	20.56	91.78

Visually there was practically no difference in colour and vigour of different plots. Only control was taller and two sprayed plots were showing equal stand. From the statement it seems that the weight of the canes in Urea spray plot is 37.8 % more than that of control plot, while, weight of cane in Urea plus P_2O_5 sprayed plot is only 28.12 % more.

The laboratory tests show that control plot gave highest brix, while Urea plus P_2O_5 plots gave less brix, lowest being of Urea sprayed plot. From this figure trial we have come to the conclusion that manuring by spraying on leaves will be equally useful as usual manuring in soil.

A- Medium soil plot size-15 gunthas, with 5 replicates. July 54 plantation.

Treatments.

- A- Urea spraying 150 lbs. of N and 29 lbs. N applied in soil.
- B- " " 270 lbs. of N plus " "
- C- " " 375 lbs. of N plus " "
- D- " " 225 lbs. of N plus " " plus 200 lbs. of P_2O_5
- E- " " 225 lbs. of N and " " plus 200 lbs. K_2O
- G- A/sulph. nitrate sprayed-225 lbs. N and 29 lbs N applied in soil.
- H- Control-512 lbs. N, 250 lbs. P_2O_5 and K_2O all in soil.

B- Heavy soil plot size 5 gunthas with 5 replicates-July 5 plantation.

Treatments.

- A- Urea spraying 237.5 lbs. plus 29 lbs. N applied in soil.
- B- " " 237.5 lbs. and " " " plus 200 lbs. P_2O_5 sprayed.
- C- " " 237.5 lbs. and 29 " N applied in soil. plus 200 lbs. K_2O sprayed.
- D- " " like above plus P_2O_5 spraying plus K_2O spraying like above.
- E- Control 475 lbs. N in soil plus 200 lbs. P_2O_5 plus 200 lbs. K_2O both in soil.

General notes.

From the statements No. 1 & 2 it will be seen that there is practically no difference between the soil application and spraying the N on crop. The little differences seem to be in favour of control at a later stage which probably indicates the want of nitrogen at a later stage where spraying is done.

(2) The strength of the solution to be sprayed should be about 15 to 20 % as higher concentration than this, especially in case of phosphate and ammonium sulphate has shown a severe scorching.

(3) Interval between two sprayings should be at least 10 days minimum.

The yield data of this plot is not available but from the observations in the plot and the foliar analysis in the laboratory indicates that manuring by way of spraying of the plants will be successful

Observations on Urea spraying

Treat- ment	Collar Ht. Ft. in	Mill. Ht. Ft. in	Inter- nodes	Girth Ins.	Coll. Ht Ft. In	Mill Ht Ft. In.	Inter- nodes	Girth Ins.
Part A — Heavy type of soil — Statement No. 1.								
Observations at 8 months age.					At 10 months age.			
A	5-9	3-9	7.5	3.7	7- 8	5- 7	11.1	13.64
B	5-3	3-5	6.9	3.7	8-11	5-11	11.8	3.8
C	5-7	3-5	7.6	3.5	8- 2	6- 0	13.1	4.4
D	5-6	3-6	7.4	3.6	7- 8	5- 5	11.0	3.76
E	6-3	4-4	8.4	3.8	8- 0	6- 0	11.0	3.87
Part B — Medium soil — Statement No. 2.								
Observations at 7 months age.					At 11 months age.			
A	5-1	3- 6	7.7	2.91	8- 6	6- 9	10.00	3.2
B	4-9	3- 4	7.28	2.81	8-13	7- 3	17.9	3.11
C	4-3	2-11	7.00	3.06	8- 3	6- 3	17.1	3.33
D	4-4	3- 0	7.2	2.87	8-11	7- 0	17.4	3.07
E	5-3	3- 7	7.4	2.77	8- 8	7- 1	17.8	3.10
F	5-4	3- 8	7.8	2.99	9- 6	7- 8	18.00	3.29
G	4-8	3- 5	7.00	2.90	9- 3	7-10	19.9	3.1
H	4-1	2- 9	5.5	3.18	7- 9	5-11	15.0	3.47

PART II—FOLIAR DIAGNOSIS

Urea Spray Experiment

In order to estimate the N, P, K status of cane under this experiment, we have ventured to adopt the novel methods of foliar diagnosis for the first time with quite good success.

In spite of the great controversy about the methods of sampling and methods of analysis the accuracy and the utility of these methods have been widely appreciated for the precision of the treatment and after going through

various articles published in the sugar journals and sugar magazines we have decided to adopt the following methods of sampling and analysis.

Sampling

Leaf samples were collected from the treatments month-wise. 3rd, 4th, & 5th leaves from the top unrolled leaf were chosen for this sampling. The leaves were brought to the laboratory, the laminar portions were removed from the central rib and only 6" to 8" portion from the central part of the laminar portions were selected for sampling. These were dried in the oven and dried samples were then further subjected to foliar analysis.

Sheath portion of the leaf was removed from the leaf and preserved in air tight packing. The moisture was determined after bringing the same to the laboratory by usual methods.

Analysis Methods

Nitrogen was determined from the dried laminar portions by Kjeldahl's method, phosphate was determined from the ash extract of the leaf by Volumetric ammonium molybdate method and the potash was determined from the acid extract by perchloric acid method (Piper).

The results of the analysis are tabulated in the table attached at end.

A glance at the figures of foliar analysis will show us that the spraying of the nitrogen in the form of urea as foliar fertilization has played its part very well. The nitrogen status is in no way less than in the treatment No. 8, of soil application of fertilizer. On the contrary foliar application of manures has raised the nitrogen level of all the treatments in their growth period (i. e. 10th month) much above the soil fertilization and that too with much reduced quantity of nitrogen. It can be observed that less than one half of the total quantity of nitrogen added in the soil is more than sufficient to raise the Nitrogen level of the treatments 2, 4, 5, 6 and 7 simply by foliar application. What treatment No. 5 has achieved for K_2O and Nitrogen levels with the 225 lbs. N plus 200 lbs. K_2O has not been achieved by soil treatment of 500 lbs. N plus 250 lbs. P_2O_5 plus 250 lbs. K_2O . This single treatment and simple foliar diagnosis is quite a strong proof of the miracle played by the foliar application and the amount of fertilizers saved, which are otherwise required for the same indices figures when applied through the soils. If this is confirmed by other workers also then will it not be a huge saving in the amount we are spending for fertilizers and in a way decrease the cost of sugar per ton as well ?

“Yield of the cane is a function of the leaf Nitrogen” (Sugar Feb-1955) and various formulae have been put forth by various eminent workers, here and abroad, for the estimation of yield and sugar per ton from the foliar diagnosis. Apart from going into the details of the formulae and calculations it is quite evident that the richness of the cane (both in yield and quality) depends on the

adequate levels of its N, P, K indices in their particular period of growth and it is also evident that the assimilation of those nutrients depends more or less on the easy availability of the same. In the light of this, the foliar application will surely help a good deal in achieving the target of higher yield and higher sugar per ton with minimum cost of fertilisers.

Our observations though they are much premature at so early a stage are still in line with the foreign workers. Countries like Java, Hawaii, Mauritius, Australia, South Africa, etc. have gone much ahead and they have already adopted the system of foliar diagnosis and foliar treatment and are getting the benefits of the same much earlier than us.

Looking to the tables again we observe that highest index figures of N & K_2O are obtained at the 10th month of age. At this time the sheath moisture is also adequate. Highest sheath moisture is observed with the highest Nitrogen index. It is also observed that higher potassium levels are also associated with higher nitrogen levels. This is in line with the observations made by the foreign workers (Sugar Feb-55). It is claimed that best sugar per ton is obtained when the leaf potash is kept above 2% between 5 to 11 months of age. This view is yet to be confirmed.

One interesting thing is observed in treatment Nos. 4 & 5 that for the same quantity of Nitrogen and same level of Sheath moisture the assimilation of Nitrogen is much more in the treatment 5 than 4 and this phenomenon may be attributed to the presence of potash in treatment No. 5, which confirms the view point put forth by some workers. Thus Foliar spraying of potash along with the Nitrogen contributes more to the uptake of Nitrogen.

The role played by the phosphate spray was rather erratic and disappointing. It is observed that the highest figures for the P_2O_5 index are obtained in the 11th month, one month later than the Nitrogen month. At the same time Nitrogen and Potash have shown a depression. The highest P_2O_5 level obtained is through the soil treatment No. 8, and it is showing higher level throughout the period under observation. Spraying of phosphate has not given any virtual response, which shows that phosphate is better taken up through the soil. This point requires further observations.

Finally we can say that Foliar spraying of Nitrogen and Potash will help a great deal in getting better yield at a reduced cost and reduced doses of fertilisers and bring down the cost of sugar per ton.

We are still continuing with these experiments and add further observations at a later stage.

Date of Planting Sept. 54

*Urea Spraying Experiment - Foliar Diagnosis*Initial dose-29 lbs. N. only
through soils
Strength of solution
-10 to 15 %

Spraying Till-21-11-54-19-4-55

No. of Sprays-13

Treatment	9th Month (June 55)			10th Month (July 55)				11th Month (August 55)				
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O	Sheath H ₂ O	N	P ₂ O ₅	K ₂ O	Sheath H ₂ O	Silica
1. 150 lbs. N (Urea Spray)	1.302	0.2666	2.067	1.389	0.3472	2.2514	81.72	1.400	0.4588	1.461	79.7	6.78
2. 270 ,, ,, ,,	1.568	0.2635	2.034	1.519	0.2449	2.209	81.60	1.585	0.4867	1.802	81.52	5.50
3. 375 ,, ,, ,,	1.449	0.2480	2.271	1.610	0.2852	2.1245	82.30	1.755	0.4619	2.073	81.70	4.16
4. 225 ,, ,, and 200lbsP ₂ O ₅ (Spray)	1.407	0.2573	2.034	1.533	0.4433	2.056	81.68	1.480	0.4550	1.869	81.63	5.48
5. 225 N plus 200 K ₂ O	1.498	0.3844	2.305	1.666	0.3472	3.229	82.60	1.635	0.4960	2.158	81.59	6.10
6. 225 N ,, 200 P ₂ O ₅ ,, 200 K ₂ O	1.330	0.3441	2.169	1.582	0.4061	2.566	81.76	1.485	0.5177	1.903	81.18	6.28
7. 225 N as AMSO ₄ -NO ₃	1.386	0.3038	1.745	1.596	0.5115	1.784	82.10	1.470	0.5053	1.869	81.50	5.760
8. Soil Application 500 N plus 250 P ₂ O ₅ and 250 K ₂ O	1.379	0.3976	1.949	1.414	0.5239	2.005	79.80	1.585	0.5456	2.003	80.72	5.720

Heavy Nitrogenous manuring of Sugarcane

By

F. S. PATEL & M. Y. KARVE
Sakarwadi

Doubtless it is that Nitrogen plays the most vital role in the vegetative growth of plants and naturally one expects proportionate rising yield with every additional unit of Nitrogen added. But the expectation is not fulfilled. Higher nitrogen application as 1000 lbs per acre are of this order is neither the only reason, not even the major reason, of the success in the prize plots. Success of any sugarcane plot depends upon the intrinsic fertility of the land, best possible home of the plants i. e. provided by higher cultural practices and required quantity of organic manures added which bring manifold benefits along with them. In prize plots an attempt is made to provide maximum optimum conditions to each and every plant and this gives the surety of success to a considerable degree. Very high nitrogenous manuring as 1000 lbs N per acre generally leads to a very hasty and luxurious growth of the cane. Such heavy crops if attacked by heavy winds in April & May, lodge very heavily and many evils come in along with this lodging. A considerable damage due to rat trouble and drying of the canes results from this lodging and it tells much upon the final yield, quality of the juice and finally the C. C. S.

Notes:—From statement No. 1 & 2 it will be seen that the differences in yield of cane are not very wide between different levels of nitrogen application per acre. In statement No. 2 where nitrogen is applied from 450 to 600 lbs in medium soil, the difference in yield is very little, giving practically the same analysis. In case of heavy B soil, where nitrogen is applied from 375 to 525 lbs. per acre, the difference in yield is very little giving better analysis in case of 375 & 450 lbs of nitrogen.

Statement No. 1 Crop No. 15. 1953-54 Crushing.

Heavy soil—Average of 3 replicates—Plot size 1-0

	Yield/one acre			P. J. Analysis		
	Tons	Cwt	Lbs.	Brix	Pol	Purity
A-550 lbs N ₂	56	17	8	18.21	15.50	85.06
B-450 „ „	50	6	45	17.49	14.65	83.81

Medium soil—Average of 3 replicates—Plot size 1-0

	Yield			P. J. Analysis		
	Tons	Cwt	Lbs	Brix	Pol	Purity
A-525 lbs N ₂	67	9	90	19.55	17.32	87.96
B-450 „ „	63	7	47	20.28	17.82	87.86
C-375 „ „	56	3	18	20.13	17.71	88.26

Statement No. 2. Crop No. 16. 1954-55 Crushing.
Medium soil-Average of 3 replicates-Plot size 1-9

	Yield			P. J. Analysis		
	Tons	Cwt	Lbs	Brix	Pol	Purity
A-450 lbs N ₂	95	15	3	16.83	14.09	84.31
B-525 „ „	97	7	88	16.36	13.48	82.17
C-600 „ „	98	5	110	16.70	13.92	83.45

Heavy soil-Average of 2 replicates-Plot size 0-20

	Yield			P. J. Analysis		
	Tons	Cwt	Lbs	Brix	Pol	Purity
A-375 lbs N ₂	66	11	77	21.54	19.46	90.34
B-450 „ „	70	4	77	21.35	18.61	87.16
C-525 „ „	69	12	57	19.06	16.67	87.46

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Application of Superphosphate through Carriers in Deccan Canal Soils

By

Kumari V. S. LAD & D. K. PATEL
Padegaon

Phosphorus is one of the three major plant nutrients. In importance, it is next to nitrogen in Indian agriculture. Its need is being recognised in manuring practices along with nitrogen, in recent years, under intensive cultivation aiming high production.

However, it differs considerably from nitrogenous fertilizers in its behaviour, in soil. Nitrogenous fertilizers when applied to soil remain available to crop, move freely in soil profile through soil moisture and possess the only danger of being leached out or lost, if applied in excess. Phosphatic fertilizers when applied to soil, remain wherever they are placed, their lateral or downward movement is practically very little and possess no danger of being leached out or lost. But the phosphatic fertilizers like superphosphate, have the characteristic property, a great disadvantage, of getting fixed or reverted from soluble to insoluble form in contact with soil, thus rendering themselves unavailable to crop.

Now it is an accepted fact that soluble phosphatic fertilizers like superphosphate, when applied to soil, get reverted to unavailable form to a considerable extent. Thus, Hopkins (1950) came to the conclusion that the standard of our major phosphatic fertilizers is very low because soluble phosphate added to soil reverts to less available form by soil fixation. Lewis, Baker and Snyder (1950) have observed that in calcareous soils of Western U. S. A. numerous chemical reactions and physical changes take place that render soluble phosphatic fertilizers unavailable for plant use. McGeorge and co-workers (1950) have found strong fixing power for soluble phosphate, in calcareous soils because of free calcium carbonate and gave evidence of the formation of tricalcium phosphate. Patel and Vishwanath (1946) in their comparative studies of Indian Soils about phosphate fixing capacity have reported that clayey soils (Black Cotton soils) have high fixing capacity and that free lime (calcareous soils) tremendously increases the fixing capacity. Raghavan and Patel (1952) in their studies of Deccan Canal Soils have made similar observations.

The soils of Deccan Canal area are highly clayey and calcareous with free lime status varying from 3 to 15 percent. In view of this, insoluble fertilizers like rock-phosphate basic slag, bonemeal etc. are not suitable and the use of soluble phosphatic fertilizers like superphosphate is only advisable but its use presents a problem in highly clayey calcareous soils.

The availability studies carried out on application of superphosphate showed that the availability decreased upto 5 to 10% in about 3 months' time with major soil types of Deccan Canal area, due to fixation. The phosphate fixing capacities of these soils were very high and it was beyond practical limit to reach saturation capacity. Even with a dose of 1000 lbs. P_2O_5 (broadcast) per acre, only about 30 to 40% was available, the rest being fixed up in unavailable form. Application of superphosphate (100 lbs P_2O_5 per acre) in row or band, maintained about 30 to 40% in available form accordingly, due to localised concentration and less mixing with soil. For better utilization of this available phosphate the superphosphate should be placed in a zone of maximum roots and where there is enough moisture always for roots to expand. For a crop like sugarcane in Deccan Canal area, it has been found that placement of superphosphate in a band, six inches deep in the furrow for deep soils and half-way down the ridge for shallow soils is advisable. This agronomic finding is well supported by periodical availability studies. There is even an indication that application of superphosphate by placement in two doses—half at planting and half at earthing up—gives more sugar.

The row or band placement method of superphosphate solves the problem partially because, still about 60 to 70% superphosphate is getting fixed or turned unavailable. Attempts were made to maintain its better availability by applying it through carriers i. e. mixing superphosphate with compost or dung, like cement-mortar for a short period. This paper presents the results of field experiments and laboratory evaluation of efficiency of the method.

Experimental

Phosphate carrier experiment—Field experiments:—A simple experiment consisting of 4 treatments in duplicate was laid out in 1952-53 at Padegaon Farm in chopan (reclaimed) area, to find out the advantage of applying superphosphate through carriers with plant cane. Each plot measured one guntha and an uniform dose of 500 lbs. P_2O_5 per acre was applied in all plots in different ways as detailed below. High dose of P_2O_5 was taken due to chopan area.

Treatment No. 1. Control:—Superphosphate and compost applied in the proportion of 1:5 by weight, separately in furrow at planting.

Treatment No. 2. Compost plus P_2O_5 :—Superphosphate and Compost mixed in the proportion of 1:5 by weight like cement-mortar adding sufficient moisture, for a period of one week with one turning. Loose dry material applied in furrow at planting.

Treatment No. 3. Control —Superphosphate and bagasse applied separately in furrow at plantings in the proportion of 1:5 by weight.

Treatment No. 4. Bagasse plus P_2O_5 :—Mixed and applied as under treatment No. 2.

Germination, effective tillering and growth performance were superior where superphosphate was applied through carriers i. e. mixed. But the results were vitiated to a certain extent, due to borer attack in control and hence the same experiment was repeated in the adjoining area in 1953-54, keeping the old experiment under ratoon after harvest, giving same treatments. The results of new experiment in 1953-54 are given below.

Table No 1.

Role of compost and bagasse as phosphatic carriers on growth of sugarcane 1953-54.

No.	Treatment	Brix	Plant population per acre	Tons per acre-mean
<i>Plant Cane</i>				
1.	Control Compost and P ₂ O ₅	21.2	32,262	41.2
2.	Compost + P ₂ O ₅ mixed	21.5	34,885	51.7
3.	Control Bagasse and P ₂ O ₅	19.7	29,639	35.5
4.	Bagasse + P ₂ O ₅ mixed	20.5	34,154	42.8
<i>Ratoon</i>				
1.	Control Compost and P ₂ O ₅	20.0	35,866	43.3
2.	Compost + P ₂ O ₅ mixed	20.2	35,300	45.6
3.	Control Bagasse and P ₂ O ₅	20.0	34,800	40.8
4.	Bagasse + P ₂ O ₅ mixed	20.2	34,453	44.2

The data in Table No. 1 clearly show that by the application of phosphate (superphosphate) through carriers i. e. thorough mixing of superphosphate with compost or bagasse in the proportion of 1:5 by weight, like cement-mortar even for a short period of one week proves highly beneficial for better quality of cane and yields. Compost seems to be superior to bagasse for plant cane.

The experiment was also continued during the year 1954-55, including dung as a phosphate carrier in the same area with the two alternative sites. The results of this experiment as well ratoons have shown promising results. But they were not so striking as those of Table No. 1 as the soil became rich in inherent available phosphate due to previous experiments at the same site.

Phosphate carrier experiment—Laboratory studies:—Detailed laboratory studies were undertaken with a view to evaluate the efficiency of three different carriers, used in field experiments, viz. compost, bagasse and dung. The experiment was carried out in pots of one foot diameter. A weighed quantity of the above-mentioned carriers was taken in separate pots in duplicate with one control in each case. Single superphosphate (18% soluble P_2O_5) was mixed thoroughly with the carrier in pots (1 part superphosphate + 5 parts carrier) and the whole mixture was kept in moist condition. Periodical samples were taken after 1, 3, 4, 8 and 16 weeks. Moisture was made up in the pots the previous day before taking the samples after thorough mixing. The samples were dried in sun and analysed as such. Four different forms of phosphate were estimated from each sample in duplicates. The details of the procedure are as under:—

(I) *Water soluble (diffused) phosphate:*—A weighed amount (5 gms.) of the air dried sample was allowed to be soaked in distilled water for one hour without stirring the contents, the ratio of sample and water being 1:100. A suitable quantity of the supernatant liquid from the treated and the control, was taken for determining the phosphate content by the normal volumetric method destroying the organic matter by the use of nitric acid. *This form of phosphate was considered liable to be fixed in soil.*

(II) *Adsorbed or absorbed phosphate:*—Residue remaining after water extract, as above, was macerated with $NHCl$ and filtered off, repeating this process 5 times. The phosphate thus extracted was estimated. *This form of phosphate was considered as available due to protection.* Due consideration was given to water insoluble but HCl soluble phosphate content of superphosphate. This was further confirmed by running a separate experiment with the mixture of dung and water extracted phosphate from superphosphate.

(III) *Organic phosphate:*—The residue after maceration was used for phosphate estimation following usual precautions. This form of phosphate is also taken as available due to decomposition of organic matter in due course.

(IV) *Total phosphate:*—This was determined by the normal procedure using 5 gms. of sample and taking all precautions of the loss of phosphate by volatilization during the course of ignition (9).

The results of the analysis are presented in Table No. 2.

Table No. 2

Phosphate carrier experiment—Laboratory studies
 Different forms of phosphate along with available protected phosphate on applying superphosphate through different carriers

Period of sampling	Different forms of phosphate	Percentage P ₂ O ₅ on over dry basis					
		Carriers					
		Bagasse		Compost		Dung	
		Bagasse + Superphos	Bagasse only	Compost + Superphos	Compost only	Dung + Superphos	Dung only
One week	Water soluble	3.10	0.06	0.71	0.04	2.08	0.23
	Adsorbed/Absorbed	1.38	0.07	4.22	0.67	6.09	0.53
	Organic	0.10	0.05	0.20	0.14	0.23	0.10
	Total	4.76	0.17	5.23	0.92	9.05	0.86
	Available Phosphate (Protected) percentage fraction of total	28.14	—	84.24	—	75.53	—
Three weeks	Water soluble	3.27	0.16	0.62	0.10	1.78	0.10
	Adsorbed/Absorbed	1.87	0.07	4.16	0.68	7.56	0.55
	Organic	0.34	0.08	0.72	0.24	0.54	0.27
	Total	5.24	0.24	5.27	0.82	9.88	1.08
	Available Phosphate (Protected) percentage fraction of total	39.81	—	88.28	—	82.80	—
Four weeks	Water soluble	3.23	0.03	0.15	0.02	0.84	0.06
	Adsorbed/Absorbed	1.76	0.03	4.94	0.74	7.90	0.53
	Organic	0.45	0.09	0.44	0.04	0.55	0.25
	Total	5.21	0.15	5.36	0.88	9.59	1.06
	Available Phosphate (Protected) percentage fraction of total	39.47	—	97.23	—	91.23	—
Eight weeks	Water soluble	3.28	0.003	0.12	0.01	0.65	0.06
	Adsorbed/Absorbed	1.96	0.07	5.06	0.74	8.46	0.83
	Organic	0.36	0.12	0.35	0.18	0.58	0.38
	Total	5.75	0.155	5.76	0.99	9.86	1.29
	Available Phosphate (Protected) percentage fraction of total	39.53	—	97.73	—	91.41	—
Sixteen weeks	Water soluble	3.19	0.002	0.13	0.004	0.38	0.06
	Adsorbed/Absorbed	2.21	0.05	4.85	0.76	8.83	0.83
	Organic	0.29	0.12	0.38	0.16	0.54	0.27
	Total	6.73	0.17	5.37	0.96	10.34	1.37
	Available Phosphate (Protected) percentage fraction of total	42.15	—	97.21	—	96.26	—

In table No. 2 the phosphate which is adsorbed/absorbed and converted into organic form is taken as available phosphate due to protection by the carriers. Over and above, about 30 to 40 percent of the water soluble (diffused) phosphate should also be considered as available under placement method.

The data show it clearly that about 70 to 80 percent of superphosphate can be maintained in available form by applying through carriers like compost or dung even with a short mixing period of about a week. The availability of phosphate due to protection goes on increasing as the period of keeping them mixed goes on increasing and thus availability rises upto 95 percent within four months. It will also be observed that the water soluble phosphate which is liable to be fixed is the highest at the beginning and goes on decreasing with time.

The application of superphosphate through compost or dung as carriers, seems to be more beneficial as compared to bagasse. Comparison between compost and dung shows that compost has maintained higher availability of P_2O_5 than dung but dung is superior to compost as a carrier if one takes into consideration the percentage concentration of phosphate in both the carriers. The application of phosphate through carriers has a further advantage that it maintains availability steadily over a longer period due to slow decomposition of the organic matter (carrier).

Discussion.

The field experiments have clearly shown that application of superphosphate through carriers i. e. mixed with compost or dung is more beneficial than separate applications for quality of cane and yields. The beneficial effect is due to the maintenance of better availability of phosphate through protection or minimised fixation. Recently Acharya (1954) has also reported that the process of reversion or fixation of superphosphate, can be, to a certain extent, be reduced by mixing superphosphate with 20 to 50 times its weight of compost or F.Y.M. before applying to field. Very recently, Walunjkar and Acharya (1955) have further reported that compost prepared with superphosphate gave higher crop yields than superphosphate alone.

The data on laboratory studies clearly show that mixing of superphosphate with compost or dung, like cement-mortar, even for a short period of one week can maintain about 70 to 80 of superphosphate in available form through protection. The availability can be increased to about 90 to 95% by increasing the period of mixing. The method of applying superphosphate mixed with compost or dung to maintain better availability through protection or minimising fixation, has an added advantage to maintain availability steadily over a long period due to slow decomposition of engulfing organic matter. It is likely to prove more suitable for a long growing crop like sugarcane.

Summary and Conclusions.

The highly clayey calcareous soils of Deccan Canal area have very high phosphate fixing capacity which renders superphosphate applied to soil, unavailable

to crop to a greater extent and hence it is advisable to apply superphosphate through carriers i. e. mixing superphosphate with compost or dung, like cement-mortar.

Field experiments have shown very promising results on applying superphosphate mixed with compost or dung (through carriers) compared to separate applications. Laboratory studies have shown that mixing of superphosphate with compost or dung, like cement-mortar, even for a week, keeps 70 to 80% of superphosphate in available form through protection or minimising contact with soil.

The availability can be increased upto 90 to 95% by increasing the period of mixing to about four months with a couple of turnings. The approximate proportion of 1:5 of superphosphate to compost or dung by weight, is suitable for mixing. The proportion can be varied according to the availability of well-fermented compost or dung.

The method recommended is just the practical solution of granular or palette-form of superphosphate used in Western countries to minimise fixation and thus maintains higher availability. The proposed method has, however, an added advantage as the availability of phosphate is maintained steadily over a long period due to slow decomposition of organic material engulfing superphosphate, which is more beneficial for a long growing crop like sugarcane.

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Planting Experiments

By

B. H. HOSHING
Ravalgaon

Good germination is a *sine qua non* to good sugarcane yields. Considerable work has been done in various sugarcane growing countries to understand the different factors responsible for good germination and to evolve practical methods to improve germination. Of the factors considered important are healthy cane setts free from disease etc. and a certain warmth in the soil. C. Van Dillewijn(1) has given a very informative review of the various methods adopted for getting better germination. Good results have been reported in Java and Hawaii by soaking cane setts in water or aqueous solutions of chemical nutrients. R. E Coleman(2) reports the beneficial effect of dry storage of setts prior to planting due to increase in readily available reducing sugars and lowering of the auxin level in cane setts. Improved germination by the brief treatment of the cane setts with organo-mercurial fungicides has been reported(3).

To assess the efficacy of the several methods suggested under the conditions obtaining in Ravalgaon, the following experiments were conducted:

- (1) Staling cane, after harvesting, for twenty-four hours.
- (2) Soaking for 24 hours fresh cane setts and one day's stale cane setts in aqueous solutions (1%) of the following chemicals—ammonium sulphate, triple super-phosphate, potash and their various combinations as given below.
- (3) Press cake was applied at the time of planting at the rate of 10 cwts. per acre.
- (4) Control.

Following observations were made:

- (1) Cane setts soaked in potash solution came up first.
- (2) Stale setts in general had better stand than fresh ones.
- (3) Cane setts planted with press cake surpassed all others as regards good stand.
- (4) Cane setts soaked in solutions of sulphate + phosphate and potash + sulphate were also having a good stand.

The average number of tillers after about two months is given below:—

		<i>Stale setts</i>	<i>Fresh setts</i>
(1)	Soaking in sulphate	2.3	1.1
(2)	„ in phosphate	1.17	1.8
(3)	„ in potash	2.8	2.4
(4)	„ in sulphate+phosphate ..	2.92	2.64
(6)	„ in potash+sulphate ..	3.00	2.1
(6)	„ in potash+phosphate ..	2.09	1.9
(7)	„ in potash+phosphate+sulphate	1.00	1.6
(8)	Press cake	2.60	2.1
(9)	Control	2.64	1.0

It will be seen from the above that tillering was more in the case of cane setts soaked in solutions of potash, sulphate+phosphate, potash+sulphate and in the case of setts planted along with press cake.

Encouraged by the early response to soaking cane setts in solution of potash, soaking in solution of molasses ash (Ash contains about 30.35% water-soluble potassium salts) was tried. In a second experiment, molasses ash was applied in the row at the time of planting at the rate of 1 cwt. K_2O per acre. Here also a good result was obtained.

As the stale cane cuttings germinated better, the staling was extended to 2 days, 3 days and 4 days and similar planting experiments conducted. It was found that stale cane setts in general germinated better than control ones but appreciable difference was not found by prolonging the staling period.

Effect of staling on the composition of cane was studied in the laboratory. Sixteen mother canes from the plot used for planting purposes were brought to laboratory, cut into parts and parts randomised to get four composite samples. One sample was crushed in the laboratory crusher the same day and juice analysed for sucrose and reducing sugars. Other samples were crushed and analysed similarly on 2nd, 3rd and 4th days. The results are given in the table below.

Table

Day	Wt. of cane lbs.	Wt. of juice lbs.	Brix	Pol	Purity	Sucrose per cent	R. S. per cent	R. S. per cent pol	R. S. per cent sucrose
1	20	13.5	13.69	10.60	77.43	10.48	1.921	18.12	18.30
2	20	13.5	14.69	11.62	79.10	11.58	1.855	15.96	16.02
3	19	12.5	14.41	10.98	76.20	11.04	2.200	20.03	19.93
4	18	12.0	13.94	10.19	73.10	10.16	2.46	24.14	24.21

The results show that the sucrose % increased on the 2nd day and then decreased, whereas the reducing sugars per cent increased. This increase in the content of reducing sugars seems to be one of the factors favouring better germination in stale cane setts.

Soaking the cane setts in aqueous solution of glucose itself was tried but without any encouraging results. Press cake alone (at the rate of 10 cwts. per acre) and press cake along with molasses ash (at the rate of 1 cwt. K_2O per acre) were applied at the time of planting. Combination of press cake and molasses ash did not give good germination. Brief dipping of the cane setts in Agallol prior to planting resulted in better germination.

The exact reactions that take place during all these treatments have not yet been correctly understood. Nevertheless, previous investigators have given plausible explanations. The beneficial effect of staling is attributed to the loss of moisture and conversion of sugars into reducing sugars. Effect of soaking in water helps the hydrolysis of sugars. Soaking cane setts in nutrient solutions will result in the intake of nutrient materials by the setts. Soaking removes some harmful substances from the setts. Good germination results, obtained when planting is done with the application of press cake, may be attributed to, in addition to usual nutrients, some growth promoting substances present in it. That the press cake contains some growth promoting substances has been recently shown by Shri J. P. Shukla and others (6).

From the experiment, it can be said that under Ravalgaon conditions, following treatments appear to be favourable:

- (1) Soaking cane setts in solutions of potash, potash+sulphate and sulphate+phosphate.
- (2) Application of press cake at the time of planting.
- (3) Staling harvested cane prior to planting.
- (4) Application of molasses ash at the time of planting.
- (5) Brief dipping of the cane setts in agallol.

I am grateful to Seth Govindji Raoji for his initiative and keen interest in the work. Thanks are also due to Shri S. N. Gundurao and Shri G. M. Patki for interest and guidance.

References

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Webre Circulator in Vacuum Pans

By

P. V. S. SASTRY
Ravalgaon

Modern trends in pan boiling are towards maximum exhaustion of mother liquor or molasses in the pan itself. To achieve this, the necessity of a good circulation in the pan, which enables uniform supersaturation conditions throughout the mass, cannot be overemphasised. Good results in pan boiling constitute rapid crystalization rates and maximum exhaustion of mother liquor without formation of false grains. By good circulation, local high temperatures and consequent colour formation are avoided. Heat transmission is increased resulting in quicker boiling and higher capacities.

This important aspect viz. circulation in vacuum pans has been receiving the attention of pan designers and is improved by stream-lining, increasing the diameter of the downtake and avoiding high levels. Even so, the circulation in such pans is far from the requirements, particularly for thick low grade boilings. Mechanical circulation has been the only really satisfactory method of achieving the required circulation. Of such mechanical circulators, the best is the Webre Circulator.

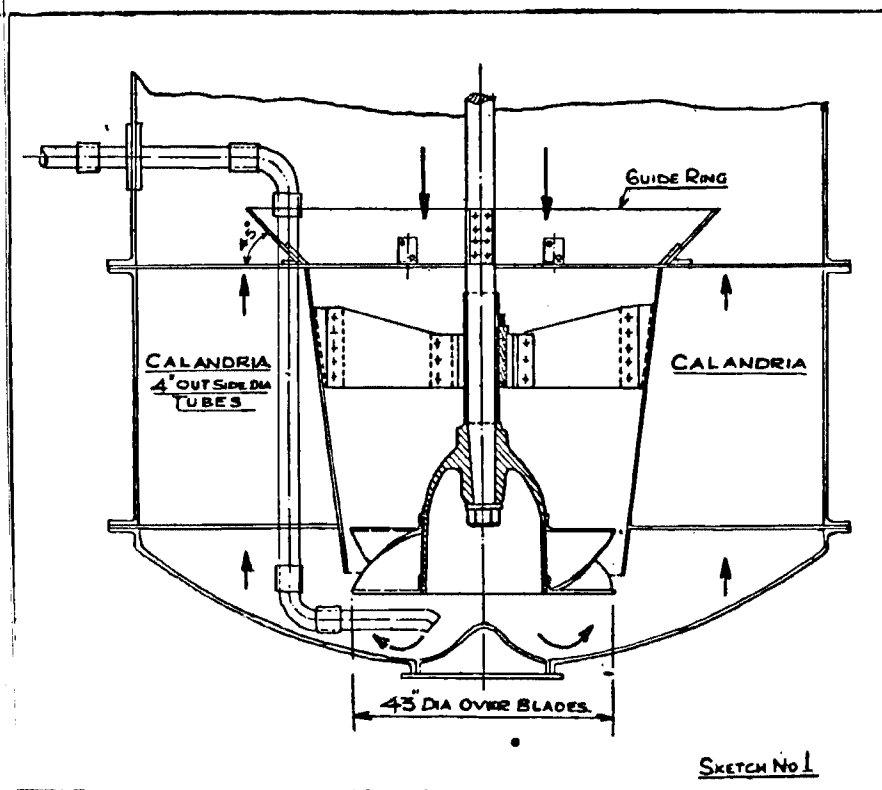
In a recent, very interesting and informative paper "Why mechanical circulation" Webre gives the following facts about 'Webre Pan Circulators' of which there are 150 units in successful operation in the world. These facts will be appreciated when it is realised that heat injury to the products is a function of temperature as well as time.

	<i>Natural circulation</i>	<i>Mechanical circulation</i>				
(1) Masecuite velocity in tubes	1.50 down to 0.087 ft. per second	Uniform 1.5 ft. per second				
(2) Time of contact with heating surface per pass at the end of C strike.	46 seconds	2.66 seconds				
(3) Rate of evaporation at the end of C strikes		Four to six times as fast as with natural circulation.				
(4) Time required to complete strikes % of natural circulation time		A strikes B strikes C strikes 85 % 75 % 60 %				
		Vacuum in Pan				
	24.0"	25.0"	26.0"	27.0"	28.0"	
(5) <i>Maximum temperatures in tubes at the end of C strikes</i> Max. temp. in natural circulation	214°F	211°	208°	205°	201°	

	Vacuum in Pan				
	24.0"	25.0"	26.0"	27.0"	28.0"
Max. temp. with mechanical circulation	186°F	179°	170°	160°	146°
Reduction in temp. with mechanical circulation	28°F	32°	38°	45°	55°
Normal pan temperature	171°F	164°	155°	145°	131°

- (6) Feed distribution is much better with mechanical circulation.
- (7) For the first time, a practical and reliable automatic feeding system is made possible by mechanical circulation.

One Webre circulator was put in our 20 tons Fletcher central flow pan (1000 sq. ft. H. S.) as shown in Sketch No. 1, and worked during the seasons 1953-54 and 1954-55. It consists of a central shaft, suspended and driven from the top and extending through the downtake, within which is installed a centering bearing with renewable wearing blocks. This bearing is supported by 6 plates welded to the downtake. To the lower end of the shaft, is fixed a hollow drum, open at the bottom. To the cylindrical part of the drum, are bolted six bronze helical vanes of slightly smaller diameter than the downtake. The drive consists of a 60 HP motor and a heavy speed reducer with thrust bearings. The speed of the circulator is nearly 10 r. p. m. An Ammeter is fixed in one of the circuits of the motor, the readings of which can indicate the concentration of the pan contents.



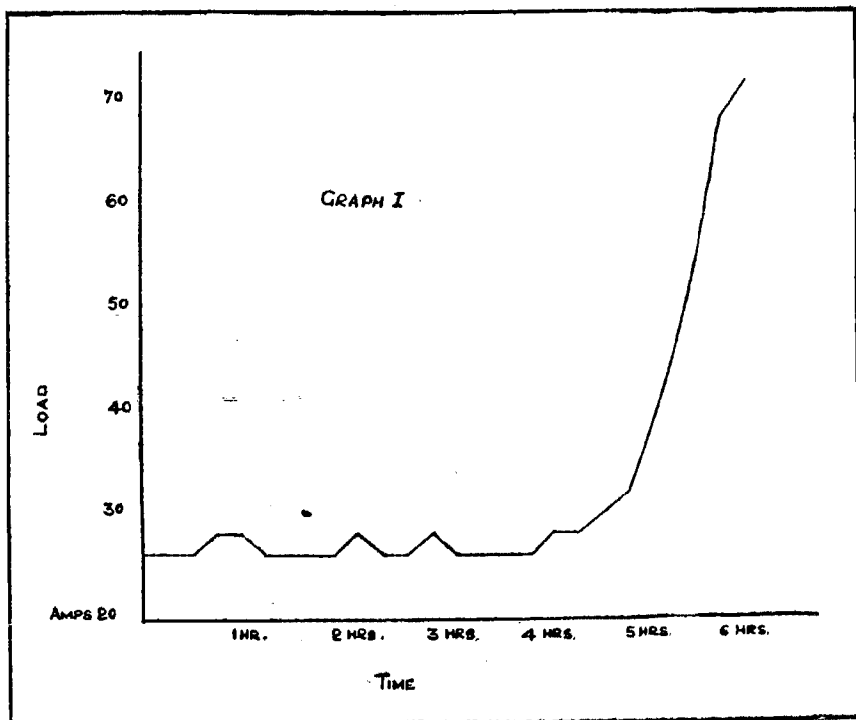
Guide rings are also fixed to the calandria as shown in the sketch for guiding the circulation in the desired way. These are expected to improve the working of the Webre circulator. The usefulness of these rings is yet to be established.

The feed is admitted into the hollow of the cylindrical drum at the bottom. Through the holes provided in the hollow of the drum, under each vane, the feed comes out and gets caught by the whirling vanes and gets uniformly mixed. For the control of densities in the pan, the proof stick method wherein the personal factor comes in, is dispensed with and with the aid of the Ammeter reading, almost all the C massecurites could be dropped at 100° Brix.

Comparative figures with and without the circulator are given below, which bear ample evidence to show that the claims of better pan boiling and greater capacity are justified.

	Without circulator		With circulator	
	Bx.	Purity	Bx.	Purity
1. C Massecurite	100.04	59.76	100.5	60.0
2. Final molasses	98.42	31.97	99.29	32.09
3. Drop in purity		27.91		27.91
4. Boiling time	8 hours		4 to 5 hours	
5. Load on Ammeter at the time of dropping			75 to 80 Amps.	

A representative graph of the boiling load is given in Graph I.



Webre suggests boiling of final massecuites at 60 % of the finishing load. Attempts were made to follow up the suggestion but difficulties were experienced due to absence of steady vacuum and steam pressure conditions. With vacuum and steam pressure conditions under control and automatic and continuous feed, better results should have become possible.

Conclusion

From the experience gained at Ravalgaon, it can be stated that the Webre circulator is a useful addition to the panfloor equipment. Considerable saving in time to the extent of 40-50 % can be achieved, particularly, with the low grade strikes which would result in an increase in capacity by 80 to 85 % at the station. Lighter coloured massecuites result. The exhaustion obtained in a shorter time was the same as before. Development of a proper technique of boiling the pan viz. boiling the strike at a load of 50-60 % of finishing load and tightening the massecuite slowly at the end, in about an hour, coupled with steady vacuum and steam conditions and a continuous automatic feed, may give better exhaustion also.

Acknowledgement

My grateful thanks are due to Seth Govindji Raoji, Director, Ravalgaon Sugar Farm Ltd., for his interest in the work and to Shri S. N. Gundurao for his guidance.

D. S. T. A.
12th Convention 1955

Padegaon findings in short (1950-55)

By

H. R. ARAKERI
Padegaon

Sugarcane Research work started at Manjri in the year 1892 was transferred to Padegaon in the year 1932. The scheme partially financed by the Indian Council of Agricultural Research was in operation upto 1944. During this period the work was concentrated on plant cane. During the period from 1944-49 the Sugarcane Research Station at Padegaon was converted into Agricultural Research Station for research work on irrigated crops in general and the work on sugarcane was restricted to testing varieties received from Coimbatore and continuation of long turn experiments in progress.

New Scheme started during 1950 has completed first 5 years' period and summary of results obtained so far is presented here.

Soil studies.

The results obtained are summarised under different headings below:-

I. Permanent Series:- Since 1932 some permanent plots have been laid out in light, medium and deep soils to study the effect of irrigation, manure, different types of sugarcane plantings and rotations on the temporary and permanent soil factors. Soil samples are taken periodically and analysed for different constituents to judge the effects of the treatments on soil. In all there are four series.

(A) Series I and II-Soil changes under continuous irrigation and manuring

They are laid out only in the medium soil and they consist of three irrigation treatments without any dose of manure or fertilizer and eleven treatments of bulky manures and nitrogenous, phosphatic and potassic fertilisers under one irrigational dose of 95 A" only. A dry control has been also maintained which receives the cultural operations carried out in other plots. Physical, chemical and microbiological analysis of the soil indicates the following:-

(i) Dry control has hardly shown any variation in the different constituents from original samples taken in the beginning.

(ii) *Soil reaction:-*Irrigation has not shown any marked effect on lowering of pH especially with lower doses, although with 120 acre inches per year, trend is

towards the reduction of the same. As expected, application of ammonium sulphate has reduced the pH and that of sodium nitrate has resulted in increase. Effect of other treatments is of little practical importance.

(iii) *Calcium carbonate and exchangeable Calcium*:—There is increase in irrigation and with the application of F.Y M. exchangeable calcium is steady, and there has been reduction with green manuring, sulphate of ammonia and with safflower cake. Fertilisers like sulphate of ammonia, sulphate of potash and muriate of potash have shown reduction in Exchangeable Calcium.

(iv) *Nitrogen*:— There is no noticeable difference between the dry control and continuous irrigation as far as this constituent is concerned. All other treatments have shown increase in total nitrogen content, the highest being with ammonium sulphate, followed by sodium nitrate and calcium cyanamide. Contrary to the belief the loss has been least in ammonium sulphate and it is higher in F. Y. M. Safflower cake also is poor in this respect showing that artificials are better in this respect than the others. Even in the plots receiving only phosphate (particularly) and potassic fertilisers, nitrogen status is better than control.

(v) *Phosphates*:— Phosphate status has been naturally high in the phosphate treatments. It has been also high in the plots receiving bulky manures and safflower cake. Out of all phosphatic fertilisers superphosphate has been the best. There has been very little movement of phosphates to lower zones along with irrigation water.

(vi) *Potash*:— Application of potassic fertilisers has resulted in the increase of this nutrient in surface as well as in lower layers showing that there has been some movement of this fertiliser. From potash status point of view F. Y. M. has been next to potassic fertilisers.

(vii) *Humus and Organic Carbon*:— There is no significant difference in humus content in dry control and irrigation treatments. Application of F. Y. M. and sann have helped in building up of humus content, F. Y. M. being the best in this respect. Safflower cake and green manuring (sann) are better than other fertilisers, where humus is depleted, depletion of organic carbon being maximum in ammonium sulphate treated plots.

(viii) *Micro-organisms*:— In general total population of micro-organisms has been higher in the plots treated with manures than those treated with inorganic fertilisers with the exception of superphosphate, which also has showed higher counts. Plots receiving potassium sulphate and calcium cyanamide also showed fair counts.

It is interesting to note that 95 A° treatment has been proved beneficial for microbial activity in January whereas 120 A° dose has given better results in April.

(B) Series III. Soil changes under continuous cropping and fallowing:—

This series has been laid out in light, medium and chopan soils of the farm. It consists of 5 different fallows having different combinations like cultivated, manured, cultivated and irrigated etc. and three systems of cropping with cane, with and without manure. In one of the treatments cane is grown by Manjri Standard Method which includes sann green manuring.

From yield point of view, there has been rapid deterioration in the case of continuous cane or ratoon either manured or unmanured while in the Manjri Standard Method there is reduction in yield only in case of chopan soil. Effect of these treatments on the chemical properties of soil is given below:—

(i) *Soil reaction*:— No significant change is produced in light and medium soils but in chopan soils slight reduction is observed in the manured plots. On the contrary in the fallow treatments there is slight increase in the pH as compared to cropped treatments.

(ii) *Free lime and exchangeable calcium*:— In chopan soils there is slight reduction in free lime reserve in manured and continuously cropped plots but there is no marked difference in exchangeable calcium in any of these plots. In light and medium soils however there is no significant difference either in free lime or in exchangeable calcium in any of the treatments.

(iii) *Humus and organic carbon*:— Manuring maintains the humus status and accordingly organic carbon at high level in fallow as well as cropped plots. In general, cultivation and irrigation has depleted the humus content of the soil in all types of soils. In fallow plots however the humus status is maintained.

(iv) *Total Nitrogen*:— In general, cultivation or irrigation has brought down nitrogen status in fallows but manuring has built up the nitrogen status even in cropped series, in all the three types of soils.

(v) *Available P_2O_5 and K_2O* :— Available P_2O_5 and K_2O are much higher in light soils as compared to other two. Cultivation and irrigation has increased the available P_2O_5 and has maintained the availability of K_2O in Chopan soils. Similarly in cropped and manured plots P_2O_5 status has gone up but in fallow but manured plots the effect is not so marked. In medium soils there is definite improvement in available P_2O_5 and K_2O due to manuring. In light soils in cropped and manured plots the status of available P_2O_5 and K_2O is low as compared to unmanured plots which can be attributed to high yield differences between the two treatments in shallow soils.

(6) *Micro-organisms*:—The population of bacteria and actinomycetes was comparatively higher in light and medium types of soil than in chopan soil. In general there has been increase in the population of soil micro-organisms in the manured plots as compared to unmanured plots.

(C) Series IV : Soil changes under continuous and rotational crops other than sugarcane:—

This series was started in 1934 with continuous cropping of jowar, cotton, sann, groundnut along with a fallow plot. In 1944 rotational series with Sann/Wheat, Groundnut/Wheat, Sann/Jowar, Jowar-cotton, Cotton-Groundnut and Groundnut-Jowar was added.

In general it has shown that rotational series is superior to continuous cropping in general fertility status especially in nitrogen status. It is significantly superior with groundnut and sann rotation except groundnut-jowar rotation. Organic carbon status has been better, C/N ratio narrower and available P_2O_5 content higher in rotational series except in groundnut-jowar rotation. However there has not been marked effect on humus status.

*II. Lysimeter Series:—*Lysimeter studies are being carried out in two series on 6 important types of soils (A, B, C, D, F, G,) of the Deccan Canal Tract. In one series cane is grown in rotation with sannhemp and in another, rotation crop is cotton. The cane crop, in cotton-cane series, is manured with 20,000 lbs. compost. One set of each series is treated with superphosphate at the rate of 100 lbs. P_2O_5 per acre.

Soil samples were taken from these lysimeters after the harvest of cane crop and analysed for different chemical constituents. Phosphate application has resulted in increase in availability of phosphate in all types of soils. The cotton-cane series which has received 20,000 lbs. of compost per acre as a basal dose to cane has shown higher values of nitrogen, available P_2O_5 and organic carbon in all soil types as compared to sann-cane series thus showing that compost is more beneficial in improving the soil fertility than green manuring. There was no definite trend as regards other chemical constituents.

*III. Effect of Krilium on Soil conditions:—*Krilium is synthetic product claimed to be 500 times more efficient in improving the physical condition of the soil as compared to ordinary organic matter. To examine the possibilities of using this material in improving the chopan soils, pot as well as field studies were taken up. Effect of Krilium application at the rate of 2000 lbs. per acre on physical and chemical properties of chopan soil was studied as compared to the application of compost to the extent of 160 tons per acre e. g. 200 times the Krilium application. Soil samples were taken at regular intervals and analysed. The results show that the application of Krilium has very good effect on soil aggregation as expected. In the Krilium treated plot percentage of aggregates of 1 mm. or bigger size was 50.5 as against 12.4 in compost treated plot (8 months after the treatment). However Krilium treatment has no effect on soluble salt content, exchangeable sodium and exchangeable calcium contents of the soil.

IV. Phosphatic Studies:—Soils of Deccan Canal tract are on alkaline side in reaction and contain large amounts of free lime. Therefore phosphates get fixed and they remain unavailable to crop plants. Laboratory studies were taken up first to investigate phosphate fixation power of different soil types. The results showed that fixation was as high as 85 to 93% when 250 lbs. of P_2O_5 was applied per acre and was decreased to 56–79% when 10.0 lbs. P_2O_5 was applied per acre. It was also seen that percentage fixation has direct relationship with calcium carbonate content of the soil. Further studies, to determine the rate of fixation in different types of soils when 500 lbs of superphosphate is applied per acre showed that the availability of P_2O_5 decreases steadily with time in all soil types, decrease being faster in the beginning. It was also shown that decrease in availability is faster in soils having higher calcium carbonate contents. An interesting feature was that the availability showed a slight increase, 50–60 days after the application of superphosphate. Field studies indicated that the problem of phosphate fixation can be overcome to a certain extent by applying superphosphate by placement instead of broadcasting on the surface.

Further laboratory and field studies were taken up to investigate the possibilities of maintaining better availability of phosphate by protecting it from getting fixed in soil by mixing superphosphate with cane bagasse or compost or fresh dung (in the proportion of 1:5) and keeping it for about a week and then applying to soil. By mixing with dung or compost phosphate can be kept in available form by protection to the extent of 80–85%. Mixing with compost was next best and the last was bagasse which was also better than direct application to soil.

V. Loss of Nitrogen through volatilisation:—It is believed that nitrogen is lost through volatilisation as ammonia when nitrogen is supplied in the form of ammonium sulphate to soils having alkaline reaction. To determine the extent of such losses laboratory as well as field studies were carried out by applying ammonium sulphate in varying doses to soils of varying pH. The results show that the losses in soils having pH upto 9 are quite negligible in Deccan Canal Soil even with as high doses as 600 lbs. to 900 lbs. N per acre. Therefore losses by volatilisation in this tract can be taken to be negligible.

VI. Potassium supplying potentiality of soils:—Potassium is present in soil in available form as well as in fixed form. Fixed potassium is released gradually and it becomes available to the growing crops. The potassium supplying potentiality of different soil types was studied. It was shown that the soils of the Deccan Canal tract have got a high reserve of potassium which is about 100–200 percent more than that in the available form. A rapid method has been developed for estimating the potassium supplying potentiality of soils.

Biochemical studies.

Biochemical studies were carried out both in the agronomic experiments and in some of the specially laid out experiments for the purpose.

I. Mineral nutrition:—Detailed investigations in the mineral nutrition of October planted and July planted canes were carried out. For October planted cane the doses tried were 325, 400 and 475 lbs. N per acre. Application of ammonium sulphate at the time of planting to supply 10% of the total nitrogen helped in obtaining better stand of the crop. Periodical observation of the crop has shown a set back with 325 lbs. of N in early stages of growth which however was made up at later stages. With 475 lbs. N the dry matter production was more uniform. The maximum production of dry matter took place during the period from July to September in all the treatments. With 475 lbs. of N the tendency was to produce more leafy material at the cost of millable cane and sucrose formation. Nitrogen uptake increases with increased dosage of N but results in low uptake of P_2O_5 and K_2O leading to unbalanced nutrition.

Results of similar studies on adsali cane indicate that there are two flushes in plant growth as well as in the uptake of nutrients, the first one ending round about January and the second one starting after April. Uptake of Nitrogen and CaO is continuous upto next October while that of P_2O_5 and K_2O is completed earlier, with tendency to fall later. When superphosphate is included in the manure assimilation of phosphate is nearly doubled and the major effect of phosphate has been on the cane population. Uptake of potash also is stimulated due to the application of phosphates. The potash uptake is also controlled by the availability of nitrogen. Uptake of calcium however has been independent of any of the factors studied.

Periodical analysis of active leaves was carried out to fix up the suitable indices for determining the deficiencies of different nutrients. Concentrations of different nutrients (N, P, K.) in the active leaves were found to follow closely the growth fluctuations in the field and correlate with the yield under deficiency condition. In general it has been observed that the indices fixed by Clements appear to hold good in determining the deficiencies under Deccan conditions also.

Mineral nutrition studies carried out in different agronomic experiments show that the phosphate uptake by plants for both the ratios (N: P_2O_5 as 2:1 and 4:1) was equal and also the cane yields and juice maturity at harvest. Phosphatic fertilisation has shown to reduce the death rate of canes during growth. No marked benefit was observed by increasing the quantity of nitrogen dosage beyond 600 lbs. per acre or by narrowing N/ P_2O_5 ratio. Compost has been found to contribute sufficient phosphate to the crop resulting in improved growth and higher yields. Groundnut cake also has been observed to supply phosphate and potash in addition to nitrogen and thus resulting in better yield than Sulphate of Ammonia alone. From the values of P index, phosphate deficiency was very clearly seen in the plots treated with sulphate of ammonia alone without compost. Phosphate supply was not improved by adding more than 20,000 lbs. of compost per acre to adsali crop.

II. Physiological behaviour of soil types:—These investigations are in progress on the crop grown in lysimeters filled with 6 major soil types of

Deccan Canal tract. There are two sets one having cotton-cane rotation and the other sann-cane rotation. In general there has been very good response to phosphate application in sann cane series, which does not receive any compost in the rotation, in all soil types although highest was in B type of soil and lowest in F type. The increase in tonnage has been both due to increase in number of canes and size of each cane except in G and F where it has been mainly due to greater number of canes. Plants treated with phosphates assimilated nearly twice the quantity of P_2O_5 . Increase in brix also was noticed in phosphate treated plots. This treatment has shown good effect on gul quality also.

Even in the compost treated plots the response to phosphate treatment has been good in recent years although it is much less as compared to sann-cane series. Such response was not observed in earlier years. In this case, increase in tonnage has been mainly due to greater number of canes and slightly due to increased height. On an average, it can be said that the uptake of phosphates increases in the phosphate treated plots and the plots receiving compost respond to a lesser degree to phosphate treatment than sann green manured plots. From phosphate uptake point of view, it can be said that it increases considerably and most of it is present in the stem and is extracted in the juice. Nitrogen and Potash values were not much affected by phosphate treatment.

III. Effect of rain water on cane growth:—A pot experiment to determine the relative value of rains in this area in the growth of sugarcane where perennial irrigation is available is in progress at this Research Station since last 15 years. Uptill very recently it was shown that the rain water has some beneficial effect as compared to canal water. Pots allowed to receive rain water yielded more, mainly due to more number of canes per pot although weight per cane was not much different. It was pointed out that this might be due to extra oxygen present in it. This point also was studied by irrigating the pots with canal water but saturated with oxygen. The results showed no difference. Finally during the last year it was shown that the beneficial effect of rain water was due to better exposure to light. Pots irrigated with canal water but kept under cover of alkathene paper which gave full exposure to light but kept the rain water away produced almost same quantity of cane as those which received rain water. This is being confirmed in the current season.

IV. Proper seed material:—From germination point of view, it has been shown that the setts from the top one-third portion of the cane are the best. From further growth and yield point of view middle sets have shown equal or even better performance than the top setts and seedlings. Water shoots have been found to be good seed material from germination as well as growth and yield point of view. Some indications have been obtained that good seed material can be obtained from a deteriorated seed by treating the plot with phosphatic fertiliser.

V. Studies on minor elements:—It was suggested that deficiency of some minor element might be responsible for the deterioration of the varieties when they

remain in general cultivation for number of years. To investigate whether there was any such possibility, the setts were soaked in dilute solutions of salts of minor elements like Zinc, Boron, Copper and Manganese and then planted. The favourable effect if any was for a very short duration indicating that there was no deficiency in the soil under study. Spray application of different micro-nutrients was also tried and the results indicated that there was no much beneficial effect of any of the minor elements tried. Boron showed slight influence on sucrose content.

VI. Nitrification of Mohwa cake:—To examine the possibilities of using mohwa cake in sugarcane manuring in place of groundnut cake both laboratory as well as field studies were taken up. Results showed that mohwa cake alone depresses the nitrate content of the soil. Therefore, mixture of ammonium sulphate, groundnut cake and mohwa cake in different proportions were tried. It was found that it is not useful even after mixing with Sulphate of Ammonia or groundnut cake as top dressing material for cane. It was observed to be mainly due to its limited decomposition in the soil. Refractory nature of the mohwa-cake protein was not observed to be due to any bactericidal property but to its composition only. It was noticed that most of the protein was insoluble in usual solvents.

VII. Gul Research:—In the beginning, research on the improvement of the quality was restricted to the use of different clarificants. Out of the different clarificants tried phosphoric acid was found to be the best. But commercial acid is known to contain some arsenic compounds and therefore it could not be recommended. Next best clarificant was superphosphate. At present the use of superphosphate is being recommended. It was also observed that filtration through activated carbon gives gul of very good attractive colour. Further detailed studies although of exploratory nature have shown that the dark colour of gul is mainly due to iron phenol pigments. It is shown that by avoiding contamination of juice with iron the quality could be improved. Studies to confirm these findings and how best this finding can be made applicable in large scale manufacturing of gul are in progress.

Further studies taken up to study different methods of storing gul show that storing of gul blocks covered under paddy husk or cotton seed reduces absorption of moisture and helps in better preservation. Clarificants like phosphoric acid or superphosphate also are useful in improving the keeping quality of gul. Further studies on the use of alkathene cloth and alkathened-gunny to cover gul blocks are in progress.

VIII. Factors affecting recovery:—To investigate the probable reasons for high recovery usually obtained at Kolhapur as compared with those in Deccan Canal areas, some preliminary studies were carried out. Although soil and climatic conditions play quite important role there are some indications that low total nitrogen and low ash content in juice and low N/P_2O_5 ratio appear to play

important role in getting high recovery in Kolhapur. Before saying anything definite in the matter it is necessary to take up more detailed investigations.

Varieties

During the period from 1944-1954 number of varieties were received for testing. The number of varieties that reached final varietal trial was 20. Out of this number 13 were tested for three years. The performance of these varieties that reached final stage of testing and tested for three years (during 1950-55) is given in Table No. 1.

Table No. 1.

Performance of varieties that reached final stage of testing during
1950-1954.

(Average of three years)

Particulars

Variety	Yield per acre in tons			Percent in cane.	
	Cane	Gul	C. C. Sugar	Fibre	Sucrose
603	38.56	4.19	5.99	13.16	17.88
614	37.73	4.00	5.40	13.83	15.63
419	44.03	4.92	6.53	13.80	16.56
C. D.	(5.36)				
647	48.99	5.72	6.12	15.03	13.63
650	44.99	4.71	5.82	16.45	14.11
655	56.92	5.78	7.34	12.44	13.99
658	43.73	4.62	6.38	15.72	15.62
419	47.68	5.64	7.59	13.55	16.65
C. D.	(4.5)				
678	54.76	5.82	6.99	15.88	14.62
680	50.58	4.83	5.72	14.35	13.61
683	49.21	4.64	6.99	13.94	16.39
685	53.26	5.47	6.95	13.67	14.01
419	50.68	6.02	7.44	12.79	16.24
C. D.	(3.01)				
649	56.76	6.93	6.48	14.49	14.81
684	56.06	7.08	7.57	14.01	15.56
O. R. B. 6	59.45	7.19	6.91	15.16	15.06
Co. 419	53.99	6.56	7.63	11.85	16.34

In the earlier years Co. 475 proved to be better than Co. 419 and therefore it was released for general cultivation. Because of its susceptibility to rust it had to be withdrawn. Since then Co. 678 is under district trial. Out of the varieties under trial at present, 740, 744, 775, 798 and 800 are promising. Varieties Co. 775 and 740 have been found to be good from keeping quality (in the field) point of view also. Co. 775 gives good coloured gul like Co. 475 but is not susceptible to rust. They are being tested at factory estates and on sub-stations. Performance of these varieties is given in Table No. 2.

Table No. 2.

Performance of some promising varieties
(One year data)
Particulars

Variety	Yield per acre in tons			Percent in cane		
	Cane	Gul	C. C. Sugar	Brix	Fibre	Sucrose in juice
Co. 740	69.20	8.56	9.56	21.23	12.48	19.32
Co. 744	60.30	7.96	8.38	32.29	14.19	20.04
Co. 775	60.98	7.14	8.99	21.19	12.24	20.08
Co. 798	67.66	8.52	9.35	21.29	12.34	19.33
Co. 800	63.46	7.48	8.33	20.65	15.28	19.21
Co. 419	55.62	6.51	8.12	21.88	10.28	19.86
Co. 475	52.04	6.55	8.20	21.94	9.51	20.72

Manuring

Experiments on manuring and fertilisation can be grouped under 4 headings:—

1. Interaction of varying doses of basal manure with nitrogenous top dressing containing varying proportions of sulphate of ammonia and cake.
2. N. P. K. requirements.
3. Maximisation of cane yields.
4. Phosphatic series.
5. Miscellaneous trials.

(1) *Interaction of basal manure with nitrogenous top dressing material:—*
This study is being carried out on plant as well as adsali canes. Experiment on plant cane has completed 16th year and that on adsali cane 4 years. The original experiment on plant cane had only 12 treatments to start with. It has been modified recently to include 24 treatments consisting of 6 top dressing ratios (Sulphate of Ammonia and cake singly and in proportion of 1:1, 1:2 and 2:1 and

no top dressing) 2 compost basals (0 and 10 tons) and 2 artificial basals (0 and compost equivalents in artificials). Second experiment consists of three levels of basal (20, 40 and 60 thousand lbs.) and different combinations of Sulphate of Ammonia and cake as in previous experiment except no N.T.D. treatment.

The results obtained in earlier years indicated the importance of compost and groundnut cake in the manuring of sugarcane. Depressing effect of Sulphate of Ammonia alone was very clearly brought out. Results of the same experiment after modification indicate that higher yields in compost plots and in the plots treated with higher proportions of groundnut cake are mainly due to better supply of phosphates and to a certain extent potash. Therefore the modified treatments which include artificials to supply N, P and K in equivalent quantities to those present in compost have started giving high yields again over those plots which have been receiving only ammonium sulphate. The results indicate that it is possible to replace groundnut cake with ammonium sulphate by supplying P and probably K also as artificials. However the humus content has gone down in no compost series. Similarly the population of micro-organisms is lower in no compost series. It is interesting to watch the long range effect of these modified treatments.

The results of the second experiment show that there is no advantage in increasing the basal dose beyond 40,000 lbs. per acre for adsali crop. The treatment with 40,000 lbs. and cake alone has out-yielded all treatments. With 20,000 lbs. of compost, the yields have gone down considerably with higher proportions of sulphate of ammonia. With higher rates of basals (40 and 60,000 lbs.) however the depressing effect is not so marked as yet probably because of correcting effect of large quantity of basals.

(2) *N. P. K. requirement* :— This experiment on pre-seasonal crop has completed 4 years and includes two levels of basals (0 and 20,000 lbs. of compost), two kinds of top dressings (sulphate of ammonia alone and in combination with cake in 1:2 proportion), two levels of P_2O_5 and K_2O each (0 and 100 lbs. of P_2O_5 and K_2O), and different methods of placements of phosphatic fertiliser. The results obtained confirm the finding that ammonium sulphate alone can be used as top dressing material provided P and K are adequately supplied in the form of artificials. In this experiment also the harmful effect of sulphate of ammonia alone in the absence of compost, P and K has been very conspicuous. Beneficial effect of P_2O_5 especially by placement method has been brought out very clearly. In the absence of compost and cake potash also has shown beneficial effect.

(3) *Maximisation of cane yields* :— This experiment has been started with a view to study the manurial and water requirements of cane crops for maximising cane and sugar yields. It includes 3 levels of nitrogen (600, 750 and 900 lbs.), two ratios of N: P (2:1 and 4:1) and two methods of irrigation (serpentine and straight furrow). Seed rate used was 15,000 sets per acre planted in parallel lines and spacing between two rows was 4'. Water was applied as and when required. Maximum yield obtained in the first year was 106.3 tons per acre

with 900 lbs. of N, 2:1 N:P ratio and straight form method of irrigation which however yielded the least next year. In the second year maximum yield obtained was only about 80 tons and that too with 600 lbs. of N and 4:1 N:P ratio and serpentine method of irrigation. During second year large percentage of dry canes were obtained. No definite conclusions can be drawn from these results obtained so far.

(4) *Phosphatic series*:—In general, application of phosphatic fertiliser has been found to be advantageous both in cane yield as well as in yield of C. C. sugar per acre. Placement application has been found to be still more advantageous than surface application. Placing in bands through moghan behind a plough to a depth of about 6" in the furrow has been found to be advantageous in deep soils and placing half way down the ridge has been found to give better results in light and medium deep soils.

Application of phosphatic fertiliser to sann crop has increased the yields of sann crop considerably. Yield of pre-seasonal cane crop grown after ploughing in sann crop receiving phosphatic fertiliser, however, has given better results than direct application to cane only in the fourth year probably, because of cumulative effect. In general, direct application to cane by placement has been the best.

(5) *Miscellaneous trials*:—Possibilities of replacing groundnut cake with mohwa cake was studied on field scale. The results show that it cannot be used even after allowing it to decompose before application, since the yields obtained with this cake are very low as compared to groundnut cake.

Cultural experiments

One of the experiments under this heading was to study the maximum period of rest which would be required for the soil to maintain its fertility under intensive cane cultivation. Objective was to determine whether it is advantageous to take adsali, pre-seasonal or plant cane after taking one crop of adsali and a crop of ratoon. This means the soil gets 3, 6 or 9 months rest according to the planting. In pre-seasonal planting green manuring was done and in plant cane plot, bajri crop was taken. Initial crop was treated with 0, 25,000 and 50,000 lbs. of compost and two levels of P_2O_5 (100 and 150 lbs of P_2O_5). Residual effect of compost was not very marked in the third crop. Higher level of P_2O_5 showed distinct advantage in the absence of compost. From the yield point of view 3 months' rest was the best giving the highest total yield closely followed by 6 months' rest with green manuring. Looking to the quantity of N required per ton of cane it is the highest in 3 months' rest and there was no much difference between 6 and 9 months showing that pre-seasonal planting is better from this point of view.

Spacing cum nitrogen requirement experiment was carried out for 3 years. It had 3 spacings (3½, 4' and 4½') and 3 levels of N (450, 525 and 600 lbs.). With 4½' spacing double line planting with 15,000 setts per acre was adopted. In general,

450 lbs. of N and $3\frac{1}{2}'$ to $4'$ spacing have been found to be the best. With increasing spacings yields have decreased but the differences are not significant. Similarly increasing dosages have produced decreasing yields.

Inter-cropping with maize was found to depress the yields considerably. The depressing effect was comparatively less when it was dibbled $3'$ apart on the side of the ridge at the time of planting cane. This depressing effect can be further reduced in case of $3'$ spacing only by giving additional dose of 50 lbs. of N per acre after the harvest of the maize crop. The borer infestation was almost same in all treatments.

Irrigational requirement

Only experiment that was conducted was to investigate the irrigational requirement of adsali crop treated with different doses of nitrogenous and phosphatic fertilisers. In general, it was shown that 450 lbs. of Nitrogen and 115 A' of water per year are the optimum requirements of adsali crop. In the years of low rainfall, higher yields of cane were obtained with higher dosage of water but there was no much difference in yield of C. C. S. per acre.

In the maximisation of cane tonnage experiment, two methods of irrigation—serpentine and straight furrow—were tried. There was no difference between the two methods in the 1st year and during the second year serpentine method has given slightly better results than the straight furrow method.

Another experiment to study the effect of prolonged interval between two irrigations, has completed only one year's testing. Indications are that if prolonged interval is practised right from the beginning of winter season the depressing effect on yield has not been observed. If it is practised from summer season however, the yields are depressed. This needs thorough testing and confirmation before anything definite can be said on this point.

Crop protection

The main work carried out under this heading is to maintain a quantitative data regarding the attack of different pests and diseases in the agronomic experiments and to take control measures as and when necessary. However some trials have been conducted to determine the economic measures of controlling the borers under Padegaon condition. Quantitative data maintained in different agronomic experiments show that there is no marked difference between the treatments regarding the incidence of both the borers.

Amongst the different mechanical methods tried, partial earthing up is found to be quite economical. Similarly fortnightly removal of affected plants has been found to be quite advantageous in controlling both the borers.

Weed control experiments were conducted with 2, 4-D compounds alone and mixed with pentachlorophenol. The results show that it is possible to control grass weeds as well as broad leaf weeds by giving pre-emergence application with 2, 4-D compound at the rate of about $1\frac{1}{2}$ lbs. acid equivalent per acre.

The role of earthworms in maintaining the soil fertility was studied by applying earthworm cultured soil to the plots as basal dose in lieu of farm yard manure or compost. It has been observed that the application of 40 cart loads of earthworm cultured soil is as good as 20 cart loads of compost per acre. The studies carried out upto now have been of preliminary nature and the results obtained need confirmation.

Regarding diseases of sugarcane the activity is restricted to taking observations on new varieties under trials as to their resistance or susceptibility to different diseases of sugarcane. Test for resistance to rust is being carried out by creating the epidemic artificially. Varieties susceptible to rust are eliminated right from the beginning.

Trials on sub-stations

In order to test the applicability of results obtained at the Central Research Station at Padegaon, cultural, manurial and varietal trials are also conducted at 7 sub-stations spread out all over the Bombay State.

Deccan Canal Tract

Out of the number of varieties tested at the sub-stations, Co. 678 proved superior in A and B types of soil and showed promise of high yield on F and G types. Co. 647 also was found superior to Co. 419 on D type of soil. It is resistant to lodging but it is low in C. C. sugar.

A dose of 450 lbs. N per acre proved superior to 600 lbs. N in case of F type, 600 lbs. N superior to 450 lbs. N in D type of soil while in A and G there was no significant difference.

Application of 75 and 150 lbs. of P_2O_5 did not produce significantly higher yields in any type although higher yields were obtained in A, D and G types of soils.

In general, top dressing with sulphate of ammonia and cake in the proportion of 1:2 was found superior in all types of soils. There was no difference in 20,000 and 40,000 lbs. of farm yard manure on all types except in D where 40 carts was found superior.

It was observed that there is no advantage in increasing spacing beyond 4' in all types of soils.

Kolhapur

In general there was response to lime and phosphate and there was no much difference between 220 and 320 lbs. of N per acre between different ratios of sulphate of ammonia and cake nitrogen. There was no difference in the seed rates varying from 12,000 to 18,000 sets per acre, nor in the nitrogen doses varying from 220 to 420 lbs. N per acre.

Alnavar (Dharwar)

Response to nitrogen (150, 225 and 300 lbs.) was significantly linear and that to 100 lbs. of P_2O_5 was very good. Difference in yields either due to different ratios of ammonium sulphate and cake N or doses of basal was not significant. None of the varieties studied proved significantly superior to Co. 419 except Co. 605 where the difference approached significance. Application of lime has increased the yield to certain extent.

Vyara (Surat)

Out of all the varieties studied Co. 419 was superior. The differences due to different ratios of sulphate of ammonia and cake N and due to various doses of basals were not significant. The response to higher doses of N upto 280 lbs. was linear. Application of P_2O_5 (100 lbs.) gave higher yields over no P_2O_5 .

N. B.—The details of all the experiments have been published in the Annual Reports of the Station and those of some of the experiments in Deccan Sugar Technologists' Association Proceedings of last few years.

Iron Deficiency-A Cause for Chlorosis (Kewadya) in sugarcane

By

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Padegaon

Chlorosis of leaves is caused due to many reasons. Under certain circumstances it may develop due to deficiency of iron in the plants. Wallace (1951) states that iron is concerned with the chlorophyl formation although it is not a constituent of it, but probably acting as catalyst. Withrow (1951) states that iron is associated closely with a protein and it is thus protein complex that catalyzes chlorophyl formation. So when iron is deficient, plants do not normally produce chlorophyl and the leaves turn yellow and produce chlorotic symptoms. The chlorosis which appears on the plants grown on soils high in lime is generally termed as lime induced chlorosis. Miller (1938) states that according to Willis & Carrero (1921) carbonate of lime in the soil reacts with iron forming ferric carbonate and thus depresses the availability of the iron. He also suggests that manganese dioxide present in the soil may also make iron unavailable to the plants. According to Russell (1950) chlorosis may also be due to immobility of iron within the leaves. Biddulph (1951) in his studies with bean plants states that under pH 7.0 and high phosphorus (0.001 M) in nutrient solution iron may precipitate at root surface and fail to enter into the plant, and at pH 7.0 and medium phosphorus (0.001 M) iron may make rapid entry into the vein system of leaves, but little or no distribution into the mesophyll. However, at pH 4.0 and medium phosphorus there is a rapid entry and equal distribution of iron throughout the leaf.

Dillewijn (1952) states that iron occurs in sugarcane only in minute quantities and a ton of millable cane contains approximately 0.4 lbs of iron. He further mentions that according to Martin iron deficiency in sugarcane occurs in the younger leaves resulting in the development of yellow strips extending over the full length of the leaves and states that spraying with 2% solution of iron sulphate results in a definite greening of the leaves.

Wallace (1951) suggests that spraying with soluble compounds is one of the simpler methods of diagnosis of iron deficiency in plants and recommends 0.2 to 1% Ferrous sulphate spray on the foliage.

Material and Method

The crop of sugarcane planted in July 1954 at Padegaon Farm on soils situated in the low lying areas and having lime nodules on the surface, was harvested in second and third week of July, 1955, for seed purposes. The new shoots that emerged out from cut canes showed the typical symptoms of chlorosis on leaves. The leaves showed strips of green and yellow colour, and in

extreme cases the leaves were completely yellow or white. The severity of chlorosis varied from stool to stool and from shoot to shoot in the same stool. The shoots showing extreme chlorotic symptoms were stunted in growth and the emergence of the leaves was retarded. The leaves that emerged out from these shoots were shorter in length and narrower in width compared to leaves of healthy plants. The chlorotic symptoms appeared in patches in the field, and at certain time of the season only, and tended to disappear slowly later. In order to confirm that the symptoms were due to iron deficiency in the plants, foliar spray with ferrous sulphate was carried out on small scale. The treatments were as given below :—

1. Control.
2. 0.2% ferrous sulphate spray. (e. g. 2 lbs. in 100 gallons of water/acre).
3. 0.5% ferrous sulphate spray.
4. 1.0% ferrous sulphate spray.

Spraying for each treatment was done in duplicate plots on 27-8-1955. The plot size was 8' × 5'. There were two sugarcane lines included in each plot. Albolineum was used as wetting agent.

Results and Discussion

Four to five days after spraying, it was observed that green spots appeared on the chlorotic leaves sprayed with ferrous sulphate. These green spots were distributed throughout the lamina of the leaf blade. Some of these spots later, enlarged and developed into continuous dark green patches. Spraying with high concentration e. g. 0.5% and 1% caused scorching on the leaves.

The results of spray indicate that the chlorosis in sugarcane may be due to induced iron deficiency in the plants. Porter and Thorne (1955) state that the soil factors conducive to or associated with lime induced chlorosis are (a) high moisture, (b) low temperature, (c) high lime and (d) high concentration of the carbonate ions. In the present study it was also observed that the chlorotic symptoms on sugarcane appeared during, and immediately after the period when there was drizzling rain and low temperature. Further it was more in plots which were low lying, ill drained and containing lime nodules on the surface. After the lapse of period of drizzling rains, when the dry weather with high temperature prevailed the chlorotic symptoms disappeared slowly. The new leaves that emerged out later from the plants previously suffering from chlorosis were green and comparatively less chlorotic. The plants later completely recovered and turned green although there was stunted growth compared to healthy plants. Similar symptoms were observed in plant cane on some shoots emerging from the cane planted in Adsali (1955) in certain other plots at Padegaon Farm, although the chlorosis was not as severe as was seen in ratoon. Chlorotic symptoms were also reported and observed on ratoon and plant cane in some of the cultivators' fields and on Factory estates on Nira Right and Left Bank canals. The symptoms there also disappeared when high temperature and clear weather occurred in September, 1955. Chlorotic symptoms at the same time were also noticed on

paddy and groundnut, and ferrous sulphate spray on these crops produced green spots on the chlorotic leaves. Thus it is seen that prolonged period of low temperature and high moisture condition in calcareous soils that prevailed this year in August, may have been the cause that induced iron deficiency in sugarcane for a temporary period, although the soil may not be deficient in iron.

On spraying with ferrous sulphate on chlorotic leaves only localised green patches were observed and the leaves did not turn green rapidly. This may be due to immobility of absorbed iron. Bould (1955) states that with application of inorganic iron salts to chlorotic leaves some in-take of iron and localised greening occurs, but the iron is rapidly immobilised. He further suggests that certain organic iron compounds known as iron chelates (ethylenediaminetetracetic acid) can be successfully used for correcting lime induced chlorosis on a wide range of crops.

Conclusion

The present preliminary investigations at Padegaon Farm indicate that appearance of chlorotic symptoms at certain stage of growth of sugarcane may be due to induced iron deficiency in the plants. Spraying with 0.2% ferrous sulphate solution on chlorotic leaves produced some localised green patches. Further studies on the various factors that lead to chlorosis in sugarcane under Deccan Canal tract conditions and on the methods of control of chlorosis are being carried out at the Padegaon Farm.

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D. S. T. A.
12th Convention 1955

Irrigation of Sugar Cane in the Nizam Sagar Tract

By

G. N. JOSHI
The Nizam Sugar Factory Ltd.

1. Introduction

The Nizam Sugar Project (constructed 1924-33) is situated in the Nizamabad District, about 85 miles north of Hyderabad City. The cost of the project was about five crores of rupees. The dam is $3\frac{1}{2}$ miles long and 115 ft. high across the river Manjira, a 400 mile tributary to river Godavari. The gross commanded area is 5,36,537 acres of which 2,75,000 acres were expected to be fed by the 98 mile long main canal, thus benefitting 400 villages in the area (1).

The irrigation scheme was designed in the year 1922, to irrigate annually an area of 3,75,000 acres, but actually the area irrigated by the Nizam Sagar Canal in 1952-53 has been ascertained to be nearly 1,60,000 acres. (2, 3)

2. Climate, Topography and Soils of the tract

The area is relatively dry with an average annual rainfall of 40 inches, mostly concentrated from July to September. The average temperature varies from 91°F. during the day to 70°F. during the night, rising up to 110°F. in May and dropping to 45°F. in December-January. The average elevation of the tract varies from 1,100 to 1,300 feet above mean sea level.

The topography of the tract is undulating and an idea of steep gradient at places may be obtained by considering the fall in the ground level from the main canal to the Manjira Basin towards which the distributories flow. These distributories take one at each mile of the main canal and numbered accordingly. At a distance of 15 miles from the reservoir, at Banswada, there is a fall from the main canal to the river of 25' over 5 miles; at 30 miles from the reservoir at Rudrur the fall is 125 ft. over 8 miles, and in Bodhan Taluqa, where the Factory Estate is located, 40 miles from the reservoir, the fall is 200 feet in 20 miles.

The Gneissic rock present gives rise mainly to two major types of soils: one found on elevations, is light and sandy, reddish in colour and is known locally as "Chalka", and the other found in valleys is heavy, black in colour and locally known as "Regur".

As all the distributories run on the highest ridges, gravity method of irrigation is used. Water is taken to the fields directly from distributories and sub-distributories.

3. The Nizam Sugar Factory Estate

The estate of the Nizam Sugar Factory, 16,000 acres in extent, of which 6,000 acres are cropped to sugarcane annually, is made up of 14 farms situated at different places. At one end the estate is irrigated by distributory 27 while at the other end by sub-distributory 50/2.

For convenience of management the estate area is divided into plots of 8 acres surrounded on all sides by field roads 20' wide. Each plot is, for cultivation purposes, divided by bunds into 16 boxes of half-acre each. The furrows are 150' in length and 3.5 ft. apart. Gutters are dug by the sides of the intermediate bunds, to drain off excess water received from rains in the early part of crop growth, the adsali cane being planted in June soon after the monsoons commence.

4. Method of irrigation on the N. S. F. Estate

To obtain even and better distribution of water, cross bunds are put at ten to fifteen feet intervals according to the local slope of the plot, at the time of final earthing when the crop is 4 to 5 months old. This system enables us to irrigate our fields by the zig-zag or serpentine method, allowing slow flow of water through the furrows, rising to the top of the ridges and thoroughly soaking of the soil.

It has been observed that in fields where cane growth has been vigorous and yield estimated at over 40 tons per acre, the crop lodges heavily due to cyclonic winds in the months of April and May, and fields become inaccessible. Under these conditions, when the irrigator cannot enter the fields to check irrigation the zig-zag method of irrigation becomes useful. Trials are being made to study if contour system of irrigation would prove more useful and economical under our conditions. Generally speaking $3\frac{1}{2}$ to 4 acre-inches are required per irrigation and in all 18-22 irrigation rounds are given to an adsali crop.

5. Water requirement of cane crop in the tract

Table I gives an outline of the average sugarcane planting programme for the tract.

Table I

Period	Crop	Factory area in acres	Farmers area in acres	Total acreage
June to October	ADSALI (18 months old crop)	4,000	2,500	6,500
Nov. to January	EKSALI (12 months old crop)	—	8,000	8,000
Nov. to February	RATOON	1,500	5,000	6,500
Total	..	5,500	15,500	21,000

In table II an attempt is made to present water requirements in different periods for the cane acreage shown above, taking into consideration the overlap of the area of the preceding standing crop for the period July to September, and the area harvested and ratooned from October to April.

Table II

Season	Month	Cane area including overlap area	Minimum Rotations	Area to be irrigated per day	Average to be irrigated per day
		Acres			Acres
RAINY	July	24,000		800	
	Aug.	25,500	30 days	850	850
	Sept.	27,000		900	
WINTER	Oct.	25,500		1,700	
	Nov.	26,100		1,740	
	Dec.	27,000	15 days	1,800	1,800
	Jan.	27,900		1,860	
SUMMER	February	26,000		3,250	
	March	22,500		2,812	
	April	21,000	8 days	2,625	2,825
	May	21,000		2,625	
	June	22,500		2,812	

From the data given above, it will be seen that as against an area of 850 acres to be irrigated per day in the rainy season the corresponding acreage goes up to 1,800 acres in winter and 2,825 acres in summer. There is thus a great demand of water in summer.

6. Canal Closures

The canal has to be closed for removal of silt and aquatic weeds and for attending to repairs to canal banks, drops, etc. The canal closures, four in number, occur annually in two periods, the first in November–December and the second in May–June. This timing has been fixed because at these periods there is no standing crop of paddy which is grown on more than 1 lakh acres annually in this tract.

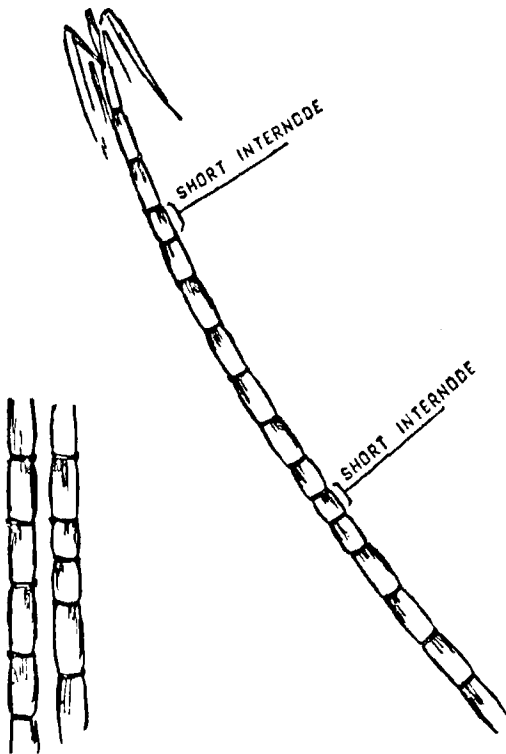
Unfortunately, on account of these closures the cane crop receives a great set-back particularly during the summer closures, when the temperature rises to 110°F. and the relative humidity falls down to 23 %. The soils dry up quickly and the demand of the grown up crop is also experienced most during these months. These summer closures not only give serious set-back to the cane growth but cause severe damage.

To illustrate the point, data for the factory estate sugarcane crop for three seasons are given in Table III below for the May-June closure.

Table III

	1953-54		1952-53		1951-52	
	First closures	Second closures	First closures	Second closures	First closures	Second closures
Closure from (date)	9.5.53	3.6.53	10.5.52	3.6.52	10.5.51	1.6.51
„ to „	16.5.53	10.6.53	15.5.52	10.6.52	15.5.51	6.6.51
Duration of closure	7 days	7 days	5 days	7 days	5 days	5 days
Interval between 2 closures	18 days		17 days		16 days	

It will be seen from the table that each closure means skipping over of irrigation round which increases the interval between two rounds to 16 days



instead of the minimum 8 days. Added to this there are other factors to be taken into consideration. There is reduced flow in the distributories, increased demand for water by all to rush irrigation, and the relatively dry condition of the soil and atmosphere. On account of these factors area under the farther stretches of the distributories suffer more and the interval between two rounds of irrigation goes up to 28 days. The damage is severe, particularly in alkaline patches during these closures.

The shortage of water is prominently reflected in the growth of the crop and is clearly seen in the shortening of the internodes as shown in the diagram below.

The damage as assessed in season 1952-53 is given hereunder. Out of the 5496 acres of factory cane, a total of 1193 acres was damaged with varying intensity as briefly shown below.

<u>Total area damaged</u>	<u>Heavy damage</u>	<u>Medium damage</u>	<u>Light damage</u>
1193 acres	86 acres	205 acres	902 acres

(i) *Heavy Damage*:—Entire cane stick was shrivelled and no juice expressed when the cane was bent. The cane was full of pith with a big cavity inside. Cane did not break on bending.

(ii) *Medium Damage*:—Top leaves were scorched, top nodes were pithy, cane was hollow inside and broke on bending.

(iii) *Light Damage*:—Scorching of leaves and pith formed in cane, but inside the cane no cavity was found.

Loss of 3 to 5 tons per acre in the lightly damaged area and 15 to 18 tons per acre in the heavily damaged area was estimated.

In July 1952, the planting of the 1953-54 cane crop was stopped for 15 days as the Nizam Sagar was practically dry due to late arrival of Monsoon and all the water that was available diverted for "Abi" (Monsoon) paddy and the standing 1952-53 cane crop. Fortunately we received rains in time and the calamity was overcome, but for which, an area of recently planted 1200 acres of cane on the Factory Estate alone would have suffered like that of the Mandya Sugar Factory under the Krishnaraja Sagar Project in the Mysore State.

Briefly, these are the difficulties found in the Nizam Sugar tract and the average yield of factory's "adsali" cane is about 40 tons per acre and that of Ryots "Adsali" cane about 25 to 30 tons per acre.

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D S. T. A.
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The Problem of Field Rats

By

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Ugarkhurd

Introduction.

The intensity of infestation by field rats and damage and loss caused by them to sugarcane varies considerably in different places. In some places, these are negligible and in others so serious that regular campaigns have to be carried out to keep the pest in control.

On the Estate of the Ugar Sugar Works Ltd., the rat trouble was negligible till April 1954; but it has assumed a serious form since then. It is estimated that there was a loss of about 10% of cane harvested during the season 1954-55. The tonnage of Estate cane supplied to the factory was 38000 tons and the approximate loss of cane was 3800 tons. It would be, therefore, seen what a tremendous loss would result, if the pest assumes a serious form.

It is intended in this paper to give a clear picture of the campaign started against field rats since April 1954.

The following observations were made during the campaign regarding the habits of rats and the nature of damage done by them to sugarcane.

1. Habits.

The rat is a very shrewd animal. It is nocturnal in habit. During day time, it lives in the burrows made in the cane plots or in the neighbouring fields of food crops. The rat colony is about $1\frac{1}{2}$ to 2 feet below the ground level and is just like a gold-mine, with two or three passages which are zig-zag and look like tunnels. The whole colony is nicely air-conditioned.

Usually the migration of rats to sugarcane takes place in two periods (i) From November onwards when the harvesting of cane is started, and (ii) From January onwards, after the harvest of the food crops, adjoining the cane fields. It is reported that a couple is capable of producing 700 to 800 inmates in a year. A female rat gives birth to 6 to 9 young ones at a time. Although production takes place all the year round, its peak-period appears to be from June to September.

Nature of Damage.

Usually, the earliest planted crops are affected the most as the cane formation in such crops starts early, providing food and shelter to the rats.

1. The underground portions of cane stools where burrows are made become hollow and lose the anchorage and so the canes in the affected stools lodge heavily, become dry, and die slowly. A lot of dead canes are found where rat attack is seen.

2. They gnaw the bottom portions of canes with their teeth which work like saws and the affected canes get dried-up.

3. They climb up the canes and make longitudinal grooves in the internodes by chewing.

4. When copious water is given to the old crop from October onwards, they go to the tops of canes for shelter, where they are marooned for some time. During this period they destroy the growing points which result in stopping the further growth of plants which get a broom-shaped appearance.

So, the aggregate effect of the different ways of damage is that the yield of cane and sugar is considerably reduced.

Control Measures.

1. *Campaign at Kusnal* :—A heavy rat-attack was seen in April 1954, at Kusnal, in the newly-formed circle when the cane crop was about 1½ to 2 months old. The damage was so severe that a large number of young tillers was eaten. No rat burrows were seen in the cane plots. An army of rats invaded the cane crop at night from the adjoining area of food crops which was recently harvested and where the lands had profusely cracked. They lived in the burrows made in the cracks and crevices of these lands. To control them, the following measures were adopted :—

(a) **HAND KILLING** :—A regular campaign was carried out at night for nearly three weeks. A squad of 25 to 30 persons with torches and sticks in their hands was specially engaged for this work. On one night, a record number of 2,477 rats was killed. At the end of the campaign, the total number of rats killed was 18,148.

(b) **POISONING** :—When it becomes rather difficult and costly to continue killing of rats by hand, poisoned baits with Zinc Phosphide were used on a large scale. About 25,000 baits were used during the period of about one month, and most of these baits were consumed by the rats. The above measures were found to be very effective as very little rat-trouble was observed in that area during the next season.

Extent of Damage.

The rat killing campaign at Kusnal made us rat conscious and so wherever we found the attack in the standing Adsali crop on the old Estate, we started killing by hand at the irrigational turn; but this could be done only for a short time and on a small area, as the crop had already started lodging.

The extent of damage was, however, seen only at the time of harvest, which was started in November 1954. It was abnormal in early planted crops and the damage was even upto 50%. It was calculated by taking observations in 40 ft. length of cane rows in different plots.

Table No. 1 will give an idea of the extent of damage.

Table No. 1.
Extent of damage by Field Rats.

Plot No.	No. of observations in 40 feet length	Percentage of dead canes to normal canes, by weight	Percentage of rat affected canes to normal canes, by number.
6	8	17.00	42.00
85	4	17.00	46.00
104	3	9.48	33.17
105	3	14.00	30.00

Many were under the impression that due to the non-burning of trash which is being removed and used for composting on a large-scale on our Estate, since 1951, the rat-attack had increased. They believed that the rats, if any, would die if the burning of trash was done. In order to verify whether this doubt was correct, a heavily rat-infested crop of about two acres was set on fire in the morning, at about 9-00 A. M., with due arrangements of killing by hand, if the rats started running out of the plot. To our surprise, not a single rat came out of the plot while or after burning trash.

Hand Killing.

1. *Ratoonable Cane*:—Immediately after burning was over, we inspected the plot and many colonies of rats were seen. To find out whether there were any rats in the colonies, one or two colonies were flooded with water. Rats came out of the colonies where thorough irrigation was given. This clearly showed us that burning does not kill the rats as they run for shelter to their colonies which are air-conditioned. Immediately after burning the crop, harvesting of cane was started. Simultaneously irrigation was given in the harvested area with a batch of ten workers to kill the rats. In about eight hours, the whole plot of two acres was irrigated and a total number of 296 rats was killed. After this experience, the same method was followed in all the ratoonable plots, immediately after harvesting was completed.

2. *Non-ratoonable cane*:—As the water in Lift Irrigation is costly, irrigation of the whole plot for rat killing was found to be impracticable and uneconomic in the non-ratoonable plots, and hence in such plots, burrows were flooded by a hose-pipe, about 100 ft. in length, fitted to the barrel - 3 feet in height. This method was also found to be successful.

3. *In Young Adsali Cane*:—We were very vigilant to watch whether there were any burrows made in the young Adsali crop. For this, a reward of one anna per colony was given to the irrigators for showing the colonies. This incentive was found to be very effective as the irrigators became very keen to inspect

every cane furrow and show the burrows to the field-staff. When the burrows were located, stripping of canes was done in about 3 to 4 furrows, adjoining the burrows and they were kept clean. Then all the burrows of the colony, except two were closed. A fishing net, about 15 ft. in length and 3 feet in breadth, was spread on the slopes of the ridges where there were burrows. When the colony was a big one, spreading in two or three furrows, one or two more nets were used. When this was done, water was allowed through one of the burrows which was kept open and the whole colony was flooded. Two or three careful irrigators, anxiously waited for the rats to come out of the burrows. The rats came out only after the colony was thoroughly flooded and when they could not breathe. They tried to escape, but got entangled into the net and so could be easily beaten and killed with a stick. This being the surest method, was adopted all over the Estate. This could be done for about 2 to 3 months from February to May when the crop was 8 to 10 months old. As the lodging started, this method could not be continued further.

4. *New Plantation*:—From the start of the new planting of Adsali in June 1955, hand killing with or without irrigation is being done.

Table No. 2 will show the total number of rats killed by hand till the 31st August, 1955:—

Table No. 2.
Number of rats killed by hand.

Kind of crop	No. of rats killed	Remarks
1. Plant cane at Kusnal.	18,148	Without irrigation.
2. Young Adsali.	2,826	With irrigation & a fishing net.
3. Ratoon (after harvest of the previous crop)	3,482	With irrigation.
4. New Plantation.	93	Both with and without irrigation.
	24,549	

Poisoning.

Side by side with hand killing, we started keeping poisoned baits in the young Adsali Crop, about 7 months old. Zinc Phosphide with changing baits of wheat or gram flour and sweet oil was used. To prepare a bait, 2½ tolas of Zinc Phosphide was mixed with one lb. of wheat flour and ½ oz. of sweet oil. These baits were kept all along the border and compartmental bunds. They were kept at a distance of 25 to 30 feet. In the beginning, for nearly a month, the percentage of baits consumed varied from 40 to 50; but later on when the rats became bait-shy, it was reduced to 5 to 10. Then the bait was changed and the Gram Dal was besmeared with sweet oil and Zinc Phosphide was mixed with it. For this mixture, a little fried asafoetida was added to give an attractive flavour. This Dal also showed good result for a week or so. *Bhajis* made of gram flour

were also tried for few days with success. When the rats became bait-shy, unpoisoned baits were used for two or three days and again poisoned baits were used.

Table No. 3 will show the number of poisoned baits kept and consumed from April 1954 to 31-8-1955:—

Table No. 3.
Number of baits used and consumed by rats.

Total number of baits used.	Total number of baits consumed.	Percentage of baits consumed
319617	150174	50.11

Cyanogassing

Cyanogassing of rat colonies was also tried after closing all the burrows of the colony, except one. But this did not prove to be effective as new burrows were seen on the subsequent days. It appeared that owing to the peculiar nature of the colony, perfect gassing was not possible and so the rats could not be killed.

Cost of Control Measures

1. At Kusnal, where there was a heavy invasion of rats, the cost of killing worked out to be half an anna per rat on an average.
2. In the young Adsali crop, the work demanded special attention and care and so irrigators were given a reward of one anna per killed rat.
3. The cost of poisoned baits came to Rs. 2/- per 1000 rats on an average. Considering the abnormal loss of cane, the amount spent on the control measures was negligible.

Summary

The Campaign against field rats being carried out on the Estate of The Ugar Sugar Works Ltd., since April 1954, is described in this paper.

1. The estimated loss of cane due to the rat-trouble was 38,00 tons i. e. about 10% on the total Estate Cane.
2. The rat multiplies very rapidly and destroys the cane in various ways.
3. The various control measures tried are described. Hand killing and use of poisoned baits were found to be effective.
4. Cyanogassing was found to be in-effective.
5. The cost of control measures is negligible as compared to the amount of loss incurred, due to this serious pest.

Conclusion

As the rat-problem is becoming very serious during the last two years or so, all over the Deccan, all possible methods of control should be adopted to eradicate this pest.

D. S. T. A.
12th Convention 1955

A new and undiagnosed Disease of Sugarcane

By

R. V. PANT BALEKUNDRI & M. N. SHAH
Sakharwadi

Introductory

Under all normal weather conditions and with all usual manurial and cultural methods followed, we could detect a sudden retardation of growth in a block of adsali cane on the estate of the Phaltan Sugar Works, Ltd. Area affected is approximately 11-00 acres. The group in which the block is included comprises of 36-00 acres. All the remaining crop of 25-00 acres has usual normal growth and we expect an yield of 60 tons from the area. There is only a field road of 25' width, between this affected and the unaffected crop. A patch of 2-00 acres in combination with this 11-00 acres was planted late in September due to wet condition of soil. But this crop is quite vigorous and healthy. Therefore, we could only say that this disease-unnamed-is not contagious. Previous crop in this 36-00 acres group was Jowar and it was quite a normal crop.

Upto date height of this affected crop is only 5' and the number of canes nearly 20000 per acre. While in our normal crop height is 11' and number of canes 46000 per acre. We expect an yield of 15 to 20 tons in this affected area. This disease has caused a serious damage of 35 to 40 tons per acre.

Cultural methods followed and manures applied

This group received all its usual preparatory tillage and was planted by the end of July. The germination was satisfactory. First dose was applied by the 1st week of September and the crop was thriving well. By middle of October the crop came to the partial hilling up stage. At this period we could detect that particular 11-00 acres patch was lagging behind. The soil is of a shallow type. On examination of the affected plants we could detect that root growth was retarded. The leaves were showing reddish tinge and leaf sheaths were loose; leaf tips and borders were drying. As the soil is of lighter type we added a lot of farm refuse to supply organic matter, usual dose of partial hilling up was given and partial hilling up was done with extra care. Still the crop did not show any improvement. Therefore again in the middle of December we gave an extra dose of 1 bag of Sulphate and half bag of Superphosphate by digging. There was still no improvement. As there was no improvement we applied half dose of earthing up and earthed up by the middle of January. Still there was no improvement. At this stage all the leaf sheaths were quite red and sort of gummy substance was found between cane and leaf sheath. Length of internodes was very short i. e. 1 to 1½" long. Premature drying of leaves were also noticed. Only 3 to 4 top leaves were green and remaining leaves were turned to trash. In short the crop was showing a ver-

unhealthy and poor condition. By now we had tried all our cultural and manurial treatments and crop has never responded in any way.

Therefore by end of January we approached Padegaon Research Station for guidance. A sample was sent to them and was forwarded to Entomologist to the Government of Bombay for further examination. Padegaon experts visited our plot and after detailed examination they suspected this might be a "Deficiency disease" or "Top rot". They recommended a dose of 100 lbs. of K_2O_5 per acre and Boron spraying. They advised us to keep a check plot untreated by Potash and Boron. This was applied as per their recommendations. The remaining earthing up dose - 25 furras of good F. Y. M. were applied, and cane was earthed up for 2nd time in April. Still there was no improvement. There was also no difference between untreated and treated plot (Potash-Boron). By this time we had eliminated the factor of soil deficiency.

Again Padegaon people visited the crop for 2nd time. They examined the growing point of the plant and suspected "Top-rot" or "Leaf-stripe". As per their opinion the disease is quite new one and so no definite remedy can be recommended. But if this would have been definitely "Top-rot" disease, the crop should have rotted from top to bottom, with no further growth. But this crop was thriving and was growing very-very slowly. The number of Internodes was the same as that of normal crop but length was only one inch. Therefore as there was some growth, the "Top-rot" disease was out of question. Again this was referred to Padegaon Station. Assistant Entomologist from Poona and Padegaon experts visited the plot for 3rd time in the 1st week of May. By this time we could detect ring-like eruptions on the inner side of the leaf sheath. As per expert opinion these eruptions were due to mites and this mite-trouble was an after-effect of rotten condition of leaf sheath.

Cane was brittle and colour of the cane was ivory. The leaf sheaths which were quite red and rotten were sticking to the cane plant due to gummy substance. Entomologist took some samples and the matter is still under consideration. By the middle of May Mr. Rafey, Mycologist from Indian Institute of Sugarcane, Lucknow, visited the crop and he also took some samples.

As per the opinion of all these experts it is found that the disease is quite a new one in India and hence no definite remedy can be recommended. The only thing which they could recommend is not to grow cane or any crop of *graminae* order for 3 to 4 years in this particular patch.

Conclusion

We have as far as possible described the incidence and growth of this new disease in our estate upto now. The disease is quite new one in India. We do not know whether it is contagious or not. This disease causes heavy and serious damage to the crop. We are putting up this article before you all technologists for further discussion.

D. S. T. A.
12 h Convention 1955

Laboratory Experiments on Electrical Method of Cane Juice Clarification

By

S. N. GUNDU RAO & H. G. KULKARNI
Ravalgaon

Since Prof. D. N. Ghosh of Patna University demonstrated his method of electrolytic clarification at Indian Institute of Sugar Technology, Kanpur in 1950 preliminary experiments were undertaken at Ravalgaon in 1951. In this process raw juice is heated to 80° C. and is subjected to the action of direct current in a battery fitted with iron electrodes. (Iron plates of 1/8" thickness were arranged so that the distance between any two adjacent plates was $\frac{1}{2}$ "). Conditions of voltage and current are so adjusted that a potential difference of 3 to 4 volts between any two adjacent plates and the current density of about 0.04 amperes per square inch are obtained. pH of juice rises on passing the current. Current is stopped when pH rises to 7.2. The juices is then filtered. This faintly alkaline juice is rendered faintly acidic (pH 6.8) with super-phosphate and heated to boiling. This on filtration gives the clarified juice which is of a lighter colour.

Figures of analysis of a number of experiments are given below

Expt. No.	Date	Juice	Bx.	Pol	Py.	Py. rise
1	2-4-51	Mixed juice	16.31	13.10	80.31	—
		Clear juice	16.41	13.27	80.86	0.55
2	3-4-51	Mixed juice	18.29	15.50	84.74	—
		Clear juice	17.86	15.20	85.11	0.37
3	4-4-51	Mixed juice	17.44	14.94	85.66	—
		Clear juice	18.23	15.98	87.66	2.00
4	5-4-51	Mixed juice	17.73	15.14	85.39	—
		Clear juice	15.52	13.48	86.86	1.47
5	6-4-51	Mixed juice	17.55	15.48	88.20	—
		Clear juice	15.32	13.74	89.69	1.49

The following observations were made:—

- (1) There is excessive production of froth.
- (2) Mere neutralisation of the first filtrate with super-phosphate to 6.8 pH does not remove all the iron which is in solution.

In order to remove last traces of iron, the following changed procedure was tried. 2 to 3 cc. of milk of lime (15° Be.) was added to 1000 ml. of milk of first filtrate, then neutralised with super-phosphate, boiled and filtered.

Analysis of juices obtained by this modification is given below:

Expt. No.	Date	Juice	Bx.	Pol	Purity	Purity rise
1	7-4-51	Mixed juice	17.54	14.85	84.66	—
		Clear juice	14.48	12.65	87.36	2.70
2	8-4-51	Mixed juice	18.40	14.63	79.52	—
		Clear juice	16.80	13.92	82.87	3.35

Later on in 1952 the above process was tried at Experimental Sugar Factory, Kanpur, and there also it was observed that residual iron affected the colour of sugar.

In view of the high consumption of electricity and of iron and the effect of residual iron on sugar Prof. D. N. Ghosh modified his process. The new process is as follows. Raw juice is heated to 70 to 80° C. It is immediately neutralised with milk of lime to 6.8 pH. The juice is then sent to an electro-clarifier and the current is passed till pH of juice is 8.3 as judged by phenolphthalein indicator. The electrolysed juice is then heated to 80° C. and filtered. To the filtrate super-phosphate extract is added until the pH is 6.9. This is heated to boil and filtered.

The data obtained at Ravalgaon by this procedure is given below:

Exp. No.	Date	Juice	pH	Bx	Pol	Py	Py. rise	Gl. Ratio	Ash
1	26-3-55	M. J.	—	18.09	14.47	79.97	—	12.1	—
		Cl. juice	6.6	18.93	15.53	82.04	2.07	11.7	—
2	27-3-55	M. J.	—	17.08	14.65	85.77	—	—	—
		Cl. juice	6.6	18.21	15.96	87.64	1.87	—	—
3	21-4-55	M. J.	—	16.25	13.21	81.29	—	10.6	—
		Cl. juice	7.1	16.40	13.57	82.74	1.45	10.3	—
4	21-4-55	M. J.	—	16.92	14.35	84.81	—	—	—
		Cl. juice	6.8	16.09	13.88	86.26	1.45	—	—
5	22-4-55	M. J.	—	16.61	13.48	81.15	—	—	—
		Cl. juice	7.0	16.66	13.84	83.07	1.92	—	—
6	23-4-55	M. J.	—	15.99	13.07	81.74	—	9.5	.50
		Cl. juice	7.0	16.40	13.71	83.60	1.86	8.7	.54
				P ₂ O ₅ % clear juice		: 0.005			
				CaO per litre		: 616 mgms.			

In all the above experiments it was found that mere neutralisation with P₂O₅ does not eliminate all the residual iron and so the following modification was done in the process.

After the electrical treatment, the milk of lime was added upto 10.5 pH and the juice was filtered without heating. The filtrate was neutralised with superphosphate upto pH 6.8. The analytical data obtained after the above modification is given below.

Expt. No.	Date	Juice	pH	Bx	Pol	Purity	Py. rise	Gl. Ratio	Ash
1	24-4-55	M. J.	—	18.25	15.40	84.38	—	—	—
		Cl. juice	6.8	18.18	15.83	87.07	2.69	—	—
2	25-4-55	M. J.	—	17.78	14.91	83.86	—	6.28	—
		Cl. juice	7.0	18.57	16.13	86.86	3.0	6.32	—
3	26-4-55	M. J.	—	18.80	15.51	82.50	—	10.05	.48
		Cl. juice	6.0	20.01	17.04	85.16	2.66	6.58	.48
4	27-4-55	M. J.	—	17.95	14.66	81.67	—	8.26	.58
		Cl. juice	6.6	17.17	14.37	83.69	2.02	7.95	.54
5	28-4-55	M. J.	—	15.61	12.39	79.37	—	13.31	.49
		Cl. juice	6.8	14.68	11.93	81.27	1.90	12.40	.46

Some analysis of ash constituents

	Clarified juice sulphitation	Modified Electrical process
CaO per litre	896 mgms.	616 mgms.
P ₂ O ₅ % ..	0.0027	0.0037
Fe ₂ O ₃ % ..	0.020	0.008

The following observations have been made:—

(1) Nearly 10-15 % of the juice overflows as foam.

(2) Heating the alkaline juice to boiling introduces darker colour due to decomposition of reducing sugars and hence after electric current is passed, lime was added upto 10.5 pH and the juice was filtered without boiling. This gave a light coloured juice. Almost complete removal of iron was also evident from the colour of the ash and which was confirmed by qualitative test for iron.

(3) Adjusting the final pH with phosphate was practically difficult.

(4) On an average purity rise of 2.5 to 3 units was obtained.

(5) Residual iron is not removed merely by neutralising with P_2O_5 to 6.8 pH. Addition of 2 to 3 cc. of milk of lime 25° Bx. per litre of juice and then its neutralisation removes iron.

(6) There is a slight destruction of reducing sugars.

(7) There is no difference in ash per cent.

Conclusion

The experiments and observations made at Ravalgaon and detailed in this paper on the Electrical method of juice clarification of Prof. Ghosh, indicate that there are good possibilities of the process becoming a practical success. For this, however, considerable further work is necessary to overcome the practical difficulties such as frothing and loss of sugar therefrom, electrical consumption, the difficulties at the filter press station due to alkaline filtration of iron precipitate, phosphate requirement where higher alkalinity by addition of lime or otherwise becomes necessary.

Our thanks are due to Seth Govindji, Raoji, Director, Ravalgaon Sugar Farm Ltd., for his interest and encouragement and to Shri S. R. Sane, Chemist, for help in the above experiment.

D. S. T. A.
12th Convention 1955

Whither Co 419 ?

By

D. K. HAVNOOR
Sakharwadi

Since last five years or so the variety Co 419 the wonder cane of today and the back-bone of the Sugar Industry in the Deccan is causing some anxiety throughout the Deccan cane growing tract in general and on some estates in particular.

The attention of technologists was first drawn to the question of this variety, when it was observed that the response of this variety to manures was not the same as before. Additional doses of manures were required to get the same response as before.

One section of the technologists think that this phenomenon is due to the deterioration of the variety Co 419 while the other section attributes this to soil exhaustion. Both these aspects of the question have been exhaustively discussed on this platform in the previous years.

If we look at the overall performance of the variety Co 419 in the Deccan, we see that the yields of cane per acre are slowly but steadily increasing and also there is definite increase in the sugar in cane. This fact indicates that neither the variety has deteriorated nor our soils are exhausted. But on the contrary the variety Co 419 is becoming nobler in character due to the last two decades of intensive cultivation. It is natural therefore that it should require more food for its extra performance. The disturbed balance of nature in our cane soils due to years of intensive cultivation and irrigation may also be responsible for the increased doses of manures required for this variety to show the same performance as before.

As a natural consequence of becoming nobler in character, the variety Co 419 is losing its vitality gradually and is becoming more and more susceptible to the attacks of insect pests and diseases. Top-shoot borer infection is on the increase. Hitherto unknown internode borer is causing considerable anxiety. The trouble of mites is universal. Pyrilla has become a serious pest in the Nagar tract. On the other hand the diseases like wilt, virus and twisted top are threatening its very existence.

Almost every year there is a new pest or disease cropping up.

This is a clear indication that the variety Co 419 on the one hand is losing its vitality or resisting power and on the other hand diseases and pests have specialized themselves due to the extensive cultivation of this variety for about two decades. It is interesting to note that the attack of pests and diseases is severe in the heavily manured areas and less in the normally manured areas and least in the backward areas where the cane is required to grow under adverse conditions.

Various other cane varieties have been tried and are still being tried but as yet no variety which can replace entirely Co 419 is found. Under these circumstances Co 419 will have to continue until a better substitute is found. Can we infuse new vitality in Co 419? It is a difficult job no doubt. This can be tried in the nursery plots under the conditions of controlled manuring and irrigation and with special hormone treatment. Even on the field scale heavy manuring should be avoided as far as possible. A resistant variety is the only practicable solution against the pests and diseases. There is a limit for curative treatments on a large scale when once the disease has spread.

It is a wise policy to be satisfied with moderate yields if this helps to keep Co 419 healthy. In trying for phenomenal yields there is every fear of losing a good variety.

D. S. T. A.
12th Convention 1955

Germination & Seed Treatment

By

F. S. PATIL, M. Y. KARVE & M. S. SHUKLA
Sakarwadi

To secure a good germination is a very vital phase in the production of good crop of sugarcane. If germination fails, it will tell much upon the final yield and the economy of cane production. This loss is many-fold; loss by way of tonnage (due to less population), loss by uneven maturity, loss by way of extra expenses of gap filling. This gap filling many a time gives low returns, as the new plants find it difficult to establish in shade of quickly growing first established crop and they are partly buried by interculturing operations.

Germination:—Germination of plant is awakening from dormant stage and establishment of an independent unit. This depends upon conditions of the buds and environment as regards moisture, warmth etc. that prevail around the buds and mechanical obstruction in coming to surface. It is next to impossibility to provide 100% optimum condition on the estate fields to all eye-buds. And this in turn results either in late germination or failure to a considerable degree many a time, creating odd vacant patches.

Seed Treatments:—On the whole the treatments can be grouped as below:

1. Use of agencies that provide good alkaline media.
2. Use of protective agencies in adverse conditions.
3. Use of agencies that help germination by hastening the activities viz. hot water treatment etc.
4. Use of growth promoting substances.

Group Nos. 1 & 2 are useful for bad home of seed whereas Group Nos. 3 & 4 are for condition of seed setts themselves.

Group No. 1:—Soaking or dipping in alkaline media—Different agents can be used for this purpose (provided they are not of nature of a very strong alkali). Soaking for 12 hours is found more helpful than mere dipping of the setts. The job is more laborious, more expensive and not practical for large scale plantations.

Statement No. 1—July plantation

Chemical	Planting 23-7-53	2 Weeks 9-8-53	4 Weeks 26-8-53
Papadkhar 2%	1800	39.83%	55.55%
Soda bi-carb 2%	1800	26.5%	34.38%
Lime Soln. 2%	1800	41.22%	53.50%

Conclusion:—Papadkhar & lime have shown higher germination. But on the whole results are not encouraging.

Statement No. 2—December plantation

Chemical	Planting 5-12-53	1 Week 14-12-53	2 Weeks 21-12-53	3 Weeks 28-12-53	4 Weeks 6-1-54	5 Weeks 13-1-54
Manganese Sulph. 2%	2000	9.8%	22.30%	31.1%	34.4%	36.1%
Borax 2%	1700	8.88%	21.43%	27.3%	30.7%	31.47%
Zinc Sulph. 2%	1650	15.81%	32.00%	40.54%	46.51%	46.52%
Control plot	1536	10.47%	32.75%	48.05%	55.52%	58.72%
Hot water treatment 40° C for 5 minutes	1523	16.81%	34.07%	51.88%	59.50%	63.61%

Conclusion:— Hot water treatment has shown slightly better germination but not practical due to difficulties.

Group No 3:— For hot water treatment the following trial was taken in garden area. But the job is very difficult due to inability in maintaining the required temp. constant. Seed sets were soaked for 20 minutes.

Statement No. 3

Temp. C Planted	1-7-54	15-7-54	18-7-54	23-7-54	29-7-54	4-8-54
50 C	47.81%	53.91%	69.6%	76.52%	70.43%	
52 C	43.9%	46.34%	67.47%	61.78%	67.47%	
54 C	45.45%	55.45%	64.6%	66.36%	63.27%	
Control	50%	56.77%	69.49%	69.49%	70.2%	

Conclusion:— Treatment for 20 minutes to such high temp. as 50 C cause a decrease in germination. However 5 minutes treatment with 40 C gives slightly higher germination than control (Stt. No. 2.)

Statement No. 4

Treatment	22-9-54	8-10-54	15-10-54	24-10-54
6 days driage	818	21.63%	27.26%	32.51%
4 „	721	30.51%	40.49%	44.24%
Control	1184	25.84%	38.50%	44.51%

Conclusion:—Cane kept under trash covered upto 4 days has given equal germination as that in control.

Group No. 4:—To do something wonderful with help of Hormone is really a good idea. Phymone is a powder used in U. S. A. for better and more rooting of garden plants. It is claimed that it contains 'Hormotone' and this is responsible for promoting rooting. According to instructions of suppliers trials are on hand.

Group No. 2:—Treatments under this group are most useful even under adverse conditions in fields. These consist of mainly mercuric compounds and many other chemicals which have got fungicidal properties. The probable phenomena may be of creating a thin film of soln. round the cut surface and preventing the rotting of setts by organisms. Chemicals like Agallol and Aretan hasten the germination to a considerable extent. And this is the main feature of advantages of these chemicals. Along with early germination, better germination is secured.

Method:—Along with different mercury compounds some germicides and fungicides were also tried. In every case 0.5% strength is used. Plot size varies from 0.75 guntha to 1.25 gunthas in replicated trial & 2.5 to 5 gunthas in simple trial.

Statement No. 5:—Observations on dipping experiments
Crop No. 17 — Heavy Soil Adsali planting 1954

Chemical & Strength	Plantation eyebuds	First week % age	2nd week % age	3rd week % age	4th week % age
Agallol .5%	3600	13.3	45.5	47.41	
Aretan .5%	3600	11.72	39.58	45.97	
Phymone .5%	3600	6.91	27.06	31.06	
Lime .2%	3600	9.25	30.90	35.41	
Control	3600	7.77	25.66	31.14	
Endrine .5%	3600	8.14	32.11	35.00	
Phospherno .5%	3600	11.5	36.2	41.5	
Chlorodin .5%	3600	6.36	22.61	28.2	

Conclusion:—Some of chemicals, like Endrine, Phospherno, Chlorodin are useful for treating the seed setts and getting better germination. Phospherno is equally good like Agallol, but more dangerous to handle due to its poisonous nature. From the statement it will be seen that Agallol has topped the list in germination %, giving 16% more & the 2nd is Aretan, giving 14% more germination than control.

Agallol:—A large scale trial with many replicates was taken for Agallol & Aretan separately with control plots.

Statement No 6:—Agallol trial on large scale (10 replicates) 1954 July plantation.

Agallol .5%	36000 p. a.	12233	18461
		36.7%	51.3%
Control	„	10598	16881
		29.0%	46.9%

G. S. Mills Ltd. Sakarwadi

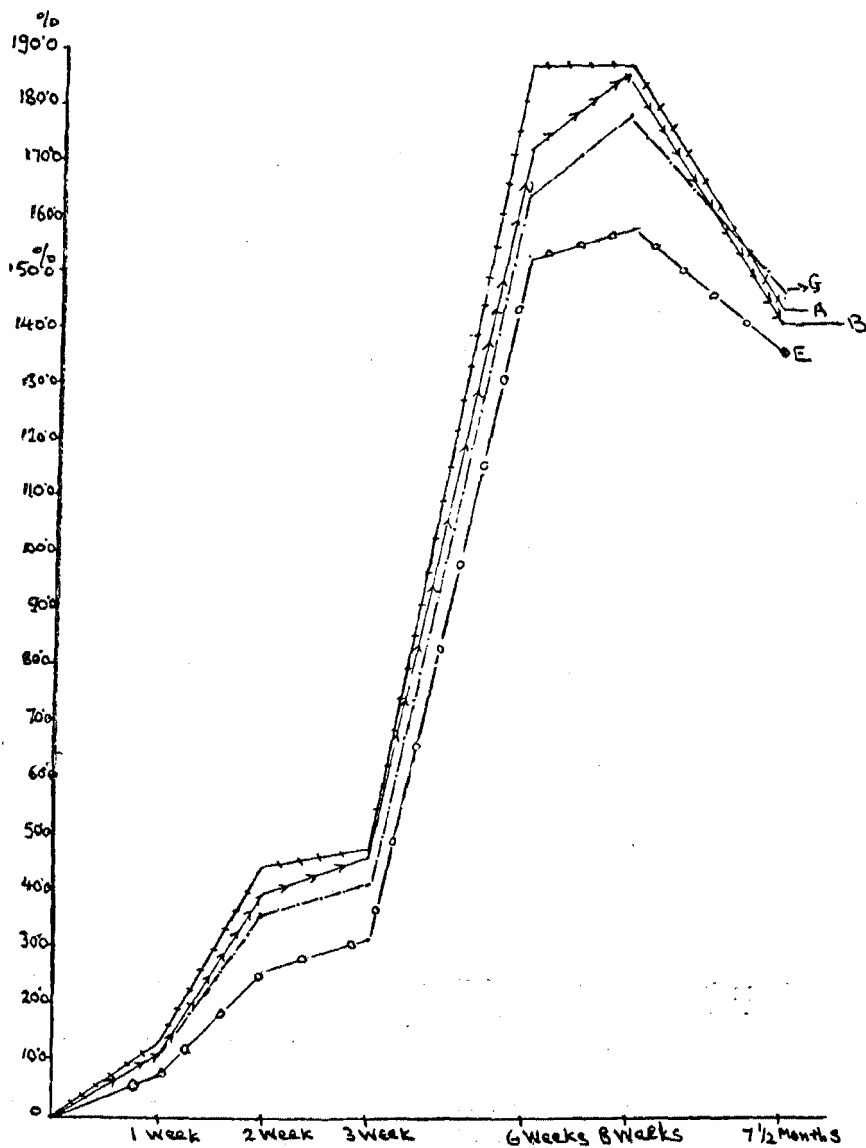
Seed treatment with Chemicals. Germination %

Ref.—A—Agallol —+—+—+—

B—Areran →→→→→

E—Control —o—o—

G—Phospherno —·—·—·—·—



Mercuric Cuproxi-chloride:—A trial was taken in July plantation in heavy soil. Observations in statement No. 8 will show that 1 to 1.5% M. C. O. C. and 0.5% Lytosol B will be useful in securing higher germination of the sugarcane sets.

Statement No. 9 July 1955 planting—Trial of different chemicals as a dip. We have repeated the same experiment for dipping for different chemicals in statement No. 9 this year. From this statement also it is proved that Agallol & Aretan have given 6% more germination over the control.

Notes:—Use of chemicals like Agallol, Aretan M. C. O. C. and Phymone is found superior over the untreated. Above chemicals are very easy for handling on a very large scale. The cost comes about Rs. 4/- for treating the seed of an acre in case of Agallol. Precaution should be taken in preparing the solution as higher concentration of this may cause skin burn.

Statement No. 7—Aretan trial in heavy soil (4 replicates) 1954 July plantation.

Chemical % Strength	Plantation eyebuds	First week % age	2nd week % age	3rd week % age	4th week % age
Aretan .5% Dipping	3000	5.5	42.46	53.31	55.96
Aretan .1% dipping	3000	6.06	38	54.8	62.48
Aretan .5% Soaking	3000	7.16	38.93	49.13	51.8
Control	3000	4.66	26.63	36.33	38.86

Statement No. 8—M. C. O. C. Heavy soil—plantation in July 1954

M. C. O. C. .3%	2250	1.46	38.84	53.95	51.33
„ .4%	2250	2.17	42.93	56.35	51.33
„ .6%	2250	2.62	41.37	53.95	52.48
„ 1.2%	2250	3.11	44.53	63.11	64.75
Lytosol B .4%	2250	3.95	45.24	56.13	60.35
Control	2250	4.31	37.55	53.24	53.33

**Statement No. 9—Different chemicals (Replicated trials in heavy soils)
1955 plantation**

Chemical & Strength	Plantation eyebuds	First week % age	2nd week % age	3rd week % age	4th week % age
Agallol .5%	3902	6.23	46.89	57.61	69.04
Aretan .5%	5195	5.1	46.19	58.86	70.05
Lytasol B .5%	4060	4.9	44.43	52.09	63.66
M. C. O. C. .5%	3862	5.74	43.6	54.68	68.19
Lime 2%	4167	4.5	37.3	42.29	55.07
Control	5009	4.23	46.61	54.46	63.14

**Statement No. 10:—July plantation 1955—Soil-Medium.
(Germination counts) S. No. 155 Kokamthan.**

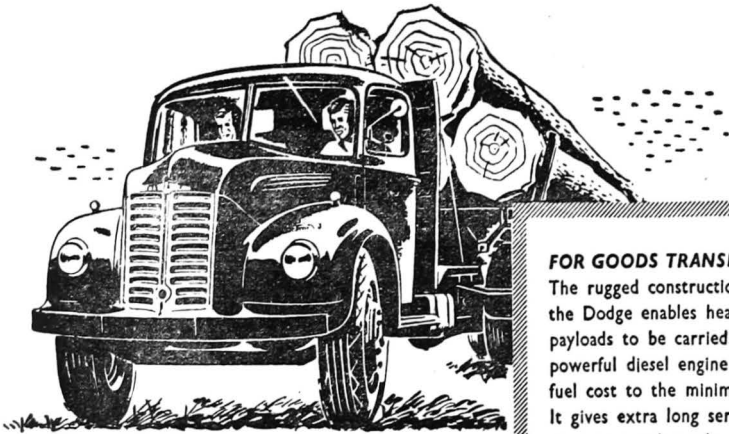
Treatment	Eye buds	2nd. week % age	3rd. week % age	4th week % age
M. C. O. C. 1.2%	300	8.5	30.16	43.03
M. C. O. C. 0.6%	300	11.00	34.83	45.16
M. C. O. C. 0.4%	300	15.00	47.00	54.83
M. C. O. C. 0.3%	300	13.00	46.83	53.16
Control	300	12.50	39.16	41.16
<i>Ends dipping in Agallol-Trial</i>				
Ends dipping	300	17.00	53.50	63.00
Whole set dipping	300	24.30	61.00	66.66
Control	300	13.00	43.00	56.50

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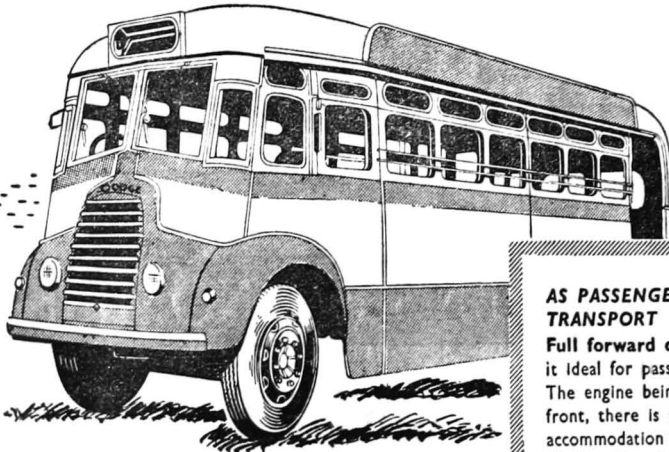
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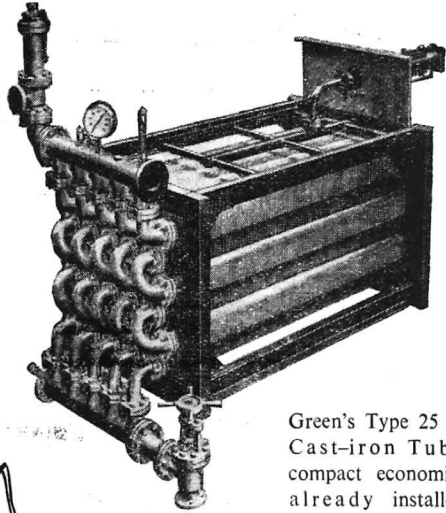
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Response of Sugarcane to Phosphate Dressings under " F " Type of Soil

By

H. R. ARAKERI & D. D. KODRE
Padegaon

Introduction & Brief Review.

Phosphate is one of the "BIG THREES" (N, P & K - the major plant-nutrients) essential for the plant-growth.

It is a well-known fact that the tropical soils are deficient in nitrogen and its application to crops grown on tropical soils has shown invariably beneficial response. Sugarcane, which is mostly a tropical crop, shows a tremendous response to nitrogenous fertilizers, thus involving a large expenditure on the item of nitrogenous manures alone. Borden (2) concluded from the results of 396 field experiments with N on sugarcane in Hawaii, conducted with an object of finding the efficiency of the applications of N fertilizers, that the yields of cane increase as the application of N is increased, but the utilization decreases per ton of cane, thus establishing the "Law of Diminishing Increments of Yield". It was also observed at different Research Stations that the quality of juice is impaired, with increasing doses of nitrogen. Attempts were, therefore, made by research workers abroad as well as in India, to increase the yield or quality of cane by the application of phosphate, which is another important plant-nutrient required by plants in adequate amounts for their satisfactory growth and full yields.

Turner (26, 27) while summarising the progress of sugarcane agriculture in Antigua and St. Kitts during the period 1933-40 reported beneficial response of water-soluble phosphates on plant and ratoon crops in Antigua, while no such response was observed in St. Kitts. There were, however, indications that larger dressings of P_2O_5 may have an adverse effect on yields of cane in St. Kitts. In Puerto-Rico, a fertilizer-cum-variety experiment was conducted from 1944-50 in which four sugarcane varieties grown at 7 levels of N, P & K the results of which indicated that N gave the highest yield increase of sugar per acre, while P and K fertilizers had no effect (23). At two locations in the principal sugarcane producing areas of El Salvador, fertilizer trials with combinations of N, P and K were conducted from 1947-50, but no response to phosphate was observed in any case (14). Potter (17) reported beneficial response of phosphate to sugarcane on phosphate-deficient soils in South Trinidad. He traced the yield response from high phosphate to the increase in number of tillers produced. Phosphate also improved the juice quality. Leake (10), however, states that phosphate dressings have given variable, generally, negative response in Trinidad, where a

far wider range of soil types occur. Fagundes (6) reported the results of fertilizer trials in Campos District, stating that maximum production resulted from the application of 600 kg/ha. of Chile Nitrate with 300 kg/ha. of Super. Sherrard (24) concluded from the results of manurial trials in the sugar belt of South Africa that super is the most economic form of P manure; greatest response being *expected* on the more sandy soil types and as the soil type becomes heavier response to P becomes less. According to Fielding (7) sugarcane responded to a dressing of super on many soil types in Natal. A two cycle fertilizer experiment on red volcanic soils of Queensland, indicated no response to super. Results of field fertilizer tests in various sections of the cane growing area of Louisiana are discussed by Davidson (5) who concluded that in general where N was applied, there was little additional response from phosphate and potash applications. Knowles, et al (13) report that neither ammophos nor super improved yields in pegassy soils of British Guiana. In Peru phosphate produced only insignificant results (9). The results of manurial expts. harvested in 1950 and 1951 in British Guiana which were mainly conducted to ascertain the value of superphosphate manuring have indicated no significant benefit (10). Leake (10) quotes the conclusion drawn by Sanchez from a series of fertilizer trials in Cuba, that phosphate has little effect. Factorial trials with 3 levels of N, P and K were conducted in several districts of Queensland, but phosphate showed no response in any case (12). In Phillipines, a complicated expt. was laid out on lime application with the combination of N, N with P or K, and N with P and K, the results of which indicated very good response to N and N with K, phosphate showed relatively small effect (12).

In India, the Indian Council of Agricultural Research started N and P and K experiments from the year 1937 at all Sugarcane Research Stations, then financed by it. Raheja (18) summarises the results obtained from these expts. conducted at different stations in the Indian Union. At Gorakhpur phosphate alone showed no effect. The similar results were obtained at Sraya, Fyzabad, Bijnor, Moradabad and Bulandshahr, but combination of N and phosphate exhibited effect in North Eastern United Provinces. At Gurdaspur and Lyallpur in Punjab, application of N and Phosphate did not result in higher tonnage. On the contrary, it was observed that by phosphate application yields are depressed both at Lyallpur and Gurdaspur. In North Bihar nitrogenous and phosphatic manures indicated beneficial influence. In Mysore at Babar Farm and Irwin Canal Farm as well as in Assam phosphate *indicated* no effect on yield of cane. At Peshawar, phosphate did not show response on yield of cane.

Parthasarthy (15) reviewed the work done on manurial trials at four stations in Madras State, from the year 1933-34 to 1950-51, namely at Anakapalle, Samalkot, Palur and Gudiatum. In no case phosphate showed improvement in yield or quality. Tandon et al (21) report that sugarcane showed no response to phosphate application in the long range experiment conducted at Shahjahanpur.

At Padegaon in Bombay State, experiments wherein 100 lbs. of P_2O_5 was applied in the form of superphosphate to Pundia cane in addition to the usual nitrogenous top-dressings, showed increase in tonnage by 19 % with high recovery of gul to cane. It also induced early vigorous tillering. Rege and Sannabhadti (20) reported that in the soils deficient in P_2O_5 , the phosphate application to the soil was advantageous in respect of cane tonnage and juice quality; but if this deficiency has been corrected, additional applications did not show appreciable differences. Rege et al (22) describe experiments on phosphatic application conducted at Padegaon which showed an increase of 3.9 tons of cane and 1.76 tons of sugar per acre by adding 450 lbs. P_2O_5 per acre.

Various factory workers presented the results of phosphatic trials conducted on the respective factory plantations on different soil types of the Bombay State to the 10th-11th Annual Convention of the Deccan Sugar Technologists' Association held in 1953 and 1954 respectively and variable results were reported.

Thus very controversial results are obtained with phosphate application. Learke (11) states that though the soils of the lower Gangetic plains are distinctly deficient in phosphorus, very little response to phosphate dressings is obtained. Though, he further adds, phosphate is in abundance in the soil, it is held in non-available form due to its reaction in the soil, a reaction particularly rapid in tropical soils. Phosphate is fixed due to its reaction with iron and aluminium, thus converting phosphate into an unavailable form. The soils of the Bombay-Deccan contain large amounts of calcium carbonate. Patel et al (16) investigated the problem of phosphate fixation in the different soil types of the Deccan and concluded that majority of it is fixed and rendered insoluble. This insolubility of phosphoric acid in soils containing free calcium carbonate is considered to be due to the formation of an insoluble compound like carbonate apatite and there exists a positive correlation of the fixation of phosphatic manure with the $CaCO_3$ content of the soil.

How to release this insoluble phosphoric acid was, therefore, a problem. High concentrations of CO_2 in the soil by artificial means release the phosphoric acid from this insoluble compound. According to Dalton et al (4), this can be achieved by the addition of phosphorus-free organic compounds such as glucose, sucrose, starch and pectin and that the metabolic products of microbiological decomposition form stable compounds with aluminium and iron, thus freeing phosphorus. Equally good results were obtained with a basal dose of 50,000 lbs. of farm yard manure applied to the sugarcane crop at the Sugarcane Research Station, Padegaon (21). But availability of bulky manures is very limited.

Cooke (3) and Hopkins (8) state that if phosphatic fertilizer is applied by placement in narrow strips or bands, its total surface of contact with

the soil will be much less than if the same amount is broadcast. With less contact with the soil, the rate of fixation is reduced. Cooke in his article on "Fertilizer Placement" describes a number of advantages obtained by placing fertilizer. In the end he states, "Fertilizer placement is by no means a universal way of automatically increasing crop yields; where it is introduced for a new crop or into a new area careful field experiments must be made to determine whether there are any advantages over more conventional ways of distributing fertilizers."

Accordingly Rege and Patwardhan (21) considered to explore the placement methods for phosphate in case of sugarcane for releasing the phosphoric acid of the superphosphate applied to the soil. They concluded from their preliminary studies at Padegaon on "B" type of soil, wherein phosphate was applied in furrows as control, half way down in the ridge and at the base of ridge, that the placement of phosphate at half way down in the ridge is the best, if its immediate advantage is to be obtained.

To confirm the results obtained at the Central Sugarcane Research Station, Padegaon, a similar experiment on the placement of phosphate was laid out at the Sugarcane Research Sub-Stations, established on different soil types. The results obtained under "F" type of soil at the Sugarcane Research Sub-Station Lakhmapur, Dist. Nasik, are discussed in the following pages.

Soil Type 'F'

According to Rege and Basu (19), the description of a typical "F" type of soil is as under:—

"It is a shallow soil 12"—15" in depth, consisting of two well defined horizons; the upper horizon (7"—8" thick) has a brown colour, lighter texture loose and granular structure with broken pieces of murum; the lower horizon is darker in colour and distinctly compacted. This horizon is of variable thickness and in very shallow phase may often be entirely absent. The murum is hard with only a faint incrustation of lime."

In the experimental plots of Lakhmapur Sub-Station, the soil type is "Immature F" wherein this lower horizon is entirely absent. Due to the absence of the lower horizon which is retentive of moisture, sugarcane crop at this station often suffers heavily in the hot summers and during periods of drought.

A sample of soil collected at different spots in the field upto a depth of 12" is analysed and from the figures of analysis given below, a rough idea about the soil can be had.

1. Total Nitrogen per cent 0.0840
2. Available P_2O_5 per cent 0.0129
3. Free $CaCO_3$ per cent 0.9000
4. Exchangeable Calcium m.e. 31.5000

Experimental details.

In the experiment laid out at this station, the treatments were:-

- (i) Three levels of phosphate (0, 75, & 150 lbs. P_2O_5/A),
- (ii) Three placements of phosphate (in furrow, half way down in the ridge and at the base of the ridge).
- (iii) Two levels of nitrogen (450 and 600 lbs. N/A).

These *eighteen* treatments are replicated three times in a split plot design with phosphatic doses and their placements as main plot treatments and nitrogenous doses as sub-plot treatments. The variety was Co 419 planted under adsali plantation.

The methods of placements of half way down in the ridge and at the base of the ridge were the same as described by Rege et al (21). The nitrogenous manurial doses were of 450 and 600 lbs. N per acre in the form of sulphate of ammonia and groundnut cake in the ratio of 1:2 N over a basal dressing of 20,000 lbs. farm yard manure per acre. The F.Y.M. was applied at the time of planting in the furrows opened at four feet distance. The planting was usually done by mid-August when the environment becomes suitable. The planting dates of the experiments are set in Table No. 1.

Table No. 1.

Placement of Phosphate with two Nitrogenous levels to adsali crop.

Crop Season	Dates of Planting
* 1. 1950-52	20th August 1950
2. 1951-53	22nd to 24th August 1951.
3. 1952-54	22nd and 23rd August 1952.

The variation in the planting dates was unavoidable due to circumstances beyond control. Chief causes were interference due to rains and unavailability of water on due dates.

Presentation of data.

The important data during the important plant phases of the cane crop during its life cycle and the harvest data are presented in Table No. 2, as an average for a cycle of three crops.

Table No. 2.—Response of sugarcane to phosphatic dressing under “F” type of soil.
Isolated Effects of Treatments. (Average of three years)

Particulars	Method of placement of P ₂ O ₅			P ₂ O ₅ Levels in lbs. per acre			Nitrogen Levels in lbs. per acre	
	Furrow applica- tion	Half way in ridge	At base in ridge	0	75	150	450	600
1. Germination per cent : At 3 weeks	51.30	47.00	46.00	47.90	48.25	48.05	48.16	48.03
6 weeks	72.30	66.70	66.90	67.96	68.96	69.10	68.80	68.40
8 weeks	77.23	71.23	71.40	72.70	73.60	73.60	73.10	73.40
2. Tillering per cent: (i) Before earthing up	315	308	292	290	318	306	301	308
(ii) One month after earthing up	208	236	223	217	233	218	214	230
3. Development Studies:								
(A) MID-APRIL (a) Total height in inches	27.9	27.3	27.1	27.6	27.9	26.8	27.1	27.8
(b) Height of mature internodes	20.1	19.6	19.6	19.8	19.7	19.7	19.4	20.1
(c) No. of internodes	3.9	4.0	3.6	3.9	3.9	3.9	3.9	3.9
(d) Girth	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5
(B) MID-JUNE (a) Total height in inches	42.9	41.7	42.2	42.6	43.2	41.1	42.0	42.8
(b) Height of mature internodes	33.9	33.3	33.6	34.0	34.0	32.5	33.2	34.0
(c) No. of internodes	12.0	10.1	9.9	10.0	10.3	10.0	10.0	10.2
(d) Girth	3.3	3.2	3.2	3.2	3.1	3.1	3.1	3.3
(C) MID-AUGUST (a) Total height in inches	71.0	69.8	69.9	70.6	71.5	68.6	70.0	71.8
(b) Height of mature internodes	56.3	55.6	56.1	56.6	56.8	54.7	55.6	56.6
(c) Girth	2.8	2.7	2.8	2.8	2.8	2.8	2.8	2.8
(d) No. of internodes	19.7	19.2	19.2	19.3	19.6	19.2	19.1	19.6
(D) HARVEST-TIME (a) Total height in inches	99.8	97.6	97.2	98.4	99.4	90.8	98.9	99.7
(b) Height of mature internodes	84.7	82.4	83.2	84.3	83.8	82.1	83.9	82.9
(c) No. of internodes	27.3	27.8	27.4	27.9	27.4	27.2	27.6	27.4
(d) Girth	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
4. Cane in tons per acre	28.0	27.0	27.3	27.9	27.6	26.7	27.2	27.7
5. Brix	19.85	19.88	19.90	20.11	19.47	20.05	20.06	19.80
6. Sucrose in juice	17.88	17.94	17.97	18.20	17.44	18.16	17.97	18.00
7. Purity per cent	90.39	90.20	90.25	90.49	89.56	90.79	90.04	90.52
8. Glucose per cent	0.665	0.648	0.717	0.644	0.761	0.625	0.702	0.651

Table No. 3.

Continued analysis of variance
(Yield-Tons/A)

Treatments		450 Lbs. N	600 Lbs. N	Main	C. D. for significance
1.	0 lbs. P ₂ O ₅	27.65	28.31	27.98	2.24
2.	75 „ in furrow	27.96	27.24	27.60	
3.	75 „ half way in ridge	26.48	27.36	26.96	27.45
4.	75 „ base of ridge	27.47	28.12	27.79	
5.	150 „ in furrow	26.92	29.29	28.11	
6.	150 „ half way in ridge	26.77	26.30	26.54	27.00
7.	150 „ base of ridge	26.24	26.46	26.35	
8.	Mean	27.20	27.75	27.47	
	C. D. for significance	1.22			

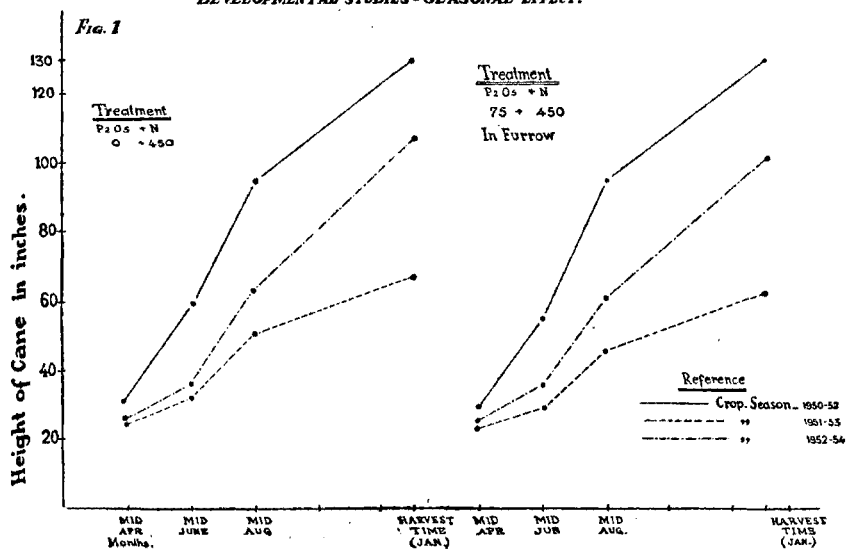
C. D. Between 2 sub-plots at one main plot = 3.29.

C. D. Between 2 main plots at one sub-plot = 3.24.

Seasonal effect.

One will be surprised to note the very low mean yields of the sugarcane crop are obtained during the cycle of three crops. One of the factors, besides the poor and 'murumad' type of soil, that contributed to low yields was the precarious water-shortage conditions prevailing at the storage tank of Chankapur during the last two years of the experimental cycle, i. e. during the summers of 1952 and 1953, which had a deleterious effect on the crops of these two years; but the effect was more pronounced on the crop which suffered during the summer of 1952 due to the long intervals of irrigation of 20-22 days and very scanty rainfall of 10.46 inches during the year, as against the rainfall of 24.72" in 1953, which made up the loss to some extent by the rapid growth of the crop in the favourable rainy season. This type of deleterious effect is very well supported by the experiments conducted at the Sugarcane Research Station, Padegaon, where delaying the irrigational turn beyond ten days (fortnightly irrigation) during summer was found to check the growth of the crop to a very great extent, and even regular irrigations later on did not make up the loss (1). In Fig. No. 1 the data for the development of cane stalks is plotted for two treatments during each year of the experiment, which clearly shows the normal growth of the crop during the first year and the arrested growth during the subsequent years.

RESPONSE OF SUGARCANE TO PHOSPHATIC DRESSING UNDER "F" TYPE OF SOIL.
DEVELOPMENTAL STUDIES - SEASONAL EFFECT.

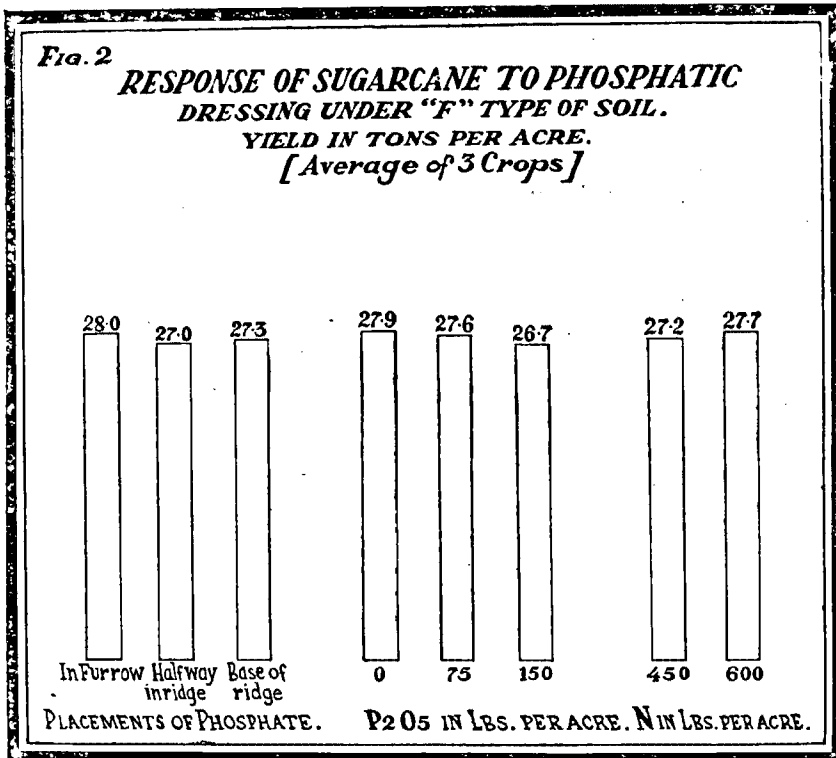


Discussion.

From Table No. 2 it will be observed that neither the different levels of phosphate nor their placements nor the increasing nitrogenous levels showed any marked difference in the rate of germination of sugarcane. The surface application of phosphate, on the contrary, has shown better response (77.23%) than that shown by the placement of phosphate half way down in the ridge (71.23%) and at the base of the ridge (71.40%).

It is said that phosphate enhances early vigorous tillering; but here it is observed that there is very little difference in the tillering capacity shown by the crop due to the application of P₂O₅ levels or their placements. As regards tillering one month after earthing up of the crop, the treatment of placement at half way down in ridge has shown superiority by 13.46% over furrow application and the placement at the base of ridge by 7.21%. The dose of 75 lbs. P₂O₅ has shown 7.4% more tillers than 0 and 150 lbs. P₂O₅ per acre, which behaved alike. The dose of 600 lbs. N per acre has indicated 7.5% increased tillering capacity than the lower dose. From the point of view of the development of sugarcane stalks at harvest time due to different treatments, it is observed that practically there is no distinct variation due to P₂O₅ levels, their placements or nitrogenous dressings.

As regards cane tonnage per acre (Fig. 2), it will be seen that no advantage is obtained by the application of phosphate nor due to its placements. A slight depression in yield is, however, observed with increasing doses of P_2O_5 . The results have indicated that 600 lbs. N per acre has not shown any significant difference in yield as against the dressing of 450 lbs. N per acre. From this it



appears that due to the porous nature of the soil the excessive quantity of fertilizers might have leached down without being made available to the crop. Even no response is observed due to phosphatic dressings on the quality of cane. A slightly better quality of cane was shown by the control (no phosphate), followed by 150 lbs. P_2O_5 per acre, than 75 lbs. P_2O_5 per acre. Also very slight variation is observed in the quality of cane due to placements of phosphate.

Conclusions.

The effect of seasons was significant. No significant differences in yields were observed due to the application of the P_2O_5 doses over the control. The linear response was negligible. A slight decrease in yields was noticed with the increase in P_2O_5 levels. The placements, neither at the single level (75 lbs. P_2O_5)

nor at the double level (150 lbs. P_2O_5), have produced any significant difference in yield. The difference in yield due to 450 and 600 lbs. N per acre was not significant.

Summary.

1. The growth of the crop was conditioned by the environmental factors in different years. Favourable irrigation and environment resulted in superior growth in the year 1950-52; it was less vigorous in the year 1952-54 and was poor in the year 1951-53.

The paper summarises the results of growth studies on sugarcane and yield and quality of cane in relation to the controllable factors of application of different levels of P_2O_5 with their placements at different depths in ridges, with application in furrows as a control treatment. To indicate the effect of soil, chemical analysis of the soil type of the farm has been stated. The results may be summarised as under:-

- (a) No significant response was observed in case of yield or quality of cane due to different levels of phosphate.
- (b) A slight decrease in yields is noticed with increasing doses of P_2O_5 .
- (c) The placements of phosphate did not improve the yield or quality of cane.
- (d) The response from the two doses of N (450 and 600 lbs./A) was not significantly different.

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Crops-Logs of Plots Receiving Different Nitrogen Doses

By

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At the Eleventh Annual Convention of Deccan Sugar Technologists' Association, a paper on "Crop-log as a guide to sugarcane manuring" was read. In Table No. II of that paper is given data collected upto July in respect of various index values of canes receiving different nitrogen doses. The cane of experimental and control plots was harvested in January 1955. Complete crop-log is now given in Table No. I and Graph No. 1, at the end.

From the Table it can be seen that though experimental plots received less nitrogen dose various index values of cane from experimental plot did not differ to any appreciable extent from those of canes from control plots receiving high nitrogen dose. Unfortunately the whole estate of Ravalgaon was affected by rat damage and yield data was not comparable on account of different extent of damage. However, crusher juice analysis in mill test did not show any difference.

Next Adsali also is under crop-log and trends so far indicate no difference in indices of canes receiving less and more nitrogen dose.

With the advent of maturity, canes show arrowing tendencies and there is a wide difference between the indices of arrowed and non-arrowed canes from the same plot as can be seen from the following Table.

Table No. II

	<i>Arrowed</i>	<i>Not arrowed</i>
Moisture % sheath	68.99	77.40
Primary Index	6.6	11.50
Phosphorus Index	0.07	0.102
Potassium Index	0.996	1.72
Nitrogen Index	1.62	1.19

All the indices except nitrogen index are lower in case of arrowed canes.

It was also noticed that the indices in different canes in the same stool after one year of growth varied considerably. The index values of different canes are given in the following Table No. III.

Table No. III

Cane No.	Moisture % sheath	Nitrogen % dry leaves	Potash % dry sheath	Phosphorus % dry sheath	Total Sugar Index
1.	83.43	1.55	2.85	0.09	6.17
2.	83.04	1.53	2.40	0.09	6.64
3.	86.21	1.35	2.90	0.13	9.37
4.	84.21	1.37	2.75	0.13	6.91
5.	81.84	1.21	3.36	0.11	9.91
6.	81.86	1.62	3.10	0.11	5.22
7.	85.35	1.21	2.70	0.12	6.48
*8.	86.91	1.55	2.15	0.09	4.76

* Cane No. 8 was a water shoot.

Conclusion

The various indices recorded so far indicate that higher nitrogen doses did not result in increase in indices. Index values individually by themselves may not give a correct indication of the requirement or otherwise of additional manuring. The various indices will have to be studied with due appreciation of their interdependence as well as in relation to other factors, such as condition and rate of growth, vigour of the crop, climatic conditions, etc. Under similar conditions of growth, deficiencies are in most cases indicated by the indices.

The indices in different canes in a stool vary considerably and therefore particular care in selecting mother canes will have to be taken for following the indices. Further it is observed that there are considerable differences in the indices of leaves as between arrowed and non-arrowed canes.

The indices appear to guide manuring much better in the earlier stages of growth i. e. the first six months after which factors like lodging, difficulties in correct sampling etc. vitiate the indices.

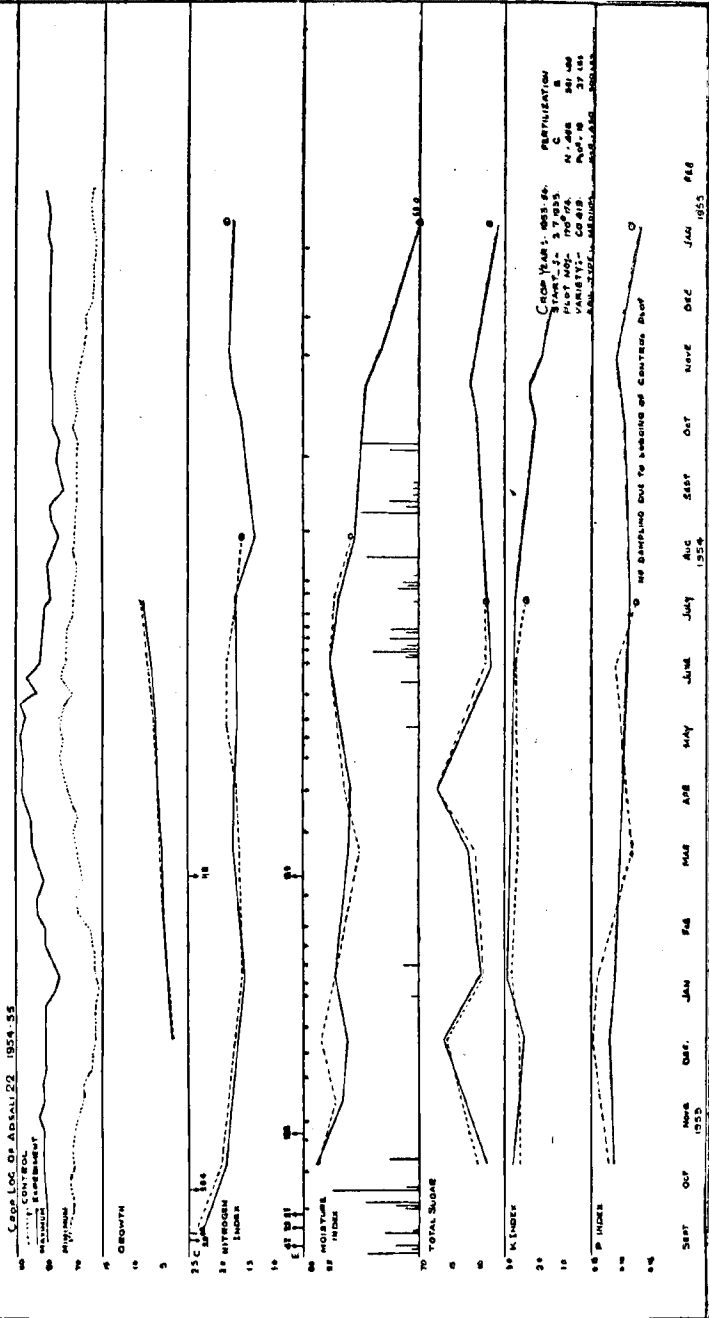
Our thanks are due to Seth Govindji Raoji, Director, Ravalgaon Sugar Farm Ltd., for his interest and encouragement.

Table No. I.

Month	Nitrogen Index		Moist. Index		Total sugar Index		K Index		P Index		Growth	
	Control	Expt	Control	Expt	Control	Expt	Control	Expt	Control	Expt	Control	Expt
Sept. 53	2.33	2.22	—	—	—	—	—	—	—	—	—	—
Oct. „	1.92	1.84	87.33	87.42	9.87	8.09	2.45	2.76	0.12	0.11	—	—
Nov. „	—	—	84.30	83.30	—	—	—	—	—	—	—	—
Decr. „	1.69	1.63	84.69	82.22	14.96	15.34	2.50	2.35	0.15	0.12	2'-4"	2'-6.5"
Jan. 54	1.55	1.51	84.30	84.40	8.85	9.09	2.72	2.84	0.14	0.11	3'-2.5"	3'-4"
Feb. „	—	—	—	—	—	—	—	—	—	—	4'-2.5"	4'-2.5"
March „	1.61	1.72	80.10	82.03	10.31	11.24	2.56	2.89	0.08	0.10	4'-11"	4'-9.5"
April „	1.65	1.69	82.87	81.70	16.62	16.62	—	—	—	—	5'-3"	5'-4"
May „	1.82	1.66	—	82.43	—	15.86	—	—	—	—	5'-11"	5'-10"
June „	1.82	1.67	85.35	85.38	8.50	7.80	2.53	2.64	0.11	0.09	7'-0"	6'-7"
July „	1.70	1.72	84.80	84.00	8.26	8.26	2.32	2.70	0.07	0.08	8'-4"	8'-0"
August „	1.60	1.40	82.00	81.00	—	—	—	—	—	—	—	—
Sept. „	—	—	—	—	—	—	—	—	—	—	—	—
Oct. „	—	1.60	—	79.88	—	10.0	—	2.05	—	0.095	—	—
Nov. „	—	1.80	—	76.49	—	10.3	—	1.75	—	0.107	—	—
Dec. „	—	—	—	—	—	—	—	—	—	—	—	—
Jan. 55	1.80	1.70	69.0	70.00	8.00	6.5	1.0	1.0	0.085	0.070	Harvest Arrowed	
	1.50	1.40	73.73	77.00	13.3	11.96	1.3	2.4	0.106	0.102	Harvest Not Arrowed.	

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12th Convention 1955

A Note on Selection of the High Speed Centrifugal Machines

By

K. N. MUKHERJEE, K. B. DANDGE & B. S. VAIDYA
Malinagar

In order to take advantage of the recent advances in the curing equipment in the sugar industry, high speed, automatic Centrifugal machines are being installed all over the world. In India, very few factories have installed this type of machine and with their experience, some points are discussed in this Paper to facilitate the selection of proper Centrifugal Machines by others.

Before proceeding further, it is very essential to know what high speed centrifugal machine means. So far as the authors are aware, it is very difficult to draw a sharp line between high speed and low speed centrifugal machines. High speed machines is a very broad term; therefore, machines can be classified as high speed, and low speed, according to their gravity factors, generally known as 'G' factor. Machines running more than 800 G may be called as High speed and those running below as low speed machines.

What is a gravity factor? This is the ratio of the centrifugal force acting on the contents of the basket to the force exerted by the earth's gravity. In other words—the 42" dia. basket revolving @ 1450 r. p. m. has a gravity factor of 1260—means the centrifugal force created by that basket is 1260 times the wt. of material.

The Centrifugal force F is given by : $F = \frac{W V^2}{g R}$

where F, is centrifugal force in grams

W, weight of particle in grams

R, Raduis of curvature of path in centimeters

V, is peripheral velocity in centimeters per second

g, is acceleration of gravity, usually taken as 981 cms/sec.

$$\text{or } F = \frac{W R}{900 g} \Pi^2 (\text{r. p. m.})^2$$

$$= \frac{(3.14159)^2}{900 \times 981} W R (\text{r. p. m.})^2$$

$$= 1.118 W R (\text{r. p. m.})^2 \quad 10^{-5}$$

$$\frac{F}{W} = 1.118 R (\text{r. p. m.})^2 \quad 10^{-5}$$

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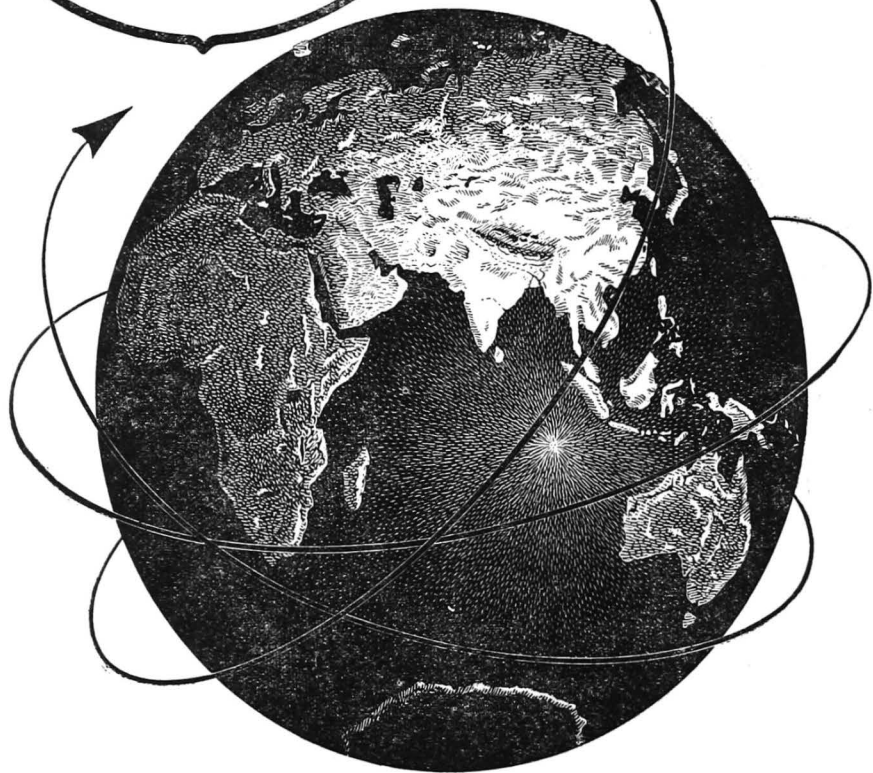
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Gravity factors of machines of different diameters running at various speeds are given in Appendix A.

Now, it is very clear that this gravity factor can be increased either by increasing the r. p. m. or the diameter of the basket of the machine. It is very convenient to increase the gravity factor of machine by increasing the speed. Now-a-days, manufacturers are incorporating the arrangement of increasing the speed of machines from 1450 to 1750 by increasing frequency from 50 to 60 cycles/sec.

Is it very essential to increase the gravity factor ?

As a matter of fact, gravity factor should not be greater than is necessary to obtain the required results in the most economical manner, because with higher gravity factors - (1) initial capital expenditure is greater, (2) maintenance is more expensive, (3) energy requirements are greater. Well boiled A massecuites are easily purgeable and hence high accelerating short cycle centrifugal machines with at least 1000 gravity factor are recommended for handling these massecuites. The centrifugal force created by the above type machines is not sufficient to separate the molasses from the crystals in the case of low grade massecuites, especially C massecuites. In this case, machines with high gravity factor are essential. In case increasing of gravity factor by increasing the r. p. m. is not possible, the installation of more machines is advisable, so that massecuite can be purged in thin wall. As a matter of fact in India, as the pan control instruments are not widely applied, the pan boiling is done on thumb rule principle, which many a time, gives rise to massecuites of uneven grains and of varying viscosities. Such massecuites when form a wall in the centrifugal basket of high gravity factor, create a tremendous centrifugal force on the wall of the basket as the 'percolation coefficient' or filtrability of the massecuite wall reaches the zero limit due to uneven grains. In other words, the sugar will pack together as an impermeable mass through which no molasses will percolate. In this case, there is a danger of breaking the perforated screens in the machines by means of excessive centrifugal force exerted on them, making the machine out of balance. The force exerted by a 4 inches thick massecuite wall on a 42" dia. basket, revolving at 1800 r. p. m. (gravity factor 1936) will be about 27 atmospheres. For every inch increase or decrease of the thickness of the massecuite wall, there will be increase or decrease of the force by 6 to 7 atmospheres. Whereas the force exerted by a 4 in. thick massecuite wall on the same basket revolving a 1450 r. p. m (gravity factor 1260) will be 19 atms.

In order to avoid this danger, more machines with 1260 gravity factor are advisable to suit Indian conditions.

Moreover, if the pan boiling can be improved in respect of even grains and every low purity C massecuites are to be purged, the gravity factor of the

machines may be raised by increasing the R. P. M. of the machines, but it should not be overlooked that the extra cost required for the frequency convertor and to make the machines robust enough to run at very high gravity factor will be near-about the cost of an additional machine.

Drive for the centrifugal machines :

In the world's sugar Industry, it is the direct electric drive which is considered to be the most modern for the high speed centrifugal machines. The electrically driven centrifugals can be classified according to the torque transmission as (1) direct coupled through flexible coupling, and (2) fluid clutch drive in which motor is always running at a full speed. The torque is transmitted to the machine by filling the fluid in the coupling.

(1) *Direct coupled machines* :— In this case, motor comes to rest or 50 r. p. m. at the end of every cycle. By using four speeds windings, in the motor rather than a single speed winding, the kick on the Turbo set can be very much reduced. Four speeds – namely 50 r. p. m. for discharging, 200 r. p. m. for charging, 750 r. p. m. for intermediate curing and a high speed winding for curing are very essential. Electrical braking from high speed to ploughing speed recovers some energy and requires no mechanical brakes. In case of self-discharging type of machines to be used for A massequite the machine has to be brought to rest by mechanical brakes to be applied at the end, i. e. after 200 r. p. m. winding is de-energised. The mechanical brakes being applied at a low speed, their wear and tear is negligible. The fixed ploughing speed helps in easy ploughing longer screen life and greater safety. Short cycle machines should preferably have a direct coupled motor to effect quick acceleration.

(2) *A fluid clutch drive* :— This type of drive allows for speeds below the maximum, the motor can provide, that is why a one speed motor with good power development at partial loads is used. A higher power motor is required when quick acceleration is required for the machine, and this high power motor runs at its full speed even if the machine is disengaged for some time in between the cycles. In this type of drive, no ploughing or charging speed can be maintained and a worker has to be trained to maintain required speed by switching on or off frequently. A mechanical brake is required to be applied in the high speed of the machine to bring the machine at ploughing speed and for this purpose, the brakes are to be every substantially built and a water cooling arrangement has to be provided.

Acceleration :— In order to reduce the time cycle, quick accelerating motors are necessary for bagging machines, as well as for those machines in which Magma or massequite to be purged consist of uniform grains and are less viscous, but for low grade or C massequites slow accelerating motors are recommended so that the flow of percolating molasses increases with the slow development of the gravity factor of the machine. In case, high accelerating motors are used, the low grade massequites will get packed suddenly and thereby reduce the percolation

coefficient of the massecuite wall to zero limit. The acceleration timings of our motors are given in Appendix D.

What is the proper size of the machine to be selected? Here, the size of the machine necessarily means the size of the revolving bracket.

Conventional sizes of the baskets with their capacities are given below:—

<i>Size</i>	<i>Cu. ft.</i>
48" × 24"	13.04
48" × 20"	10.83
42" × 24"	10.25
40" × 24"	9.0
42" × 20"	8.66
36" × 18"	5.65
30" × 18"	4.20

Baskets of 42" × 24" are predominantly used in most of the machines. 48 inches diameter baskets are very rarely used for a 1000 tons sugar factory, whereas 40 inches diameter baskets are popular in America.

The curing capacity of a centrifugal machine depends upon – (a) time cycle load to load and, (b) the size of the machine. Therefore, a centrifugal machine of 42" × 24" size and 3 minutes load to load cycle will cure $20 \times 10.25 = 205$ cu. ft. of massecuite, per hour theoretically. To avoid the overflowing of massecuites over the basket 9 cu. ft. of massecuite can safely be charged. So, $20 \times 9 = 180$ cu. ft. of massecuite can be cured in an hour, or $180 \times 22 = 3960$ cu. ft. per day of 22 hrs. This capacity is only applicable to high grade or A massecuites. As the quality of the massecuites in respect of purity deteriorates the capacity should be treated on a descending scale to the extent of 40% in the case of very low grade massecuites, which can only be spun in a thin wall. Lower the grade of the massecuite, lower the capacity of the basket with higher the time for load to load cycle. For 42" × 24" machine data observed at our factory is given in Appendix C.

For bagging, the capacity should be divided into more than one machine, so that in case one machine fails, only part of the curing capacity is cut until the machine is put to work again. Secondly, all the machines should be of uniform size in view of their maintenance and spare parts.

Single and double curing.

With the high speed of machines, great percolation coefficient of massecuites and the less viscosity of the molasses, A massecuite can be single cured with ease, to produce high quality white sugar. B massecuite also can be single cured, but with decreasing percolation coefficient and increasing viscosity of the molasses the sugar obtained by single purging is slightly inferior to that of

A massecuite. This difference in grade was marked by us during the last season when A and B massecuites were cured alternately on our steep cone type bagging machines.

The sugar produced from B massecuite was inferior to that from A massecuite in respect of both colour and crystal grades. Under the same conditions of gradation the percentages of D grains in D grade sugar from A and B massecuites were 91 and 80 respectively. Therefore, 29 D sugar from B massecuite was inferior in appearance to the 29 D from A massecuite.

In C or low grade massecuites, the percolation coefficient is low and the viscosity of final molasses is high. Therefore the separation of molasses has to be effected by spinning the massecuites in either thin walls or with high gravity factor machines. The final molasses thus separated does not flow rapidly from the monitor case to the gutters and there is always a possibility of mixing the final molasses with the C light molasses, if these massecuites are single cured. For this obvious reason, the single curing of lowest grade massecuites is undesirable. Again, if at all, they are to be single cured, the time cycle will have to be increased to such an extent that additional machine will be required as is required in double curing. Therefore, single curing does not become advantageous in the curing of C massecuites.

Automatic operation in centrifugals.

It is absolutely essential to have important operations automatically controlled to get the maximum efficiency of this section in respect of capacity and quality of the product. It is a realised fact that the machines are more reliable than the human workers.

Completely automatic centrifugals are also designed and being installed, but it is always better for the safety, to have charging and plough discharging manually operated.

The necessary automatic operation may be chosen to be incorporated with the machines curing different massecuites according to the nature of curing, viz. single or double. The alternative arrangement of hand operation is necessary in case the automatic devices fail.

In single curing process, maximum number of automatic arrangements are necessary as separation of molasses, washing and drying of sugar are done in the same machine.

In double curing, as fore-workers do the job of separation of heavy molasses only, no automatic arrangement, except curing time of the cycle, are necessary.

In the 'C' after-worker additional arrangement of water-wash and if necessary, syrup separator may be incorporated. Drying of sugar is not done so steam wash is not necessary.

Ploughing:—The bagging machines should be of self-discharging type, so that the time of about 20 secs. for ploughing is saved. For other machines, easy hand ploughing arrangement should be incorporated, at a fixed speed of 50 r. p. m. A safety arrangement should necessarily be made of releasing the safety catch for the plough only when the basket revolves at 50 r. p. m. and not otherwise. In the machines for curing C massecuite the sugar discharge cover is not necessary to save some time required for lifting the same.

Water-wash:—Efficient water spray in the machine is responsible for the production of white sugar. The water to be sprayed should be very hot (i. e. at least 90° C) so that if a first wash is given for a few seconds at an intermediate speed of 750 r. p. m. all the adhering molasses get washed out without re-solution of sugar and high quality light molasses can be obtained. In order to make the wash more effective, the water should be sprayed at a pressure of 4 to 6 atmospheres.

If super-heated water be used for washing the sugar in the machines and rest of drying of sugar be arranged elsewhere, the time cycle of the bagging machine can further be reduced in view of increasing its capacity. In such case, no steaming is required in the machine. The time required for drying sugar with steam at 100 lbs per sq. inch in our machines, can be seen in Appendix D.

Syrup separation:—In single curing process, knife-edge separation of light and heavy molasses is required to be effected. Such an efficient separation of molasses by means of conical ring is now a standard practice. With ordinary spout type of syrup separator, the purities of separated molasses and wash can be regulated by the delayed action of the separator. In the latter case, an arrangement for automatic water washing of the inside of the monitor case before change of separator will give high quality light molasses.

Process timers:—The timers should be compact and should be mounted at a convenient place. In view of the spares, the ranges of the timers should be uniform. Short range timers in the case of inter-connected timings are advantageous in respect of accuracy in their setting. The timers of independent timings are of wide ranges and therefore cannot be set as accurately as those in the case of inter-connected timings. Independent timers show the time from the beginning of the cycle whereas inter-connected ones show the time in between the consecutive operations. In either case, the timers should be of suitable ranges.

The timers controlling our machines are of the inter-connected timing type. The time settings for different massecuits and different machines are given

in Appendix D with inter-connected timings as well as the timings from the beginning of the cycle.

Pre-curing treatment necessary:—Preparation of massecuites or in other words, reducing the viscosities of the molasses for easy spinning either by dilution or re-heating is of very much importance. As re-heating is preferred to dilution efficient thermostatically controlled heat exchanging unit is essential to be installed in the pug-mills of the machines. It is always better to have separate heat exchanging units for the pug-mills of each massecuite.

In order to avoid setting of sugar crystals in discharge gates of the pug mills for high grade massecuites, it is recommended to get them hot water jacketted.

Some advantages resulting from the efficient pre-heating treatment in the pug-mill, are given below:

1. Re-heating in crystallizers can be eliminated to increase the capacity of the crystallisers and also the heat loss occurring in conveying the re-heated massecuites to pug-mill is eliminated.
2. The purity of sugar is substantially increased.
3. The purity of molasses is lowered.
4. Less quantity of water is required for washing sugar and therefore less boiling in pans.
5. Centrifugal capacity is increased.

Some observations regarding curing with ordinary water driven centrifugals and with high speed centrifugals and subsequent effect on pan boiling, at our factory:

Six high speed machines out of which two of self-discharging type were installed in our factory in the beginning of the season 1953-54. The distribution of these machines for curing different massecuites then was as follows:

- (a) Two self-discharging type, quick accelerating machines, for curing A massecuites mixed with B Magma;
- (b) One flat bottom, quick accelerating plough discharging type as a B fore-worker;
- (c) Two flat bottom, slow accelerating plough discharging type as C fore-workers;
- (d) One flat bottom slow acceleration plough discharging type as C-after worker.

Later on, during the season 1954-55, when the crushing was increased to 850 tons per day, curing capacity for C massecuites became insufficient and we

Gravity Factors of Baskets of Various Diameters and at Various Speeds — Revolution per minute

Dia. of basket inches	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800
30	428	472	517	563	616	669	723	765	836	898	959	1028	1096	1163	1232	1310	1384
36	513	565	622	675	740	802	867	930	1004	1077	1150	1232	1308	1395	1482	1570	1660
40	568	626	690	753	820	888	959	1038	1108	1199	1280	1370	1452	1544	1650	1740	1840
42	598	660	722	789	860	936	1010	1085	1168	1260	1342	1433	1532	1630	1730	1830	1936
48	684	754	828	900	984	1070	1156	1240	1340	1440	1534	1640	1756				

APPENDIX-B

Amperes Peaks in Acceleration and Regenerative Braking

	Z 9 motor for self discharging type machine	Z 9 motor for flat bottom type machine	Z 7 motor for flat bottom type machine	
Acceleration	50 R. P. M. Winding absent	Braking at 50 r. p. m.		
from 0 to 200 r. p. m.	50—→0	60—→0	50—→0	The peaks are momentary and are reduced within a couple of seconds
from 200 to 750 r. p. m.	300—→25	250—→25	90—→25	
from 750 to 1450 r. p. m.	250—→25	250—→25	80—→25	
Regenerative braking:				
from 1450 to 750 r. p. m.	300 and diminishing	350 and diminishing	110 and diminishing	
from 750 to 200 r. p. m.	75 - do -	80 - do -	90 - do -	

APPENDIX-C.

Type and size of the centrifugal machine	Number of charges per hr.	Volumetric capacity of the basket cu. ft.	Kind of massecuite	Quantity of massecuites that can be cured per charge in cu. ft.	Quantity of massecuite that can be cured by each machine in a day of 22 hrs. cu. ft.	Total quantity of massecuite to be cured while crushing 850 tons cane per day—cu. ft.		Number of centrifugal machines required		For a 1000 tons cane crushing capacity—			
						Process		Process		Total quantity of massecuites to be cured Cu. ft.		Number of centrifugal machines required	
						A	B	A	B	A	B	A	B
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Steep Cone bottom type, self discharging machine with Z9 motor 42" × 33"	20	10.25	A	9	3960	3944	4811	1	1.2 i. e. 2 Nos	4640	5660	1.17	1.4 i. e. 2 Nos
— do —	17	10.25	B	8	2992	1776	1827	1	This type of machine is not suitable.	2089	—	0.70	— or 2 machines will alternately work for A & B.
Flat bottom type plough discharging machine with Z9 motor 42" × 24"	15	10.25	B	8	2640	—	1827	—	1 No.	—	2149	—	1 No.
Flat bottom type plough discharging with Z7 motor 42" × 24" C fore-workers	6	10.25	C	5	660	1717	1717	3 Nos	3 Nos	2020	2020	3 Nos	3 Nos
Flat bottom type plough discharging with Z9 motor 42" × 24" C after-worker	15	10.25	C Magma	7	2310	1717	1717	1 No.	1 No.	2020	2020	1 No.	1 No.
Total:								6	7			6	7

(1) Z9 and Z7 are high accelerating and low accelerating motors respectively.

(2) Volumetric capacity though same in all the above machines, the charging capacity varies according to the quality of the massecuites to be cured. These are given in Column 5.

Process A: Sugar from both A & B massecuites is directly bagged resulting in the production of 20% E sugar.

Process B: In order to eliminate E grade sugar, sugar produced from B massecuite is returned in the process instead of bagging.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).
Statement showing the working of the Companion Member Sugar Factories in Deccan.
Season 1954-55.

Factory Performance.

S. No.	Name of the Factory	Crushing capacity Tons	Working days	Total cane crushed Tons	Sugar Recovery	Sugar % cane	Fibre % cane	Mill Extraction	Mixed Juice Purity	Overall Recovery	Boiling House Recovery	Foam correction in M.J. % M.J.	Dirt correction in M.J. % M.J.	Bagasse % cane	Maceration % Cane	Extra fuel in terms of Bagasse % cane	Date of Start	Date of close	Reduced Mill Extraction	Reduced B. H. R. Deer	Reduced Overall Recovery
1.	The Nizam Sugar Factory Ltd. I	1200	147	1,59,750	11.51	14.03	13.09	91.73	82.58	81.83	89.20	(0.5)		29.09	16.09	2.486	19-11-54	14- 4-55	92.15	90.96	83.82
2.	The Nizam Sagar Factory Ltd. II	2000	158	2,47,684	10.78	13.60	13.47	90.96	82.29	79.04	86.90	(0.5)		30.03	16.99	0.3559	3-11-54	11- 4-55	91.70	89.25	81.84
3.	The Belvandi Sugar Farm Ltd.	270	98	21,341.04	11.443	14.1223	14.29	90.514	83.547	80.866	89.341	1.5	1.0	30.677	12.596	7.554	9- 1-55	11- 4-55	91.87	90.44	83.09
4.	The Brihan Maharashtra Sugar Syndicate Ltd.	1000	125	1,13,496.24	11.59	13.98	14.51	92.86	86.07	82.73	89.10	—	1.40	29.91	19.26	1.23	7-12-54	18- 5-55	93.99	88.11	82.81
5.	Shree Changdeo Sugar Mills Ltd.	700	149	75,688.45	10.85	13.16	13.69	93.84	84.29	82.44	87.85	—	—	28.12	15.26	9.12	27-11-54	18- 5-55	94.45	88.49	83.58
6.	The Phaltan Sugar Works Ltd.	750	142	1,07,766	12.67	14.73	11.86	95.37	84.04	85.99	90.16	—	0.2417	22.97	23.64	nil	15-10-54	2- 4-55	95.08	90.85	86.38
7.	The Godavari Sugar Mills Ltd. Laxmiwadi	750	172	96,725.57	10.64	13.31	12.54	91.66	82.04	79.94	87.21	0.4 to 1.2	0.2 to 0.3	25.81	15.35	7.79	11-11-54	1- 5-55	91.69	89.69	82.24
8.	The Godavari Sugar Mills Ltd. Sakarwadi	850	164	1,09,674.925	10.96	13.48	12.795	93.69	82.56	81.16	86.62	2.42	0.28	27.10	14.28	6.91	25-11-54	7- 5-55	93.85	88.82	83.36
9.	The Kolhapur Sugar Mills Ltd.	850	153 days 19 hrs. 45 mnts	1,06,828.556	12.68	15.00	13.13	93.42	86.09	84.37	90.32	—	0.21	26.52	11.35	28.66	4-11-54	6- 4-55	93.78	89.43	83.87
10.	The Maharashtra Sugar Mills Ltd.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5-11-54	3- 5-55	—	—	—
11.	The Pravara Sahakari Sakhar Karkhana Ltd.	500	166	84,530.7	11.066	13.63	11.89	91.55	83.99	81.19	88.68	(1.976)		26.30	18.13	4.744	—	—	91.05	89.52	81.51
12.	The Ravalgaon Sugar Farm Ltd.	850	159	1,02,763.75	10.98	13.36	11.48	95.10	83.52	82.19	86.42	—	0.47	22.73	15.26	0.67	3-12-54	10- 5-55	94.60	87.86	83.11
13.	The Saswad Mali Sugar Factory Ltd.	800/ 850	151	96,930.3156	10.73	12.63	12.08	94.63	82.94	84.98	89.79	2.24	0.19	25.29	12.80	4.54	4-11-54	7- 4-55	94.41	91.23	86.13
14.	The Ugar Sugar Works Ltd.	500	124	63,568.65	11.62	14.62	11.81	92.66	82.62	78.91	85.16	—	0.16	25.28	14.00	3.55	—	16- 4-55	92.17	87.66	80.80
15.	The Walchandnagar Industries Ltd.	1400	162	1,79,929.9	12.51	14.55	12.50	95.15	85.40	85.96	90.34	—	1.09	—	—	—	—	—	95.15	90.19	85.81
16.	The Belapur Co. Ltd.	1000/ 1100.	156	1,59,628.51	12.08	14.10	11.24	96.41	84.01	85.67	88.89	—	0.15	21.71	23.66	0.27	23-11-54	27- 4-55	95.95	89.70	86.07

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Statement showing the working of the Companion Member Sugar Factories in Deccan.

Field Performance.

Season 1954-55.

S. No.	Name of the Factory	Max. & Min. Temp. reached °F	Rainfall inches	Source of Irrigation	Area of Cane harvested for milling				Average out-turn of cane tons per acre.				Average sugar per acre
					Adsali	Plant	Ratoon	Total	Adsali	Plant	Ratoon	Total	
1 & 2	The Nizam Sugar Factory Ltd. I & II	105 52	36	Nizam Sagar Canal	Farm	329-20	1125-30	5074-14½	41.05	24.60	25.87	36.18	—
					Rayots	1128-34	4376-38	13798-12	—	—	—	16.55	—
3	The Belvandi Sugar Farm Ltd.	104 60	20.8	Visapur Tank Canal Water	nil	117-13	2-00	119-13	—	57.84	45.01	57.63	—
4	The Brihan Maharashtra Sugar Syndicate Ltd.	—	—	Canal	937-00	406-00	548-00	1891-00	61.20	47.30	40.37	52.20	6.95
5	Shree Changdeo Sugar Mills Ltd.	110 44	21.30	Canal & Lift	650-00	59-00	208-00	917-00	50.90	36.60	35.30	—	—
6	The Phaltan Sugar Works Ltd.	109 48	16.45	Canal	1129-20	56-24	774-35	1960-39	56.45	34.56	29.94	45.34	5.74
7	The Godavari Sugar Mills Ltd. Laxmiwadi	112 50	18.95	Canal, River & Well lifts.	790- 3½	113-18	50-28	954-9½	68.7	48.2	38.5	64.2	6.34
8	The Godavari Sugar Mills Ltd Sakarwadi	100 60	18.15	Canal, River Nala & Well lifts.	1856-15½	596-11	81-31	2534-17½	68.0	46.3	43.7	62.1	6.8
9	The Kolhapur Sugar Mills Ltd.	—	37.82	River lifts	513-31	35-10	200-9	749-10	43.74	40.47	31.04	40.21	5.24
10	The Maharashtra Sugar Mills Ltd.	—	—	—	—	—	—	—	—	—	—	—	—
11	The Pravara Sahakari Sakhar Karkhana Ltd.	110 74	16.54	80% Well lifts & rest Canal	422-00	598-00	730-00	1750-00	59.00	46.00	41.00	48.3	5.4
12	The Ravalgaon Sugar Farm Ltd.	110 50	26.64	Canal	928.20	—	583-00	1511-20	49.5	—	14.8	36.1	3.96
13	The Saswad Mali Sugar Factory Ltd.	107.5 53	23.42	N. R. B. Canal	755.39	2-30	623-29	1382-18	82.82	55.77	54.78	70.11	7.52
14	The Ugar Sugar Works Ltd.	—	23.00	Lifts from River	433.15	140.30	348-10	922-05	51.19	27.74	29.78	39.53	4.59
15	The Walchandnagar Industries Ltd.	111 45	21.23	Canal and River Lifts	—	—	—	3994-13	—	—	—	42.2	—
16	The Belapur Co. Ltd.	108 46	23.11	Pravara L. B. Canal	2642-00	160-19	69-20	2871-39	56.75	47.03	30.69	55.58	6.715

in Appendix D with inter-connected timings as well as the timings from the beginning of the cycle.

Pre-curing treatment necessary:—Preparation of massecuites or in other words, reducing the viscosities of the molasses for easy spinning either by dilution or re-heating is of very much importance. As re-heating is preferred to dilution efficient thermostatically controlled heat exchanging unit is essential to be installed in the pug-mills of the machines. It is always better to have separate heat exchanging units for the pug-mills of each massecuite.

In order to avoid setting of sugar crystals in discharge gates of the pug mills for high grade massecuites, it is recommended to get them hot water jacketted.

Some advantages resulting from the efficient pre-heating treatment in the pug-mill, are given below:

1. Re-heating in crystallizers can be eliminated to increase the capacity of the crystallisers and also the heat loss occurring in conveying the re-heated massecuites to pug-mill is eliminated.

2. The purity of sugar is substantially increased.

3. The purity of molasses is lowered.

4. Less quantity of water is required for washing sugar and therefore less boiling in pans.

5. Centrifugal capacity is increased.

Some observations regarding curing with ordinary water driven centrifugals and with high speed centrifugals and subsequent effect on pan boiling, at our factory:

Six high speed machines out of which two of self-discharging type were installed in our factory in the beginning of the season 1953-54. The distribution of these machines for curing different massecuites then was as follows:

- (a) Two self-discharging type, quick accelerating machines, for curing A massecuites mixed with B Magma;

- (b) One flat bottom, quick accelerating plough discharging type as a B fore-worker;

- (c) Two flat bottom, slow accelerating plough discharging type as C fore-workers;

- (d) One flat bottom slow acceleration plough discharging type as C-after worker.

Later on, during the season 1954-55, when the crushing was increased to 850 tons per day, curing capacity for C massecuites became insufficient and we

Gravity Factors of Baskets of Various Diameters and at Various Speeds — *Revolution per minute*

Dia. of basket inches	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800
30	428	472	517	563	616	669	723	765	836	898	959	1028	1096	1163	1232	1310	1384
36	513	565	622	675	740	802	867	930	1004	1077	1150	1232	1308	1395	1482	1570	1660
40	568	626	690	753	820	888	959	1038	1108	1199	1280	1370	1452	1544	1650	1740	1840
42	598	660	722	789	860	936	1010	1085	1168	1260	1342	1433	1532	1630	1730	1830	1936
48	684	754	828	900	984	1070	1156	1240	1340	1440	1534	1640	1756				

APPENDIX-B

Amperes Peaks in Acceleration and Regenerative Braking

	Z 9 motor for self discharging type machine	Z 9 motor for flat bottom type machine	Z 7 motor for flat bottom type machine	
Acceleration	50 R. P. M. Winding absent	Braking at 50 r. p. m.		
from 0 to 200 r. p. m.	50—→0	60—→0	50—→0	The peaks are momentary and are reduced within a couple of seconds.
from 200 to 750 r. p. m.	300—→25	250—→25	90—→25	
from 750 to 1450 r. p. m.	250—→25	250—→25	80—→25	
Regenerative braking:				
from 1450 to 750 r. p. m.	300 and diminishing	350 and diminishing	110 and diminishing	
from 750 to 200 r. p. m.	75 - do -	80 - do -	90 - do -	

APPENDIX-C.

Type and size of the centrifugal machine	Number of charges per hr.	Volumetric capacity of the basket cu. ft.	Kind of massecuite	Quantity of massecuites that can be cured per charge in cu. ft.	Quantity of massecuite that can be cured by each machine in a day of 22 hrs. cu.ft.	Total quantity of massecuite to be cured while crushing 850 tons cane per day—cu. ft.		Number of centrifugal machines required		For a 1000 tons cane crushing capacity—			
						Total quantity of massecuites to be cured Cu. ft.		Number of centrifugal machines required		Total quantity of massecuites to be cured Cu. ft.		Number of centrifugal machines required	
						Process A	Process B	Process A	Process B	Process A	Process B	Process A	Process B
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Steep Cone bottom type, self discharging machine with Z9 motor 42" × 33"	20	10.25	A	9	3960	3944	4811	1	1.2 i. e. 2 Nos	4640	5660	1.17	1.4 i. e. 2 Nos

in Ap begin	ater-wash off	Syrup separator	Steam-wash on off		Braking to 0 or 50 r. p. m.	Ploughing	Total time taken for cycle	Charges per hour
1	15	20	3					
mills } jacket }	58	63	61	180	180	—	180	20
	20	40	3					
pug-1	63	83	66	210	210	—	210	17
the cr masse	20	40	3					
	60	83	66	210	210	255	255	14
	5	kept idle	43					
	48		91	155	155	200	200	18 actually 15 as machine requires cleaning after every fourth cycle
boilin	15	—	20					
	63	—	68	165	165	210	210	
at gals ad factor	—	—	No arrangement		545	600	600	6
	15	—						
instal of the	93	—	„		295	340	340	10 to 11

RANGES OF THE TIMERS

masse	mediate ing time	Curing time	II water wash-on	II water wash-off	Steam-wash	Syrup separator
fore-)	Seconds	½ minute	3 Seconds	3 Seconds	3 Seconds	3 Seconds
to		to			to	to
)	Seconds	5½ minutes	43 Seconds	43 Seconds	43 Seconds	43 Seconds
work	Seconds	1½ minute	3 Seconds	3 Seconds		3 Seconds
to		to			nil	to
work	Seconds	16½ minutes	43 Seconds	43 Seconds		43 Seconds

timers for II water wash on and syrup separator for machines 3, 4 & 5 and 6
ge of curing time.

had to utilise the C after-worker machine as C-fore-worker and the B-fore-worker as a C after-worker. The capacity of the bagging machines being more than sufficient, these machines were used alternately for A and B massecuites, sugar from both the massecuites being bagged.

The pan boiling and curing process in the season 1952/53 and 1953/54 were identical except in the later part of the season 1953/54 when single cured sugar of B massecuite was partly used as seed for A massecuite, thus re-circulating 25 % of B massecuite sugar in process. Average results for both the seasons are given below.

	Ordinary machines	High speed machines	
Season	1952-53	1953-54	
Recovery	10.48	10.40	
Solids in massecuites per 100 solids in syrup:			
A Massec.	117.99	124.83	+6.84
B "	59.88	55.92	-3.96
C "	53.82	50.98	-2.84
			} This increase is due to the use of B sugar seed in- stead of C sugar
Total solids	231.69	231.73	
Purity of B Magma (B sugar mixed with A heavy)	86.04	91.86	+5.82
Purity of C Magma (Magma with B heavy)	73.51	77.28	+3.77
Purity of C seed (with syrup)	88.81	93.79	+4.98
Purity of C light	46.24	54.47	+8.23

Conclusion

Apart from other things, such as labour saving etc. the H. S. centrifugal machines with efficient pre-heating arrangements help a lot in improving the quality of the product, thereby causing less re-circulation of non-sugar. With this point of view, they deserve to be installed in the modern factories, which are being erected now or those which are going to replace their existing curing plants for becoming unserviceable.

Our sincere thanks go to the Management of the Saswad Mali Sugar Factory Ltd., Malinagar, for their kind permission to present this Paper for publication.

D. S. T. A.
12th Convention 1955

The Phenomenon of Water-Shoots

By

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Introduction

Everybody acquainted with sugarcane and its cultivation knows very well that at times there are seen some late tillers which grow very rapidly to produce erect, thick and succulent canes that easily outweigh other normal canes but are themselves very poor in sucrose contents. These are known as suckers, water-sprouts or bull shoots. In most of the Bombay-Deccan, they are commonly called water-shoots and go by various local names such as हत्ती कोंब, वायकोंब, हत्ती सोट, कोंबारे etc.

Numerous Dutch writers claim that the Javanese language has provided a number of most appropriate words in sugarcane agriculture. The same can be said with advantage of Marathi language too. The word हत्ती कोंब not only indicates the abnormal size of the tiller comparable to that of the biggest of the terrestrial animals but also hints at the same time when these shoots are prominently visible in cane fields. They are prominently seen at the time of late rains of हस्त नक्षत्र or हत्तीचा पाऊस usually received in the month of September.

The exact reasons as to how these suckers are formed and how they develop abnormally are not yet thoroughly known. It is often noted that when an early formed tiller or mother-cane having made sufficient growth in about a year's time and having a well developed root system with a large enough Canopy, lodges upper-most to have all advantage of space and sunlight, it fails to develop with that rapidity exhibited by a much younger shoot put forth by its very own underground bud. This young shoot emerges with extraordinary vigour amidst a well grown surrounding crop and within a few months forms itself into a broad, erect, heavy water-shoot. Normally when young plants have to grow in an already growing vegetation, they assume an etiolated lanky appearance and possess an abnormal height not balanced by proportionate stem development.

Numerous observations regarding water shoots and their behaviour were made during the last three seasons in the Estates of the Saswad Mali Sugar Factory Ltd. Data gathered from these as well as that from other farms presents very interesting features. The problem of water-shoots should weigh heavily with sugarcane-growers who would like to eliminate these from their fields.

The factors affecting production of Water-shoots

The likely causes of the production of water-shoots can be roughly classed as follows:

(a) Climatic conditions. (b) Soil. (c) Variety. (d) Fibre percentage. (e) Manures applied (f) Lodging. (g) Cultural operations. (h) Sunlight and Shade.

(a) *Climatic conditions*:—As is already mentioned above, water shoots rarely make their appearance in the fields before the advent of Monsoon. Adkali plantings of nearly 11 months age and plant-cane fields of hardly 6 to 7 months age begin to produce water-shoots almost at the same time in monsoon. The grand period of growth appears to be closely related to the production of water shoots. It may mean that intake of material by the root-system is not balanced with utilization of same by the plant, having lodged on account of winds. The up-take being thus hampered a lot of ready foot-material is available for the new shoots coming up from the underground adventitious buds. It is, however, noticed that water-shoots continue to grow and are produced anew even in winter-season right upto the time of crop-harvest. It is not on record anywhere that water-shoots have been produced in Summer season.

(b) *Soil*:—Soil seems to affect the production of water-shoots very little. Heavy crops produced in all sorts of soil have been observed to produce a large number of water-shoots. The Prize-plots grown in the various competitions organized by the D. S. T. A. have shown that heavy growing of crop is not restricted to a single type of soil alone. Defectively drained or heavy chopan soils rarely produce large number of water-shoots. This, however, is related to the poor plant-food and aeration availability in such soils.

(c) *Variety and Water-shoots (Please refer Table III)*:—Observations made in crop planted early in the month of December regarding Water-shoots and varieties are given in Table No. III. The percentage of water-shoots in the yield of sugarcane per acre was the highest in case of Co 685, Co 680 and Co 683. Co 419 also produced a fair quantity of water-shoots, while as the other varieties produced a very small percentage. The final juice quality will, no doubt, be influenced by the presence of these water-shoots in the cane crushed. In crushing cane from this plot no water-shoots were discarded. Thus it will be seen that the primary juice analysis judged from this view point makes it evident that the quality of Co 419 cane is still more superior to that of its nearest approaching variety Co 678. This plant cane rarely produced a water-shoot reaching a height of over 6'. It appears that age of the crop is also a point of material importance in the production of water-shoots. The Laboratory analysis of water-shoots compares not very favourably with that of normal canes in case of late water-shoots. The average analysis figures, given in Table III show that Co 683 has produced water-shoots richest in sugar. It may be interesting here to note that the average height of cane crop in this variety is also the highest. This, however, is not borne out in the case of Co 678 wherein the average height of the crop was almost the same. There the quality of water-shoots was comparatively poor.

Observations made in Adsali crop on several varieties at the Akluj Sub-Station farm also show that Co 685 had the maximum number of water-shoots. Co 419 comes a close second. All this crop showed a very small amount of lodging. The yields are also comparatively low. Please refer Table II.

(d) *Fibre Percentage*:— It is obvious to follow that larger amounts of fibre in the cane will make it less susceptible for lodging and in as much as lodging and production of water-shoots are very closely associated, it can be assumed that varieties or crops that lodge less, will produce smaller quantities of water-shoots. A matter of common observation in the Bombay Deccan is that POJ 2878 crops produced smaller percentage of water-shoots as compared to those produced by Co 419 cane. POJ 2878 has a higher fibre percentage than that of Co 419. Co 745 planted usually as a wind-break has a very high amount of fibre and it does not lodge. It is also observed that in spite of the advantages of border-space, sunlight, manure, etc., this variety rarely produces any water shoots. It may, therefore, be presumed that very high percentage of fibre retards the production of water-shoots. Comparative analysis figures of Co 419 and Co 745 are given below,

	Brix	Pol	Purity	Fibre%
Co 419	20.24	18.77	92.75	12.28
Co 745	14.02	8.25	58.84	33.40

(e) *Manure*:— Manure application especially of Nitrogen seems to be closely associated with the production of water-shoots. Crops poorly manured rarely produce any water shoots. Probable reason is that there is very little of surplus food available for the rapid growth of water shoots after coping with the needs of the mother-canes and early tillers. These observations have been made by other authors in other countries also.

Figures from table No. I give information regarding water shoots, their quantity and quality produced by plots treated with varying doses of manures. It cannot be said on the whole that higher doses of manures are co-related to higher number of water shoots produced. This, however, seems to be true to certain extent. Nitrogen quantities of 750 and 900 have produced a very large number of water shoots. The highest percentage was produced by plots receiving 900 pounds of Nitrogen. Application of varying doses of P_2O_5 does not appear to have affected water shoots' production. The yield of sugarcane is also not directly correlated to the yield of water-shoots. It may, however, be safe to assume that higher percentages of manures are likely to cause heavier production of water-shoots. This is probably due to the large quantities of readily available plant-food-material for the rapid growth of these late tillers.

(f) *Lodging*:— Lodging seems to be closely associated with the production of water-shoots. Almost all the writers have stressed that lodging of cane is probably the only cause of water-shoots' production. In spite of this, few cane growers seem to have realised the economic importance of this phenomenon. The

exact reasons of lodging are not ascertained. The known reasons according to Dutt are the variety including, its morphological and anatomical make-up, chemical contents of the plant, type of root system, agriculture practices and climatic conditions. All these factors as can be very easily seen, are out of control of the Deccan Sugar Growers in as much as the cultivation has to be restricted at least for the present to a single variety and to a typically intensive method of cultivation which necessitates heavy manuring and frequent irrigations. Lodging and soils have not been observed to be correlated. Sugarcane growers in general and those in Deccan in particular have often tried to improve the quality and especially the depth of earthing up with a view to afford additional support to the canes for preventing or minimising lodging. This has had little effect in achieving the objective. Intensity of winds is undoubtedly one of the factors contributing to heavy lodging of sugarcane.

Various wind-breaks like Castor, Sesbanaea, Co 745 etc. have met with little success in preventing heavy lodging in well-manured adsali fields. Wind-breaks of Co 745 were particularly tried and it was observed that even in plant cane crops they could help very little in the prevention of lodging. Various other methods of propping, tying of canes in bundles etc. have also been tried by various cultivators in different parts of the country. At least for the present it appears to be out of question to utilise these methods economically and efficiently. Soil moisture or rather the method of irrigation seems to have had little effect on lodging. Long furrow method as well as the usual zigzag method showed no difference in the lodging of crops. Dutt says "Co 419 and Co 312 lodge towards maturity when the vegetative growth is nearly completed." Experience in the Bombay Deccan, however, is quite different, as far as the cultivation of Co 419 is concerned. In the Estate of the Saswad Mali Sugar Factory Ltd. lodging has been noticed to begin in Adsali fields from the end of March onwards and it is quite common to see heavily lodged cane, in almost all adsali fields well before the arrival of the first monsoon shower. All varieties whether in adsali or in plant-cane season, have been observed to lodge equally heavily in these fields.

Lodging of the crop especially before the advent of Monsoon influences the production of water-shoots. Figures given in Table II refer to observations made in the Adsali fields of Akluj Research Sub-Station. The general lodging in these plots was very much less than that in the plots of the Saswad Mali Sugar Factory's Adsali crop. It is probably due to this lodging which occurred 2 to 3 months later than that occurring in factory's crop, that the amount of water-shoots produced is appreciably low. The quality of cane naturally is better when smaller amount of water-shoots are produced.

Observations made in the Adsali plots at Akluj Sub-Station farm given in the Table IV show that the higher quantities of nitrogenous manure have slightly influenced the water-shoot production. On the whole higher doses of manures have produced slightly higher quantities of water-shoots. The yields of

the plot being somewhat lower than those of the factory plots the crops showed considerably less lodging of cane.

(g) *Cultural operations*:—Various cultural operations like distance of planting, hilling, mode of irrigation and earthing up do not seem to have much effect upon the production of water shoots. Figures given in Table V show different types of plantations with different furrow-widths. It is clearly seen that inspite of an appreciably marked difference in these widths there is very little variation in the percentage weight of the water shoots produced. The yields of sugarcane were also approximately alike. The wider plantations must have afforded more scope of space, light and manure for the production and growth of water shoots. It is peculiarly marked that this has failed to influence water shoots' production in any appreciable manner. All the crops under observation had lodged very heavily and produced nearly 5 to 7 percent of dead canes, observed at the time of harvest. Planting at 4½' width has somehow produced fewer water shoots early in the season. The total number of water shoots, however, shows very little difference.

Long furrow and zigzag methods of irrigation were followed in these treatments of different planting distances. Even in these the number and weight of water shoots did not vary appreciably.

Early or late earthing up has had no effect upon the lodging nor upon the number and quality of water shoots produced by the different plots.

(h) *Sunlight and Shade*:—Most of the writers have associated sunlight and higher soil temperatures to be closely associated with the production and growth of water shoots. In a tract like ours, where the normal temperatures are sufficiently high, the question of temperature counts very little in the germination or production of cane shoots. Once the crop starts growing, all the soil is completely covered by cane foliage within about 10 weeks of the planting. From then onwards, soil is rarely exposed to the continuous sun-light except only at such times when lodging is general. This rarely happens before the advent of strong breeze usually experienced in the latter part of the summer and the storms of early monsoon period. With a view to ascertain effect of shade upon the production and growth of water-shoots, observations were made in plots that were shaded by the wind-break of *Sesbana*. The height of this wind-break was 21.3 ft. and it cast shadows upto 19' length, at mid-day. The length of shadows covered a distance of 30 ft. at 4 p. m. The six small plots of 1/16th acre each allowed numerous observations to be made which are given in table VI. It is seen from these that the number of water shoots is slightly higher in the shaded portions than that in the unshaded one. The percentage weight of water shoots in the yield is, however, slightly higher in the case of unshaded plots. It may mean that though less in number, water shoots in the unshaded portion made better growth in the same period to achieve a slightly higher weight. The quality of water shoots produced by these two types of plots does not show appreciable

difference either way. It is, however, peculiar to note that water shoots in the shaded portion are not low in Brix.

Other Observations.

Other observations made in respect of water shoots are given in tables VII and VIII. Table VII shows the periodical observations made during the harvesting season extending from 72 to 78 weeks of crop age. From this, it is clearly seen that none of the water shoots compare very favourably with normal canes as regards their quality. Late water shoots positively offer no advantage in being crushed and when calculated on economic basis, it is clear that the crushing of such water shoots will mean a positive loss to the Mill. The amount of sugar afforded by such late water shoots is too small in proportion to the expenses that may have to be incurred by way of the cost of cane and its processing. The mid-late water shoots do not show any positive loss but may cause a lowering of normal recovery that will be very much discouraged by the Manufacturing staff in any factory. Early water shoots however do not bring much of loss in sugar.

The number of internodes produced by early water shoots is nearly 50 to 50 percent of that of the internodes found in normal canes. Mid-late water shoots also produce a fairly large number of internodes which many a time nears 50% of that of the normal canes. The late water shoots obviously produce a very small number of internodes. The number of internodes and the total leaf area are directly related and it can thus be seen that early water shoots though weighing much more than normal canes have a comparatively smaller leaf-area. The girth of water shoots as recorded in various cases will show that earlier the water shoot more is the girth. The girth does not reduce with the growing length of the early water shoots. The weight of water shoots per running foot is nearly 170% of that of the normal canes and early water shoots on the whole show the maximum weight per ft. of cane. The height of water shoots produced is generally not dependent upon the general average height of the crop. This may have something to do with the time of lodging, amount of plant food available and other factors.

Economic Value.

The economic value of water shoots produced by the normal adsali sugarcane crop can be considered in various aspects. When sugarcane is sold on weight basis without consideration of quality the water shoots will add valuable weightage in favour of the grower.

Water shoots form excellent seed material for planting of plant cane. Many of the sugar-concerns carefully avoid inclusion of a large number of water shoots in the cane sent to the mills. The shorter ones especially are carefully picked out and discarded. This is obviously done with a view to avoid the adverse effects upon sugar recovery. It has also been noticed that wherever gur

manufacture is carried on in a careful manner, short and medium water shoots are discarded at the crushers to avoid extra use of fuel and the subsequent lowering of gur quality. Such discarded water shoots even when stripped with sickles and with partially damaged eye buds were used as seed for planting cane in an area of 3 acres at one of the Somaiya Farms. The resulting crop was equally good. In fact the shoots from this area were more vigorous than those in the normal cane crop. The reason for this vigour might be that such seed will be in a very sappy condition with abundant invertible sugar material easily available to supply the needs of the growing shoots in initial stages. The eye-buds in the water shoots' seed material do not have a tough scaly covering as is usually found in normal year old seed material. This may account for good germinations in such plots.

G. D. Patel of Godavari Sugar Mills Ltd. has observed that crop planted from such seed material flowers slightly earlier than normal crop. Observations made at the Somaiya farms however do not coincide with this. It would be most interesting to verify it further.

Water shoots form valuable fodder. Young water shoots are best utilized for this purpose. Very short and young water shoots in the fields under harvest rarely reach the factory wherever hired cartmen attend to field transport. While the cart is being loaded the cartman, always a more careful farmer, picks up these young water shoots and feeds them to the cart-animals who are observed to relish them. One often sees bullocks happily munching these sweet, succulent, tender shoots in the cane fields under harvest. Most of the sugar factories discard water shoots shorter than about 4 ft. These, in some places, are sent to the cattle sheds for being sliced and fed to the working and milch animals. It is, however, seen many a times that the healthy rivalry and zealous efforts of the agricultural staff to increase the yields of their cane plots often induce them to include as many water shoots as possible in the cane sent to the factory. The value of this material as fodder is very obvious and in a country like ours probably no better use can be suggested.

Summary and Conclusion.

The problem of water-shoots is of immense economic importance to sugar-cane growers in Bombay Deccan.

The rate and quantity of water-shoots produced are not much affected by type of soil, variety, shade and cultural operations. It is however influenced

Table I

183-A

Plot No.	Manurial Treatment per acre		Sugarcane yield per acre	% of Water shoots in yield	Plant population at harvest	No. of Water shoots per acre	Average of Laboratory Analysis											
	N lbs.	P ₂ O ₅ lbs.					Normal Cane			Early Water Shoots			Mid-late Water Shoots			Late Water Shoots		
							Brix	Pol	Purity	Brix	Pol	Purity	Brix	Pol	Purity	Brix	Pol	Purity
1	600	300	81.4	11.91	46120	5340	20.69	18.89	91.30	20.40	17.48	85.68	17.37	13.47	77.54	11.42	5.91	51.75
2	600	150	79.85	11.59	46100	5138	20.66	18.94	91.67	19.37	16.57	85.54	16.79	13.37	79.63	13.32	8.49	63.73
3	750	375	88.30	12.92	47466	7020	21.65	20.05	92.61	19.45	16.01	82.31	17.42	12.79	73.13	11.15	8.74	75.13
4	750	187.5	80.65	15.03	46880	7180	20.51	18.24	88.93	19.56	16.84	86.09	16.59	12.95	78.06	12.83	7.65	59.62
5	900	450	85.18	11.49	46400	5533	21.78	20.45	93.89	19.35	16.47	85.12	15.71	11.67	74.28	12.44	7.25	58.28
6	900	225	82.30	17.10	45440	7401	20.25	18.78	92.75	19.48	16.50	84.67	17.13	13.75	80.30	12.17	6.51	53.52

Table II

*Adsall Planting.**Harvest Age 67 weeks.*

Variety	Population at harvest	Yield per acre tons	No. of Water shoots per acre	% of water-shoots in yield
Co 419	40080	63.73	1920	2.55
Co 658	41080	56.25	373	0.59
Co 647	51160	72.92	120	0.11
Co 678	38880	74.31	213	0.30
Co 685	46720	65.42	2720	3.60
Co 683	43360	63.10	187	0.20

Table No. III.

183-B

Variety	Population at harvest	Yield of cane per acre in tons	Average height of crop at harvest in ft.	No. of Water shoots per acre	Wt. of W. S. per acre in tons	% of Water shoots in yield	Average Wt. in lbs. per rft.		Laboratory Analysis								
							Normal cane	Water shoots	Normal Canes			Mid late water shoots			Late water shoots		
									Brix	Pol	Purity	Brix	Pol	Purity	Brix	Pol	Purity
Co 419	38240	65.15	10.41	993	1.02	1.57	0.48	1.11	21.77	18.85	86.58	11.53	6.70	58.10	9.60	3.78	39.37
Co 678	34880	63.45	11.92	227	0.26	0.40	0.59	1.05	18.03	15.58	86.41	11.07	6.11	55.19	9.92	4.78	48.18
Co 655	45280	52.65	9.58	526	0.38	0.71	0.46	0.72	17.48	12.31	70.42	12.24	5.69	46.48	11.21	4.93	43.97
Co 680	44240	50.80	11.50	1143	1.04	2.49	0.49	0.81	17.39	12.10	69.62	11.74	6.55	55.99	10.95	5.42	49.49
Co 658	42760	49.30	11.00	450	0.38	0.76	0.48	0.83	21.37	16.36	76.55	14.89	9.58	64.34	14.62	7.44	50.88
Co 685	54480	57.65	11.25	4256	3.72	6.46	0.53	0.70	19.00	14.71	77.42	15.01	9.79	65.22	13.82	8.34	60.35
Co 683	42280	54.30	12.00	1256	1.13	2.09	0.41	0.91	21.72	19.17	88.26	16.34	10.19	62.36	14.50	7.22	49.79

Table IV

Adsali Planting

Harvest age - 18 months

Average height in ft.	EARLY WATER SHOOT Girth in inches			No. of internodes	Weight in lbs per rft.	Average height in ft.	MID LATE
	Bottom	Middle	Top				Girth
8.25'	6.75	4.50	4.0	20	0.81	7.16'	6.0
9.16'	6.25	4.75	4.0	22	0.87	7.08'	6.25
8.83'	6.00	4.75	3.75	26	0.94	6.75'	6.0
9.33'	6.50	5.00	4.25	20	0.96	6.66'	6.25
8.25'	6.75	5.50	4.25	19	0.85	6.66'	6.00
8.58'	5.75	4.50	4.25	23	0.85	6.66'	5.50

Table VIII

Observation made in adsali crop at harvest (18 months)

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12th Convention 1955

Studies in the causes of High Production of Molasses at Sakarwadi

By

D. P. KULKARNI

Introduction

Sugar loss in molasses is by far the most important of all the losses encountered in sugar manufacture inasmuch as it represents about 50% of the total loss in process. In view of its influence on the efficiency of process this loss is of vital importance from the point of view of chemist. Molasses loss is a function of both quantity and quality of molasses produced. Whereas purity of molasses is dependent on the nature of non-sugars, as well as the methods of boiling and crystallisation practised, the percentage of molasses is mostly determined by the quantity of non-sugars present in the juice. It has been pointed out previously by Khanna et al (*1*) that the molasses loss is directly correlated with the percentage of molasses. At Sakarwadi for the last several years percentage of molasses has been higher than in the neighbouring factories or other factories in the Deccan and high production of molasses has naturally resulted in high sugar loss in molasses. In the season 1954-55, in particular, the problem of high production of molasses became more serious in the latter part of the season and the percentage of molasses and consequently the loss in molasses shot up suddenly in the month of March and continued to be high till the end of the season. Data regarding the molasses percent cane and molasses loss have been presented in table no. 1, while in table No. 2 molasses percent and molasses loss have been given monthwise for the last seven years.

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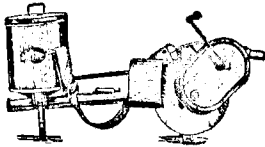
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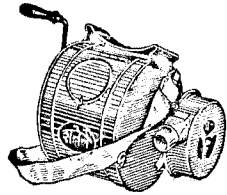
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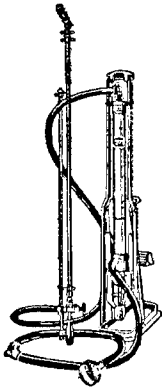
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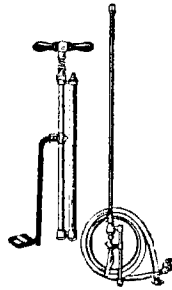
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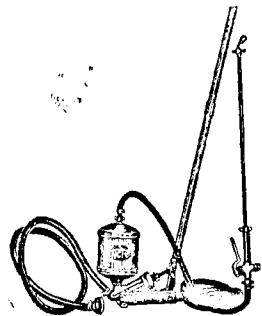
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Table 1

S. No.	Season	Molasses % cane	Purity F. M.	Sugar loss in molasses % cane	Sugar loss in molasses % sugar in cane	Molasses % cane for B'bay State
1.	1939-40		32.43			
2.	1940-41	3.88	32.00	1.21	10.12	
3.	1941-42	3.80	32.78	1.22	10.22	
4.	1942-43	3.42	32.58	1.12	8.57	
5.	1943-44	3.60	32.34	1.16	8.44	
6.	1944-45	4.01	32.29	1.29	9.86	
7.	1945-46	5.07	31.92	1.53	11.69	
8.	1946-47	4.057	32.97	1.29	9.85	
9.	1947-48	4.37	33.27	1.41	10.29	
10.	1948-49	4.31	33.38	1.38	10.47	3.87
11.	1949-50	3.82	31.51	1.20	8.44	3.64
12.	1950-51	4.16	33.79	1.33	9.88	3.61
13.	1951-52	4.29	33.35	1.37	10.43	4.05
14.	1952-53	3.86	34.74	1.27	9.22	3.76
15.	1953-54	4.22	35.55	1.41	10.12	
16.	1954-55	4.432	35.24	1.48	10.98	

Table 2

Molasses % Cane

No.	Season	November	December	January	Feb.	March	April	May
1.	1949-50	5.29	3.96	3.80	3.68	3.81	4.19	
2.	1950-51	4.43	4.15	4.03	3.77	4.37	4.50	
3.	1951-52	5.01	4.09	4.04	3.73	4.13	4.89	5.27
4.	1952-53		3.66	3.46	3.98	4.16	4.55	
5.	1953-54		4.26	4.41	4.00	4.26	4.14	
6.	1954-55	4.77	4.33	4.07	4.23	4.62	4.72	5.323

Nature of the Problem

It will be observed from table No. 1 that molasses % cane at Sakarwadi has been higher than the average for Bombay Deccan by about 5 to 10%. It will also be seen from table No. 2 that in the month of November due to immature condition of the cane as also after the month of March when cane has already passed the maturity stage, the percentage of molasses has been abnormal.

It would be interesting to compare the figures of theoretical percentage of molasses with those of actual production as given in table No. 3. Theoretical percentages of molasses have been calculated on the basis of non-sugars in clarified juice. Perusal of data in table No. 3 shows that whereas in previous years the calculated molasses percentage used to be lower than the actual by about 2 to 8% in the last two seasons, (viz. 1953-54 & 1954-55) actual production has exceeded that, expected on the basis of input of non-sugars in the process, by 9.9 and 8.05 percent respectively.

Table 3
Calculated and Actual Molasses

No.	Year	Molasses % cane actual	Molasses % cane calcu- lated	Mol. produced Mol. calcu- lated	Difference be- tween calculat- ed & actual
1.	1940-41	3.88	4.93	78.70	- 21.30
2.	1941-42	3.80	4.22	90.09	- 9.91
3.	1942-43	3.42	3.61	94.41	- 5.59
4.	1943-44	3.60	3.64	98.92	- 1.08
5.	1944-45	4.01	4.03	99.50	- 0.50
6.	1945-46	5.07	4.43	114.45	+ 14.45
7.	1946-47	4.057	4.01	100.99	+ 0.99
8.	1947-48	4.37	4.76	91.72	- 8.28
9.	1948-49	4.31	4.85	91.40	- 0.60
10.	1949-50	3.82	4.35	87.68	- 12.32
11.	1950-51	4.16	4.29	97.52	- 2.48
12.	1951-52	4.29	4.16	103.15	+ 3.15
13.	1952-53	3.86	4.07	95.00	- 5.00
14.	1953-54	4.22	3.84	109.90	+ 9.90
15.	1954-55	4.43	4.10	108.05	+ 8.05

It was therefore necessary to study the causes of high production of molasses in details and work was therefore undertaken with a view to finding out if any molasses was formed in the process. Any molasses formation in the process could take place if non-sugars were introduced at any stage of the process from outside. This possibility has, however, to be ruled out since except during clarification the juice syrup and molasses do not come into contact with any reagents which are likely to get absorbed thereby increasing their non-sugar content. Another possibility is that sucrose itself might get decomposed giving rise to products which find their way in molasses, thus increasing its quantity. The only reaction which can cause decomposition of sucrose to such an extent as to affect the quantity of molasses is its hydrolysis under the action of heat and acid. As is well known inversion or hydrolysis of sucrose transforms it into glucose and fructose which being uncrystallisable under conditions of sugar manufacture

go to increase molasses. Attempts were therefore directed towards studying the extent of inversion taking place at each stage of manufacture.

Previous Work

According to temperature inversion curves of Stadler (2) at temperatures from 70 c to 75 c and pH values of 5.4 to 6.0 about 0.1 percent sucrose is inverted per hour. McAllep, Cook & Baumonti (3) have found that acidity develops on heating pure sucrose solutions with an initial pH of 7.0. This according to them is associated with inversion. Chaturvedi and Kushwaha (4) have shown that in the case of pure sucrose solutions sucrose is inverted to the extent of 0.07% at pH 5.85 and temperature 70°C within 4 hours. In their experiments with juices (5) however they found that at 70° c sucrose inversion is negligible at pH 6.3 and above. It has been stated in literature (6) that the presence of neutral salts lowers down the rate of inversion. Of course the extent of inversion depends on the ash content of the particular product and also the constituents of ash. As far as reducing sugars are concerned, fructose is highly sensitive to heat even at pH below 7. One percent fructose solution undergoes decomposition in 12 hours when pH of the solution is 6 but at 7 pH for the same amount of destruction 126 minutes are required (7).

pH and temperature in sugar manufacture

At low pH sucrose gets hydrolysed, while the reducing sugars are fairly stable, on the other hand at high pH (> 7) sucrose is quite stable but reducing sugars undergo decomposition. High temperatures in any case accelerate the decomposition reaction. In the normal sulphitation process with simultaneous liming and sulphitation 7 pH i. e. a neutral condition is aimed at to avoid both inversion and decomposition of reducing sugars. During concentration, in evaporator the juice which is at 6.9-7.0 pH is boiled under vacuum so that temperatures are low and inversion is avoided. The syrup is then treated with sulphur dioxide gas so as to bring down its pH to 5.4 or so. This sulphited syrup is concentrated in vacuum pans further at about 70 C for crystallising out sucrose. All the pan operations which involve boiling of syrup and molasses, are carried out at about 70 C under vacuum, pH remaining near about 6.0; pH of the final mother liquor emerging out of the last phase of operation is about 5.5 or 6.0. It is thus obvious from above that conditions of temperature and acidity are so maintained in all stages of the process, as to avoid any destruction of sucrose or reducing sugars.

In clarification, juices are subjected to the action of lime, sulphur dioxide and heat. Here both pH and heat play an important part in deciding the decomposition of sucrose and reducing sugars. In the evaporator the juice, which is invariably neutral, is boiled in the first vessel usually at atmospheric pressure and subsequently under reduced pressure. It is therefore the effect of heat which is important at this stage. In syrup sulphitation the temperature is

near about 60°C but the pH plays the main role in effecting changes in reducing sugar content. In the latter stages of the process however i. e. during pan boiling heat is the only agent which brings about decomposition of sugars. In any case, of course, time is an important element and longer the duration of contact with heat or acid and alkali larger will be the amount of decomposition.

Just as we have to guard against sucrose decomposition, we have to avoid destruction of reducing sugars also, in so far as it leads to poor exhaustion of molasses and results in formation of undesirable products which inhibit the rate of crystallisation.

Study of the changes in reducing sugars at various stages is thus expected to throw light on the sucrose decomposition taking place in the process. Importance of inversion from the point of view of assessing the extent of molasses formation in the process being thus evident it was decided to carry out inversion studies at every stage of the process.

Methods Adopted.

Some standard basis has to be adopted for finding out invert sugar increase or decrease so that all results are expressed on that basis. The essential condition, which governs the choice of such a standard is that it should remain constant during a process or a particular stage of the process. Sucrose basis is unreliable because sucrose itself undergoes decomposition under certain conditions. Brix basis is unscientific for investigations with low purity products, in that as is well known, indications of dry substances by brix percent in products with low sucrose content are absolutely incorrect, and are subject to variation even with dilution. Higher the concentration of non-sugars in a particular sugar house product larger are the deviations of brix from dry solids. As for ash percent, it changes during clarification and hence is of no use as far as clarification stage is concerned. Chloride would be an ideal standard since it remains unchanged throughout the process, but the chloride estimation has been found to involve much difficulty and probably only potentiometric titrations against standard silver-nitrate solution might give correct values of chloride content of juices and molasses.

In view of the impracticability of selecting one standard for the whole process it would be necessary to adopt different standards at different stages. Brix can be safely used as standard on which to base the results of reducing sugar estimation for comparison at the clarification stage as well as at evaporator stage because changes in brix caused by changes in purity alone are of little magnitude. Each unit change in purity will mean a change in brix percent by about 0.2 which in turn would affect the results expressed as percent brix by about 0.05. Moreover in sulphitation process the rise in purity, if any, is very little, particularly so with juices of Bombay Deccan. All these considerations, therefore, justified adoption of Brix as standard for expressing results of analysis upto syrup sulphitation stage. Ash content in the whole process after concentration of juice remains

constant, removal of ash in the form of scales on the heating surface of pans being negligible as compared to the total ash content of syrups and molasses. Ash percent was therefore selected as standard for carrying out inversion studies in the boiling process.

Sampling and analysis.

In the case of juices, preservation was done by the addition of mercuric chloride at the rate of 0.5 gm per litre. It has been shown previously by Gundu Rao and Kulkarni (8) that under conditions obtaining in the Deccan cane juices can be preserved for 10 hours by the addition of 0.5 gram of mercuric chloride. That the syrup does not deteriorate on keeping for 24 hours was verified by conducting a few experiments in which syrup samples were kept and analysed at regular intervals upto 30 hours. Syrup and molasses samples were composited for 24 hours and analysed for Brix, Pol, Purity, Reducing Sugars and Ash. Reducing sugars were estimated by Eynon and Lane method and sulphited ash was found by following the standard procedure. This series of analysis was carried out for two weeks.

As regards sampling at evaporator, the incoming juice and outgoing syrup were continuously sampled for a period of 4 hours each time and samples analysed in the laboratory.

Changes of Reducing sugars in the Process.

Clarification:— At Sakarwadi simultaneous liming and sulphitation process is followed with superphosphate addition to make up for the phosphate deficiency. The juice heated to about 150°F goes to sulphitation vessels for clarification where it is treated in batch operation. The time of reaction is about 10 minutes.

Samples of juice were drawn from hot juice receiving tank and also from the sulphitation tanks after the same juice had been treated with lime and sulphur dioxide. The treated juice was heated in the laboratory to boiling, filtered and the clear juice analysed along with the untreated juice. It will be seen from table No. 4 that during liming and sulphitation treatment, some reducing sugars are destroyed, the extent of decomposition being 0.198 percent brix. This, however, seems inevitable and can be ascribed to the effect of local alkalinity caused by lime.

Evaporation and Syrup Sulphitation:— Data in Table No. 5 pertaining to the composition of juice before and after concentration in the evaporator shows clearly that there is definitely some inversion taking place in the evaporator resulting in higher invert sugar percent brix in the syrup than in the juice entering evaporator. The invert sugar percent brix has increased by 0.259%. During sulphitation of this syrup there is further decomposition of sucrose to the extent of 0.388% brix as shown by data in table No. 6. The overall increase in reducing sugar percent brix at both these stations is therefore 0.647.

Pan Boiling :— At Sakarwadi, A Massecuites are boiled in Fletcher centre flow pans while B and C massecuites are boiled in Skoda pans. All the pans have good circulation and there is no possibility of any pockets remaining stagnant in the pans in contact with heating surface thereby causing decomposition of sugars. Table No. 7 throws light on the amount of inversion taking place in the pans in different stages of boiling.

Study of the above table reveals that in A boiling considerable amount of inversion has taken place as shown by the invert sugar/ash ratio which has increased from syrup to A heavy by 0.21. From A heavy to B heavy there is slight decrease in the reducing sugar/ash ratio which indicates that instead of sucrose probably a part of reducing sugar has been decomposed. In C boiling the ratio has further decreased thereby showing positive destruction of reducing sugars. In all the three stages thus there has been a net decomposition of sucrose expressed in terms of invert sugar/ash ratio by 0.21.

Discussion of the results.

During clarification sucrose undergoes no change whereas reducing sugars are to some extent decomposed under conditions of local alkalinity. In the evaporator there is increase in reducing sugar content of the juice. Besides other factors, low vacuum has probably been partly responsible for this inversion. In syrup sulphitation also further inversion has taken place. How far this inversion can be attributed to pH and temperature is a matter which requires further investigation. The total increase in reducing sugar content upto syrup sulphitation amounts to 0.647 percent brix. When expressed on percent cane this means that there is extra molasses formation by 0.116% cane.

In the boiling process, there is increase in reducing sugars in A boiling only. The possible causes which might have contributed towards inversion are:

(i) *Time of boiling* :—Massecuites used to boil for about 6 to 10 hours in the pans. Thus it is likely that the time element has played an important part in bringing about the inversion. Sucrose in syrups which had a low pH of 5.4 or so when in contact with heat for such a long time is likely to get inverted.

(ii) *Low vacuum* :—The pans used to boil at 22½ to 23" vacuum with the result that the temperature of massecuites at the time of strike used to be above normal.

When massecuites are boiled for making big grains there is always certain amount of recirculation of sugars. Particularly when both quality and big sized grain are desired it is necessary to reboil quite a good amount of sugar. Whether this contributes to the inversion taking place in the pan and if so to what extent it does so, is a matter which calls for detailed investigation.

In B and C boiling there is no indication of any sucrose inversion. The time of boiling of B massecuites was about 5 hours per strike and it appears that neither time nor pH favoured any substantial decomposition of sucrose or reducing sugar. In C boiling there is definite evidence of reducing sugar destruction. C massecuites require about 12 hours from graining upto dropping the pan. Here the concentration of sucrose is much less and that of mineral matter and reducing sugars much higher than in the case of A massecuites. Time and temperature appear to have been responsible for the destruction of reducing sugars. It is however likely that in B and C boilings also some sucrose has inverted but since reducing sugar destruction has taken place the extent of inversion could not be assessed.

In the boiling process thus there has been 0.21 increase in the reducing sugar/ash. This increase has contributed towards formation of extra molasses by 2.3% taking into account average ash content of molasses which is 10.96. Thus the total increase in molasses percent caused by decomposition of sucrose resulting in the formation of invert sugar in the whole process is $2.30 + 2.35 = 4.65$ and this when expressed on percent cane comes out to be 0.22.

Thus it will be obvious from the above discussion that only 4.65 percent of the total molasses produced can be explained as being due to inversion alone.

Purity of final molasses

Another factor which deserves attention so far as high molasses production is concerned is the purity of molasses. It is important to know the contribution of rise in molasses purity towards increase in percentage of molasses. In the season 1954-55 the molasses purities also went high along with its percentage from the month of March. All possible efforts were made to bring down the purities by tightening control at every stage of boiling and curing but owing to certain limitations set in by the equipment and also due to some unknown reasons connected with the composition of juices the attempts did not succeed. The average analysis of molasses for the season 1954-55 is

Bx.	Pol	Purity
94.83	33.42	35.24

As compared to results of the past, this purity is higher by two units. That the molasses quantity would have been lower by 3 percent if the purity had been lower by two units can be shown by following calculations.

Bx	Pol	Purity	Nonsugar	Water
94.83	33.42	35.24	61.41	5.17

Keeping non-sugars constant for 33.24 purity the pol percent would be

$$\frac{5}{5+61.41} = 33.24$$

$$5 = \text{pol per cent molasses} = 30.58$$

The composition of molasses would be

$$\begin{array}{r} \text{Non-sugar} = 61.41 \\ \text{Pol} = 30.58 \\ \text{Total Brix} = 91.99 \end{array}$$

Water content corresponding to this brix can be calculated from the water content of the present molasses.

$$5.17 \times \frac{91.99}{94.83} = 5.01$$

The total molasses quantity would be

$$\begin{array}{r} 91.99 \\ +5.01 \\ \hline 97.00 \end{array}$$

i. e. less by 3 percent.

It has already been pointed out that whereas in previous years the actual molasses percent used to be less than that theoretically calculated on the basis of non-sugars, in the last two seasons i. e. 1953-54 and 54-55 the actual production has exceeded the expected production by 9.90 and 8.05% respectively. It has however been possible to explain part of this difference on the basis of inversion taking place in the process. In view of the fact that theoretical calculation of molasses is based on Brix and Pol values of molasses and the nonsugars resulting therefrom, it is difficult to rely on this basis particularly in the light of Eric Powels (9) finding that there is no correlation between true and apparent purities.

Summary

The causes for high percentage of molasses at Sakarwadi were investigated and one single factor viz. inversion which is most important and has a great bearing on the formation of molasses in the process was followed up closely. It was found, as a result of these studies that inversion can account for only 4.65% of the total molasses produced. Effect of rise in purity has also been shown to increase the percentage of molasses by three. Both these factors however have to be carefully examined in details and it requires further study to elucidate the causes and nature of inversion taking place. Similarly the composition of juices deserves critical examination in so far as it influences the purity of final molasses. Although high initial non-sugar content of juice is the primary cause of high molasses production, the factors mentioned above cannot be said to play an insignificant part in increasing molasses loss. It is therefore proposed to deal with this problem from various angles again.

The author acknowledges with thanks the help rendered by Shri. V. A. Bapat in carrying out analysis.

Table No. 7

193-B

Analysis of daily composite samples of Syrup, A. Heavy, B. Heavy and Final Molasses

Date	SYRUP						A. HEAVY					
	Brix	Pol.	Pty.	R. S.	Ash %	R. S./Ash:	Brix	Pol.	Purity	R. S.	Ash	R. S./Ash
12.4.55	63.52	54.41	85.65	3.258	1.6178	2.014	76.53	51.27	66.98	10.86	5.042	2.153
13.4.55	69.07	58.11	84.13	3.510	1.803	1.951	87.27	56.76	65.04	9.655	4.571	2.112
14.4.55	62.13	53.01	85.32	2.921	1.850	1.579	88.53	55.28	62.44	9.575	4.910	1.95
15.4.55	66.00	54.84	83.09	3.550	1.809	1.963	85.35	55.94	65.55	11.345	6.028	1.881
16.4.55	60.45	50.97	84.32	3.015	1.515	1.990	86.88	54.95	63.25	11.95	5.451	2.192
17.4.55	61.44	49.11	79.93	3.412	2.179	1.567	84.89	57.09	67.25		9.083	
19.4.55	64.23	54.51	84.87	3.038	1.76	1.726	83.37	55.76	66.88	9.661	5.43	1.779
20.4.55	58.77	49.32	83.92	2.953	1.506	1.961	85.80	56.86	66.26	10.982	5.18	2.12
21.4.55	66.66	56.25	84.38	4.291	1.77	2.424	67.10	54.27	65.53	12.25	4.81	2.547
22.4.55	57.06	48.03	84.17	3.77	1.82	2.071	86.25	56.88	65.95	12.37	4.72	2.621
23.4.55	60.45	50.22	83.07	3.694	1.663	2.221	90.30	61.84	68.45	10.735	4.731	2.268
Average						1.951						2.1623

Table No. 7 (Contd.)

Date	B. HEAVY						FINAL MOLASSES					
	Brix	Pol.	Pty	R. S.	Ash	R. S/Ash:	Brix	Purity	R. S.	Ash	R. S/Ash	
12.4.55	86.99	46.28	53.20	14.75	8.051	1.832						
13.4.55	92.16	47.25	51.27	14.58	7.173	2.033	94.8	35.65	21.93	10.27		2.135
14.4.55	90.05	44.89	49.85	16.25	8.642	1.88	94.6	34.99	22.496	11.29		1.992
15.4.55	93.30	49.32	52.86	19.616	8.706	2.253	94.40	34.53	22.11	10.90		2.029
16.4.55	97.78	47.98	49.07	18.92	8.134	2.326	94.90	34.88	21.90	11.42		1.917
17.4.55	95.94	46.84	48.83	17.41	8.43	2.065	96.00	35.52	23.55	10.84		2.173
19.4.55	95.13	48.64	51.12	16.584	8.75	1.895	95.4	35.22	22.99	11.005		2.089
20.4.55	97.43	48.5	49.78	18.01	8.27	2.177	95.20	35.81	22.49	11.54		1.949
21.4.55	92.62	63.49	45.51	18.582	7.63	2.435	94.90	36.25	21.82	11.467		1.903
22.4.55	83.20	40.80	49.04	16.85	8.624	1.953	94.60	35.20	21.92	11.12		1.971
23.4.55	96.26	47.59	49.44	18.518	7.50	2.469	94.70	36.83	21.75	10.18		2.130
24.4.55							94.30	36.90	22.59	10.80		2.091
25.4.55							94.20	36.73	22.21	10.71		2.073
Average						2.12				10.96		2.038

The author's thanks are due to Shri. R. N. Agarwal, Chief Chemist and Shri. A. L. N. Moorthy, Manager of G. S. Mills Ltd. Sakarwadi for their encouragement and kind interest in the above work.

I also express thanks to the Managing Agents of G. S. Mills Ltd for giving necessary facilities for the above work.

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Report on Prize Plot Competitions.

Planting Season 1953-54]

[Harvesting Season 1954-55

With a view to study the potential capacity of Deccan Soils and Sugar-cane Cultivation two Prize Plots' Competitions were continued this year also. One Competition was for the Bombay State Prize and the other was for a Prize offered by Seth Gulabchand. Detailed Rules and Regulations governing the competitions are given in Appendices 1A and 1B.

The following entries were received for the Competitions.

<i>Entrant</i>	<i>Bombay State Prize</i>	<i>Seth Gulabchand Prize</i>
(I) The Phaltan Sugar Works Ltd.		
1) Messrs. V. S. Deshpande and B. A. Padhye.	One Acre	Ten Acres
2) Messrs B. V. Karkhanis and Shah.	"	"
3) Messrs. V. S. Vaishampayan and B. A. Kulkarni.	"	"
(II) The Godavari Sugar Mills Ltd. (<i>Sakarwadi</i>)		
4) Shri G. D. Patel	"	"
- do -		"
- do -		"
(III) The Godavari Sugar Mills Ltd. (<i>Laxmiwadi</i>)		
5) Shri G. D. Patel	"	"
- do -		"
(IV) The Walchandnagar Industries Ltd.		
6) Shri N. K. Athavale	"	"
7) " K. J. Deshpande	"	"
8) " K. B. Nadgauda	"	"
9) " K. C. Kapadia	"	"
10) " V. T. Chaugule	"	"
11) " V. V. Kulkarni	"	"
12) " S. B. Limaye	"	"
13) " G. M. Godbole	"	"
14) " S. G. Sapre	"	"
15) " B. D. Katage	"	"
	<hr style="width: 100%; border: 0.5px solid black;"/>	<hr style="width: 100%; border: 0.5px solid black;"/>
	15 Plots in all	18 Plots in all

The harvesting of plots was undertaken from 3rd week of January 1955 to 1st week of March 1955 with the usual methods of supervision and control. The Association is very much thankful for the hearty co-operation rendered by the following Companion Members in sparing supervising units for harvesting of Prize Plots.

- 1) The Phaltan Sugar Works Ltd.
- 2) The Walchandnagar Industries Ltd.
- 3) The Nizam Sugar Factory Ltd.
- 4) The Brihan Maharashtra Sugar Syndicate Ltd.
- 5) The Ravalgaon Sugar Farm Ltd.

The Association is also thankful to the members of the supervising units for their careful and zealous work.

Two of the Competitors Messrs. S. G. Sapre & B. D. Katage withdrew from the Competitions before the beginning of harvest. Of the remaining plots, 9 were withdrawn from the Bombay State Prize Competition and 8 were withdrawn from Seth Gulabchand Prize Competition. The detailed results of the remaining 4 plots for Government Prize Scheme and 8 plots for Seth Gulabchand Prize Competition are given in the Appendices 2 to 7.

1) *Soils*:—The harvested Prize Plots were planted in soils of A, B, C & D types of soil. Further details of this will be found in the Appendices 3A & 3B. It is thus seen that growing of Prize Plots was not restricted to any particular type of soil.

2) *Furrow Width*:—The furrow widths adopted in plantings were only two, i. e. 3' and 3½'. The furrow width arrived at appears to be a result of previous experiences.

3) *Planting Length*:—The planting length per acre varies from 11000' to 14520'. The yields appear to be associated to a certain extent with the planting lengths.

4) *Manures*:—Sheep-folding was practiced by only three of the Competitors in case of Ten acre plots and by one Competitor for one acre plot.

The quantities of F. Y. M. and Compost applied show variations from 20 to 91.5 pharas per acre. Only one of the plots had received previous Green Manuring with sann. Ash and Pressmud cakes were also used as bulky Manures.

In the other organic Manures ground-nut cake forms the major portion. The quantities applied per acre varied from less than a ton to well over 6 tons. Castor cake has also been used in some of the plots, especially by one Competitor Shri G. D. Patel in sufficiently large quantities of nearly 6 tons per acre. This was probably done with a view to obtain high sugar percentage. Certain cake mixtures were also used in a few cases.

In the inorganic manures sulphate of ammonia and superphosphates were mostly used by almost all the Competitors. For supplementing potash, sulphate of potash was used by some of the Competitors.

Sodium Nitrate has been used by only two of the Competitors for supplementing other Nitrogenous Manures.

Full details of manuring are given in Appendices 6A & 6B. It is noteworthy that a single variety, Co 419, was used to plant all the Prize Plots.

5) *Botanical Observations*:—Botanical observations for the various plots are given in Appendices 5A and 5B. The number of millable canes per acre varies from as low as 31900 to 77000. The variation is very wide and unusual. Most of the plots showing better yields are obviously those having larger plant population. Average cane heights recorded are as low as 8'-8" and very few plots have had average height above 13'. As can be expected from the heavy Manure application a very small percentage of arrowed canes is seen in the Prize Plots except in the case of one plot of Shri G. D Patel where the number of arrowed canes exceeds that of non-arrowed ones. The number of Water-Shoots is generally very high. A phenomenal figure was noted in the case of Shri K. B. Nadgauda's plot where nearly 1/3rd of the canes were Water-Shoots and they weighed as much as 32 tons, of the total plot yield of 112 tons.

6) *Yields*:—Details of cane and sugar yields per acre are given in Appendices 4A and 4B.

The cane yields per acre vary from 75 to 106.5 tons in the case of one acre plots while as in the case of ten acre plots they vary from 72.71 to 91.04 tons. Yields of sugarcane on the whole are very much below the normal expectations. It would be interesting to ascertain the various causes that have affected these yields. Rat trouble, resulting in a very large number of dead canes is given as one of the reasons of low yields. Seasonal variations particularly the heavier rainfall seem to have adversely influenced the cane yields.

Yields of sugar per acre range from 8.33 to 12.59 tons in the case of one acre plots while as in the case of ten acre plots they vary from 8.587 to 11.987 tons. Messrs Karkhanis and Shah of the Phaltan Sugar Works Ltd., very narrowly missed the mark of 12 tons sugar per acre to qualify for Seth Gulabchand Prize.

7) *Cost*:—Appendices 7A and 7B give details of cost of cultivation in the case of various prize plots. The cost of cane per ton varies from Rs. 27-4-0 to Rs. 47-6-0. It is probably the low cane yields that have caused this steep rise in the cost of cane per ton.

Sd/ P. M. Govitrikar
Hon. Secretary

D. S. T. A.
12th Convention 1955

APPENDIX NO. 1-A

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (India)

RULES AND CONDITIONS FOR SUGARCANE PRIZE PLOTS, BOMBAY STATE PRIZE

Planting season 1953-54]

[Harvesting season 1954-55

1. **Objects:**—Object of the competition is to encourage raising of maximum crop of sugarcane and available sugar per acre in the Deccan either on canal or Lift Irrigation.

2. **Prize:**—The Government of Bombay have kindly agreed to give Rs. 2,000/- as prize to any sugarcane grower in the Bombay State who will produce 125 tons or above sugarcane per acre with a minimum recovery of 11.5% of cane. In case, none of the competitors is able to achieve the above targets, both for tonnage and recovery, a prize of Rs. 1,000/- may be given to one who produces maximum quantity of 125 tons of sugarcane only, irrespective of the sugar recovery.

The Deccan Sugar Technologists' Association will conduct the competition. For this purpose, the Association will appoint a Committee on which the Sugarcane Specialist will be nominated member nominated by the Government.

3. Conditions of the Competition.

(1) Any sugarcane grower, who wants to take part in this competition should apply to the Secretary, D. S. T. A. in the proper form. He should be a member of the Association.

(2) The entry fee for every plot entered for competition will be Rs. 100/- payable in advance.

(3) Every competitor should submit every month to the Secretary, D. S. T. A., Labour Allocation Sheets duly filled in. Any competitor who fails to supply the information regularly will be disqualified for the prize. Along with the application form every competitor should send a sketch of the plot and also the form for plot history duly filled in.

(4) A competitor should grow one acre sugarcane in one block of a survey No. or a group of survey Nos. and this should be marked separately by bunds according to the rules of the Irrigation Department of the Bombay Province. The measurement of the plot will be taken after harvest and the area should not measure more or less by $1\frac{1}{2}$ gunthas. For final results, outturns of such areas will be calculated on one acre. If the area is less or more than the permissible limit of $1\frac{1}{2}$ gunthas it would disqualify the competitor. The water channels feeding this one acre and the inner bunds will be included while calculating one acre.

(5) A competitor can raise any crop either Adsali, Suru or Ratoon or plant any variety of sugarcane in the prize plot. The mixture of varieties upto 5% is permissible. He should adopt any method of cultivation, interculturing, manuring, etc.

(6) The harvesting will be done under the direct supervision of the representatives of the Committee appointed by the D. S. T. A. The date of harvesting should be informed to the Committee quite in advance so as to enable them to arrange to send their representative. One month's advance notice for harvesting a plot is essential.

(7) Watering of the crop should be stopped at least 10 days before the harvest.

(8) The candidates should supply well stripped clean cane free of tops, trash, soil, roots, etc. Topping should be done in such a way that no whorl is retained with the cane. Dry, seriously diseased or sour canes should be rejected.

(9) The maximum of 3 days would be allowed for harvesting one acre plots. Weighment will be done at any of the sugar factory weigh-bridges in the vicinity of the area of the competitor duly checked by the representatives of the harvesting Committee. While the harvesting of the prize plot is in progress the competitor is not to undertake the harvest in any area in the vicinity of his jurisdiction.

(10) The competitor will not be made known the figures of weighment of cane while harvesting of his plot is in progress.

(11) The competitor is expected to give all co-operation to the harvesting and inspecting staff and arrange for their conveyance, boarding, lodging etc. give them all facilities for inspection whenever they visit the prize plot.

(12) In order to know the quality of cane and to arrive at the figures of recoverable sugar, mill-test on 20 to 25 tons of cane per acre will be run and recovery of sugar will be calculated per acre.

(13) The Committee, on the completion of the harvest, will submit all the results to the Director of Agriculture who will recommend to Government the name of the competitor who should be awarded the prize of Rs. 2,000/- or 1,000/-.

Sd/ P. M. Govitrikar
Hon. Secretary, D. S. T. A.

APPENDIX No. 2-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Programme of harvesting of Bombay State Sugarcane Competition Plots.

S. No.	Factory	Area acres	Name of Competitor	Approximate date of harvest	Supervising Unit from	Staff			
						Manufacturing Officer	Harvesting Officer	Mukadam	Watchmen
1.	Phaltan Sugar Works Ltd. Sakharwadi.	1-0	Shri B. V. Karkhanis and ,, Shah	Third week of January 55	Walchandnagar Industries, Ltd.	1	1	2	1
2.	Godavari Sugar Mills Ltd. Laxmiwadi.	1-0	,, G. D. Patel	Second week of February 55	Ravalgaon Sugar Farm Ltd.	1	1	2	2
3.	Godavari Sugar Mills Ltd. Sakarwadi.	1-0	,, G. D. Patel	Third week of February 55	Nizam Sugar Factory Ltd.	1	1	2	2
4.	Walchandnagar Industries Ltd. Walchandnagar.	1-0	,, K. B. Nadgauda	Last week of February 1955.	Brihan Maharashtra Sugar Syndicate Ltd.	1	1	2	2

APPENDIX NO. 3-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Sugarcane Prize Plot Competition - Bombay State.

Statement showing the lie, topography and soil type of plots (Planting season 1953-54 and Harvesting season 1954-55).

Sr. No.	Name of Competitor	S. No and Village	Area planted	Colour of soil	Depth of soil ft.	Genetic soil type	Nearness to river	Slope from and to	Previous Crop	Depth of water Table Ft.	Direction of Furrows	Furrow width ft.	Total No. of Furrows
1.	Shri B. V. Karkhanis and Shah	135 136 Hol	1-0	Black	4	B	One mile from big Nallah	W to E and N to S	Jowar	More than 5 feet below	North South	3-0	1
2.	„ G. D. Patel	17 Rui	1-0	Black	2	A	3½ miles	N to S	Irrigated cane	5 ft. below	East West	3 1/3	1
3.	„ G. D. Patel	63 Wari	1-0	Brownish Black	3 to 4	B	4 furlongs	W to E and N to S	Sugarcane plant & half area Lucerne	Below 4 ft.	North South	3½	1
4.	„ K. B. Nadgauda	175 Kalamb	1-0	Brown Black	4	D	4 furlongs	E to W and N to S	Paddy	5	East West	3	1

APPENDIX No. 4-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Statement showing the cane yields and analytical data.

S. No.	Name of Competitor	Place	Survey No.	Area planted	Date of planting	Date of harvesting	Variety	Sugarcane Av. yield per acre tons	Mixed Juice			Pol % Cane	Fibre % cane	Recovery	Sugar per acre Tons
									Bx.	Pol.	Py.				
1.	Shri V. B. Karkhanis and Shah	Phaltan Sugar Works Ltd. Sakharwadi	135 136 Hol	1-0	2-8-53	17-1-55	Co 419	92.58	16.72	14.38	86.00	15.18	11.25	13.20	12.22
2.	G. D. Patel	Godavari Sugar Mills Ltd. Laxmiwadi	17 Rui	1-0	23-7-to 27-7-53	12-2-55	Co 419	75.0	15.86	13.13	82.79	13.06	10.74	11.11	8.33
3.	G. D. Patel	Godavari Sugar Mills Ltd. Sakarwadi	63 Wari	0-39	4-7-to 8-7-53	18-2-55	Co 419	79.89	16.00	13.30	83.12	12.57	13.10	10.65	8.50
4.	K. B. Nadgauda	Walchandnagar Industries Ltd. Walchandnagar	175 Kala- mb	1-0	—	5-3-55	Co 419	106.5	17.06	14.25	83.52	13.83	10.97	11.82	12.59

APPENDIX No. 5-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

Botanical observations of the Sugarcane Prize Plot Competition - Bombay State

Planting season 1953-54.

Harvesting season 1954-55.

S. No.	Name of the Competitor	Planted length per acre in ft.	No. of Millable Canes	Av. height of cane in feet	Wt. of canes in tons per acre (calculated)	Av. weight of cane in lbs.	Wt. per foot height in lbs.	Wt. of cane per planting foot in lbs.	No. of arrowed canes per acre (calculated)	Wt. of arrowed canes per acre in tons (calculated)	No. of non-arrowed canes per acre (calculated)	Wt. of non-arrowed canes per acre in tons (calculated)	No. of Water shoots per acre (calculated)	Wt. of water shoots p/a in lbs. (calculated)	No. of internodes p/a (calculated)	Av. girth of cane inches (calculated)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.	Shri B. V. Karkhanis and ,, Shah	14520	47190	10.0	84.42	4.0	0.4	13.0	8712	20.74	33396	57.24	5082	6.48	—	—
2.	,, G. D. Patel Laxmiwadi	12875	42487	13.2	78.7	3.8	0.29	13.7	4828	10.34	36050	62.9	1609	5.4	35.2	4
3.	,, G. D. Patel Sakarwadi	11300	38662	—	75.66	4.3	—	15.0	5356	22.19	5650	12.11	nil Cane pieces 22600	nil 75.46	—	—
4.	,, K. B. Nadgauda	14000	77000	9.4	112.03	3.2	0.34	17.9	6650	14.2	46200	65.7	24150	32.0	—	—

APPENDIX No. 6-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Statement showing manures used per acre for Sugarcane Prize Competition Plots - Bombay State
 Planting season 1953-54. Harvesting season 1954-55.

S. No.	Name of Competitor and place	Green Manuring	Sheep folding	F. Y. M. Pharas	G. N. Cake Tons	Castor cake tons	Mahoda cake tons	Press Cake Pharas	Ash Pharas	Soil Pharas	Am. Sulphate Tons	Single super-phosphate tons	Double super-phosphate tons + Sulphate of potash	Soda Nitrate tons	Bonemeal tons	Manure Mixture tons	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Karkhanis and Shah Phaltan	—	—	80	5.9	—	—	—	4	—	0.7	—	0.17	—	—	—	Sulphate Nitrate 0.05
2.	G. D. Patel 17 Rui Laxmiwadi	—	—	91½	2-12-64	—	—	—	—	—	0-2-8	1-16-70	—	0-2-88	—	—	Castor Cake Manure Mixture 0-18-24 G.N.cake Mixture 1-2-96
3.	G. D. Patel 63 Wari Sakarwadi	—	—	60½	0-12-56	5-19-72	—	—	2-4-72	—	0-4-56	1-9-56	—	0-12-0	0-1-0	—	—
4.	K. B. Nadgauda Walchandnagar	nil	2000 one night	40	6.14	nil	—	nil	nil	nil	0.75	0.43	nil	nil	nil	—	nil

APPENDIX NO. 7-A.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

*Statement showing the cost of cultivation per acre of Sugarcane Prize Competition Plots-Bombay State.
Planting season 1953-54. Harvesting season 1954-55.*

S. No.	Name of the Competitor	Place	Tillage and Harvesting	Bulky Manures	G. N. Cake and Fertilizers	Land rent	Irrigation Cess	Seed	Supervision	Sundry expenses	Per acre Total	Cost per ton of cane.
1	2	3	4	5	6	7	8	9	10	11	12	13
			Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs. a.p.	Rs.a.p.
1.	Karkhanis and Shah	Phaltan Sugar Works Ltd.	100-0-0	280-0-0	1576-8-0	75-0-0	150-0-0	100-0-0	nil	284-2-0	2928-3-0	32-9-9
2.	G. D. Patel	Godavari Sugar Mills Ltd. Laximiwadi	694-4-3	366-6-3	1883-8-6	21-0-0	255-0-0	216-0-0	48-12-0	23-13-0	3509-12-0	46-12-6
3.	G. D. Patel	Godavari Sugar Mills Ltd. Sakarwadi	722-0-0	243-3-0	2316-6-3	21-0-0	255-0-0	200-0-0	50-9-3	124-6-3	3932-8-9	42-2-3
4.	K. B. Nadgauda	Walchandnagar Industries Ltd.	63-0-0 170-0-0	162-0-0	2075-0-0	16-8-0	199-6-0	75-0-0	108-0-0	90-0-0	2946-0-0	27-4-0

APPENDIX 1-B

SETH GULABCHAND PRIZE

RULES AND CONDITIONS

As declared at the time of the 9th Convention of the Association held at Poona, a Prize of Rs. 1000/- (One thousand only) has been declared by Seth Gulabchand Hirachand on behalf of the Walchandnagar Industries Ltd., for producing the highest sugar per acre on 10 acre basis. The rules and regulations for growing such prize plots are as under:—

This Prize is for Planting Season 1953-54 and Harvesting Season 1954-55.

1. Sugar Factories and private sugarcane growers, who are members of the Deccan Sugar Technologists' Association will be eligible for taking part in this prize plot competition on the following conditions:

2. Factories growing 1200 acres of cane or more must grow at least 3 prize plots and those growing less than 1200 acres must grow at least 2 prize plots. Private Cultivators can grow only one plot.

3. The private cultivators taking part in the competition must be prepared to supply the cane grown in their prize plots to a Sugar Factory of their choice for crushing and test.

4. The area of the plot should be 10 acres in one compact block. It should not measure less by more than 5 gunthas i. e. the area should in no circumstances measure less than Acres 9-35. These plots which would measure less than 9-35 acres will not be taken into consideration.

5. For the purpose of prize plot, all the plots grown are eligible for the prize.

6. The entrance fee will be Rs. 100/- for each of the member factories, irrespective of the number of plots grown by them. For a private cultivator, the entrance fee will be Rs. 50/-.

7. Those who intend to take part in the competition, should send their application in the form prescribed by the Association before 30-6-1953. The entrance fee should also be sent with the application.

8. For becoming eligible for the prize, the prize plot should yield more than 12 tons of sugar per acre. The competitor, who will give the highest sugar above 12 tons, will get the prize.

9. Every competitor should send the monthly allocation sheets in the form prescribed by the Association with all the information contained in the form.

10. The rules regarding harvesting of the Prize plots and determining the sugar content will be published by the Committee in due time. The Technical Sub-Committee appointed by the Association will lay down the rules and regulations regarding the same.

11. The decision given by the Association will be final and binding on the competitor.

12. In order to enable the members to take part in the competition by growing these plots from June 1953, it is requested that all the factories and big Bagaitdars will take part in the competition and make the competition a success.

Note:—Forms of application will be supplied on request.

Sd/- **P. M. Govitrikar**
Hon. Secretary, D. S. T. A.

APPENDIX No. 2-B.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Programme of harvesting of Seth Gulabchand Sugarcane Competition Plots.

S. No.	Factory	Area Acres	Name of Competitor	Approximate date of harvest	Supervising Unit from	Staff			
						Manu- facturing	Harvest- ing Officer	Mukada- ms	Watch- men
1.	Phalatan Sugar Works Ltd.	10	Karkhanis & Shaha	Third week of January	Walchandnagar Industries	1	1	2	1
2.	Walchandnagar Industries Ltd.	10	K. C. Kapadia	Third week of February	Brihan Maharashtra Sugar Syndicate	1	1	2	2
3.	- do -	10	V. V. Kulkarni	Last week of February	Phaltan Sugar Works Ltd.	1	1	2	2
4.	- do -	10	K. B. Nadgauda	Last week of February and First week of March	Brihan Maharashtra Sugar Syndicate	1	1	2	2
5.	Godavari Sugar Mills Ltd. Laxmiwadi. 17 Rui.	10	G. D. Patel	Second week of February	Ravalgaon Sugar Farm Ltd.	1	1	2	2
6.	Godavari Sugar Mills Ltd. Sakarwadi. 63 Wari.	9-35	G. D. Patel	Third week of February	Nizam Sugar Factory Ltd.	1	1	2	2
7.	- do - - do - 393 Samvatsar.	10	G. D. Patel	First week of February	Nizam Sugar Factory Ltd.	1	1	2	2
8.	- do - - do - 160 Samvatsar	9-36½	G. D. Patel	Second week of February	Nizam Sugar Factory Ltd.	1	1	2	2

4.	K. B. Nadgauda	—	Co 419	88.43	19.86	17.06	85.90	17.88	14.98	83.78	14.47	11.01	12.38	10.95	13.13
5.	G. D. Patel Laxmiwadi 17 Rui.	23rd to 27th July 1953	Co 419	84.03	17.85	15.00	84.03	15.67	12.68	80.92	12.48	10.06	10.49	8.81	10.80
6.	G. D. Patel Sakarwadi 63 Wari.	4th to 8th July 1953	Co 419	83.33	18.33	15.60	85.11	16.34	13.60	83.23	12.73	12.64	10.76	8.966	11.25
7.	G. D. Patel Sakarwadi 393 Samvatsar	15th to 23rd July 1953	Co 419	81.65	18.68	15.96	85.44	16.80	14.00	83.33	13.35	12.23	11.27	9.20	11.40
8.	G. D. Patel Sakarwadi 160 Samvatsar	9th to 25th June 1953	Co 419	72.71	19.30	16.87	87.41	17.21	14.67	85.24	13.82	11.69	11.81	8.587	11.30

APPENDIX No. 5-B

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

Botanical observations of the Sugarcane Prize Plot Competition (Seth Gulabchand) Prize

Planting season 1953-54

Harvesting season 1954-55

Sl. No.	Name of the Competitor	Planted Length per acre in ft.	No. of millable canes	Average height of cane in feet	Weight of canes in tons per acre (calculated)	Av. weight of cane in lbs	Wt. per foot height in lbs	Wt. of cane per planting foot in lbs	No. of arrowed canes per acre (calculated)	Wt. of arrowed cane per acre in tons (calculated)	No. of non-arrowed canes per acre (calculated)	Wt of non-arrowed canes per acre (calculated)	No. of water shoots per acre (calculated)	Wt. of water shoots per acre (calculated)	No. of Internodes per cane
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APPENDIX No. 2-B.

1.	Karkhanis and Shaha	14520	46018	11'-1"	88.42	4.3	0.38	13.62	14292	36.64	26279	47.03	4348	4.69	27.7
2.	K. C. Kapadia	14000	75601	8'-11"	114.82	3.4	0.38	18.37	11112	21.89	47031	67.21	17456		25.72
3.	V. V. Kulkarni	14520	57438	12'-0"	100.00	3.90	0.32	15.43	12159	27.00	34935	58.45	10344	14.55	32.24
4.	K. B. Nadgauda	14000	63612	8'-8"	80.12	2.82	0.32	12.82	5500	12.01	43312	50.47	15487		19.14
5.	G. D. Patel 17 Rui.	12875	43245	13'-5"	102.05	5.28	0.39	17.75	5742	16.19	35412	81.37	2510	5.37	35.4
6.	G. D. Patel 63 Wari	11300	48165	—	86.64	4.03	—	17.17	7817	25.22	8287	18.13	1977 Cane pieces 20481	3.44 38.93	
7.	G. D. Patel 393 Samvatsar	11000	31900	11'-6"	67.03	4.7	0.41	13.6	11825	33.4	9212.5	20.00	1650 Cane pieces 9212	3.19 10.47	
8.	G. D. Patel 160 Samvatsar	11000	48950	11'-0"	89.91	3.92	0.36	17.4	8525	22.65	6325	25.16	1650 Cane pieces 23925	3.8 38.27	

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APPENDIX No. 7-B.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (
Statement showing the cost of cultivation per acre of Sugarcane
(*Seth Gulabchand Prize*)

54

Place	Tillage & Harvesting	Bulky Manures	G. N. Cake & Fertilizers	Land rent	Irrigation Cess	
	Rs.	Rs.	Rs.	Rs.	Rs.	
Phaltan	—	—	—	—	—	
Walchandnagar	67-0-0 260-0-0 327-0-0	153-0-0	1711-0-0	16-8-0	199-10-0	7
Walchandnagar	6264-3-0	3505-13-0	14748-9-0	25-0-0	194-0-0	18
Walchandnagar	233-0-0	162-0-0	2057-0-0	16.8	199.6	7 PE
Laxmiwadi 17 Rui.	695-4-6	366-6-3	1883-8-6	21-0-0	255-0-0	21 S
Sakarwadi 63 Wari	722-0-0	243-3-0	2316-6-3	21-0-0	255-0-0	20
Sakarwadi 393 Samvatsar	751-8-3	325-0-9	2164-2-3	21-0-0	255-0-0	18 IA,
Sakarwadi 160 Samvatsar	695-4-6	366-6-3	1883-8-6	21-0-0	255-0-0	21

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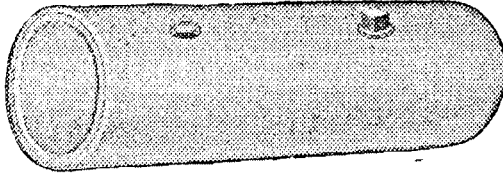
INDIA)
Prize Plots.

Harvesting season : 1954-55

	Seed	Supervision	Sundry expenses	Per acre total	Cost per ton of cane
	Rs.	Rs.	Rs.	Rs.	Rs.
	—	—	—	—	—
APPENDIX					
No. 2-R.					
5-0-0	108-0-0	110-0-0	2764-10-0	31-0-0	
6-0-0	846-0-0	nil	29400-9-0	32.3	
45.0	10.00	—	2753-0-0	31.3	
6-0-0	48-12-0	23-13-0	3509-12-0	41-12-9	
10-0-0	50-9-3	124-6-3	3932-8-9	47-6-0	
0-0-0	55-11-3	27-11-9	3780-2-3	46-10-6	
6-0-0	48-12-0	23-13-0	3509-12-0	41-12-9	

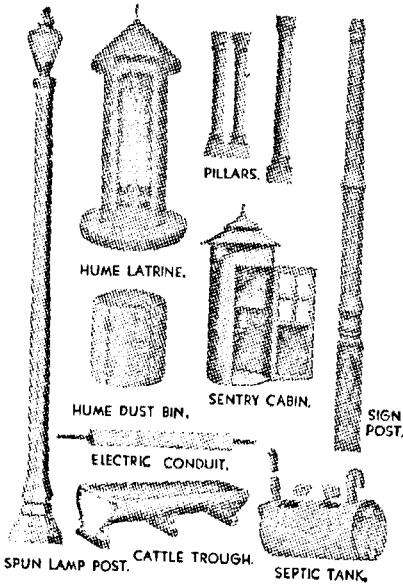
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Shri H. B. GIRME

Managing Director

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Managing Director

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THE HYDERABAD CONSTRUCTION Co. Ltd.
ABID ROAD. HYDERABAD (Dn.)

APPENDIX No. 7-B.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

Statement showing the cost of cultivation per acre of Sugarcane Prize Plots.

Planting Season · 1953-54

(Seth Gulabchand Prize)

Harvesting season : 1954-55

S. No.	Name of the Competitor	Place	Tillage & Harvesting	Bulky Manures	G. N. Cake & Fertilizers	Land rent	Irrigation Cess	Seed	Supervision	Sundry expences	Per acre total	Cost per ton of cane
			Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1.	Karkhanis & Shah	Phaltan	—	—	—	—	—	—	—	—	—	—
2.	K. C. Kapadia	Walchand-nagar	67-0-0 260-0-0 <u>327-0-0</u>	153-0-0	1711-0-0	16-8-0	199-10-0	75-0-0	108-0-0	110-0-0	2764-10-0	31-0-0
3.	V. V. Kulkarni	Walchand-nagar	6264-3-0	3505-13-0	14748-9-0	25-0-0	194-0-0	1846-0-0	846-0-0	nil	29400-9-0	32.3
4.	K. B. Nadgauda	Walchand-nagar	233-0-0	162-0-0	2057-0-0	16.8	199.6	75.0	10.00	—	2753-0-0	31.3
5.	G. D. Patel	Laxmiwadi 17 Rui.	695-4-6	366-6-3	1883-8-6	21-0-0	255-0-0	216-0-0	48-12-0	23-13-0	3509-12-0	41-12-9
6.	G. D. Patel	Sakarwadi 63 Wari	722-0-0	243-3-0	2316-6-3	21-0-0	255-0-0:	200-0-0	50-9-3	124-6-3	3932-8-9	47-6-0
7.	G. D. Patel	Sakarwadi 393 Samvatsar	751-8-3	325-0-9	2164-2-3	21-0-0	255-0-0	180-0-0	55-11-3	27-11-9	3780-2-3	46-10-6
8.	G. D. Patel	Sakarwadi 160 Samvatsar	695-4-6	366-6-3	1883-8-6	21-0-0	255-0-0	216-0-0	48-12-0	23-13-0	3509-12-0	41-12-9

APPENDIX No. 6-B.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA).

Statement showing manures used per acre for Sugarcane Prize Plot (Seth Gulabchand Prize)

Planting season 1953-54.

Harvesting season 1954-55.

S. No.	Name of the Competitor	Green manuring	Sheep folding	F. Y. M. pharas	G. N. Cake Tons	Castor Cake Tons	Maheda Cake Tons	Press Cake Tons	Ash pharas	Soil pharas	Am. Sulphate Tons	Single Super-phosphate Tons	Double Super-phosphate Tons	Sulphate of Potash Tons	Soda Nitrate Tons	Bonemeal Tons	Manure mixtures Tons
1.	Karkhanis and Shaha	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2.	K. C. Kapadia	nil	500 sheep 5 days	20 and 20 pharas Com-post 53.7	4.86	1/4	—	—	—	—	0.6	0.5	—	—	—	—	—
3.	V. V. Kulkarni	—	—	—	4.3	1.9	—	17	—	5½ bags	1	—	—	—	—	—	—
4.	K. B. Nadgauda	nil	2000 one-night	40	6.14	nil	nil	nil	nil	nil	0.75	0.43	nil	nil	nil	nil	nil
5.	G. D. Patel 17 Rui	—	—	91½	T.Cwt.lb. 2-12-64	—	—	—	—	—	T. Cwt. lb. 0-2-8	T. Cwt. lb. 1-16-70	—	T. Cwt. lb. 0-2-88	—	—	C. Cake = 0-18-84 G. Cake = 1-2-96
6.	G. D. Patel 63 Wari	—	—	60½	0-12-56	5-19-72	nil	—	T. Cwt. lb. 2-4-72	—	0-4-56	1-9-56	—	0-12-0	0-1-0	—	—
7.	G. D. Patel 393 Samvatsar	—	—	54	3-7-21	2-2-96	nil	—	1-7-45	—	0-10-37	1-15-0	—	0-3-0	—	—	—
8.	G. D. Patel 160 Samvatsar	—	Com-post F.Y.M. 32½	44½	1-17-16	3-1-48	—	—	3-11-48	10½	0-5-28	2-2-0	—	0-3-0	—	—	—

APPENDIX No. 4-B.

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

Statement showing the cane yield and analytical data
Seth Gulabchand Prize Plot.

Sl. No.	Name of the Competitor	Date of planting	Variety	Average Yield of Sugarcane per acre Tons	Crusher Juice			Mixed Juice			Pol. % cane	Fibre % cane	Recovery	Sugar per acre	Weekly recovery of the factory
					Brix	Pol	Purity	Brix	Pol	Purity					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Karkhanis and Shaha	2.8.53	Co 419	89.90	20.77	18.35	88.35	17.23	14.78	85.78	15.37	11.42	13.334	11.987	13.67
2.	K. C. Kapadia	—	Co 419	86.88	20.06	17.38	86.64	18.16	15.37	84.64	14.60	12.12	12.51	10.87	13.08
3.	V. V. Kulkarni	17.8.53	Co 419	91.04	19.70	17.31	87.87	17.96	15.34	85.41	14.49	11.33	12.78	11.63	13.08
4.	K. B. Nadgauda	—	Co 419	88.43	19.86	17.06	85.90	17.88	14.98	83.78	14.47	11.01	12.38	10.95	13.13
5.	G. D. Patel Laxmiwadi 17 Rui.	23rd to 27th July 1953	Co 419	84.03	17.85	15.00	84.03	15.67	12.68	80.92	12.48	10.06	10.49	8.81	10.80
6.	G. D. Patel Sakarwadi 63 Wari.	4th to 8th July 1953	Co 419	83.33	18.33	15.60	85.11	16.34	13.60	83.23	12.73	12.64	10.76	8.966	11.25
7.	G. D. Patel Sakarwadi 393 Samvatsar	15th to 23rd July 1953	Co 419	81.65	18.68	15.96	85.44	16.80	14.00	83.33	13.35	12.23	11.27	9.20	11.40
8.	G. D. Patel Sakarwadi 160 Samvatsar	9th to 25th June 1953	Co 419	72.71	19.30	16.87	87.41	17.21	14.67	85.24	13.82	11.69	11.81	8.587	11.30

APPENDIX No. 5-B

THE DECCAN SUGAR TECHNOLOGISTS' ASSOCIATION (INDIA)

Botanical observations of the Sugarcane Prize Plot Competition (Seth Gulabchand) Prize

Planting season 1953-54

Harvesting season 1954-55

Sl. No.	Name of the Competitor	Planted Length per acre in ft.	No. of millable canes	Average height of cant feet	Weight of canes in tons per acre (calculated)	Av. weight of cane in lbs	Wt. per foot height in lbs	Wt. of cane per planting foot in lbs	No. of arrowed canes per acre (calculated)	Wt. of arrowed cane per acre in tons (calculated)	No. of non-arrowed canes per acre (calculated)	Wt of non-arrowed canes per acre (calculated)	No. of water shoots per acre (calculated)	Wt. of water shoots per acre (calculated)	No. of Internodes per cane
1.	Karkhanis and Shaha	14520	46018	11'-1"	88.42	4.3	0.38	13.62	14292	36.64	26279	47.03	4348	4.69	27.7
2.	K. C. Kapadia	14000	75601	8'-11"	114.82	3.4	0.38	18.37	11112	21.89	47031	67.21	17456	25.72	
3.	V. V. Kulkarni	14520	57438	12'-0"	100.00	3.90	0.32	15.43	12159	27.00	34935	58.45	10344	14.55	32.24
4.	K. B. Nadgauda	14000	63612	8'-8"	80.12	2.82	0.32	12.82	5500	12.01	43312	50.47	15487	19.14	
5.	G. D. Patel 17 Rui.	12875	43245	13'-5"	102.05	5.28	0.39	17.75	5742	16.19	35412	81.37	2510	5.37	35.4
6.	G. D. Patel 63 Wari	11300	48165	—	86.64	4.03	—	17.17	7817	25.22	8287	18.13	1977 Cane pieces 20481	3.44 38.93	
7.	G. D. Patel 393 Samvatsar	11000	31900	11'-6"	67.03	4.7	0.41	13.6	11825	33.4	9212.5	20.00	1650 Cane pieces 9212	3.19 10.47	
8.	G. D. Patel 160 Samvatsar	11000	48950	11'-0"	89.91	3.92	0.36	17.4	8525	22.65	6325	25.16	1650 Cane pieces 23925	3.8 38.27	

Statement showing the lie, topography and soil type of plots

Seth Gulabchand Prize Plot

S. No.	Competitor.	Survey No.	Genetic soil type.	Depth of soil.	Colour of soil	Substratum.	General depth of Water Table.	Previous crop.	Slope of Soil.	Direction of Furrow	Furrow Width.	Approximate distance from river or big Nallah	The direction & the situation of plot with respect to 13.	Preparatory tillage given.	Outturn of Av. Adsali crop within the vicinity of the Prize plot during previous years.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Karkhanis & Shaha	135-36 Hol	B	4 feet.	Black	Murum in the upper, part & black soil in lower Portion.	More than 5 ft. Below.	Jowar (Outturn 8 bags /acre)	West to East North to South	North to South	3 ft.	One mile from big Nallah	South-West	Two ploughings Three discings, Rooter twice. Ridging by Tractor	About 60 tons all the years
2.	K. C. Kapadia	175-76 Kalamb	D	3 to 4 feet.	Brown Black	Soft Murum.	5 feet.	Jowar & Vegetable	North to South East to West	East West	3 ft.	6 fur-longs	North of river on the left Bank	Three ploughings, Three discings with tractor implement	60-65 tons
3.	V. V. Kulkarni	48-52 Kalamb	D	3 ft.	Greyish	Murum to the depth of 3½ ft.	8 feet.	Paddy	West to East North to South	—	3 ft.	3 miles 4 fur-longs	To North of river	2 ploughings 2 Discings, ridging by bullocks	60 tons 52 tons
4.	K. B. Nadgauda	175 - Kalamb	D	4 ft.	Brown-Black	Soft Murum.	5 feet.	Paddy	East to West North to South	East West	3 ft.	4 fur-longs	North of River	3 ploughings 3 discings with Tractor	60 to 65 tons
5.	G. D. Patel	17 Rui	A	2 ft.	Black	Soft Murum.	Below 5 ft.	Irrigated cane	North to South	East West	3 1/3 ft.	3½ miles from river	To the West of River	2 ploughings 2 discings by Tractor	41 tons and 64 tons
6.	G. D. Patel	63 Wari	B	3 to 4 feet.	Brownish Black	Murum.	Below 4 ft.	Plant cane & Lucerne	West to East North to South	North South	3 1/8 ft.	4 fur-longs	North-East	2 ploughings 2 discings	Plant: 40 tons Adsali: 80 tons
7.	G. D. Patel	393 Sam-vatsar	A	2 to 2½ feet.	Coffee-Black	Soft Murum.	6 feet.	Sunhemp	South to North	North South	3½ ft.	4 fur-longs	North-East	2 ploughings 1 harrowing 1 Ridging.	62 tons 77 tons
8.	G. D. Patel	160 Sam-vatsar	C	2½ to 3½ feet.	Greyish Black	Soft Murum.	8 to 9 feet.	Adsali cane.	North to South West to East	North South	3½ ft.	1 mile	To North of river	2 ploughings 1 harrowing 1 Ridging.	60 and 72 tons