

SHARKARA

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NATIONAL SUGAR INSTITUTE

Department of Food & Public Distribution
Ministry of Consumer Affairs, Food & Public Distribution

Government of India

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SHARKARA

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From Director's Desk.....



As the institute is preparing itself for commencement of the new academic session from July 2017, the sugar industry is also gearing up for the forthcoming crushing season 2017-18. While the institute, keeping in view the requirements of the industry has introduced two new courses viz. "Diploma in Industrial Instrumentation & Process Automation and "Diploma in Sugarcane Productivity & Maturity Management" from the new academic session, the sugar & alcohol industry, particularly, in the gangetic plane appeared to be busy more with the up gradation of their effluent treatment plants after getting a stick from CPCB.

The sugar factories still comfortable with the prices of sugar ruling in different markets overcoming their doubts over any possible slump after imports. But, I reiterate, considering issues related to finalizing power purchase agreements by various state governments & competition in power tariff's offered through non-conventional energy resources, options for using bagasse in some other innovative manner for value addition are to be harnessed & the institute has already reached to success by developing processes for producing "Surfactants" from bagasse. Similarly, cost effective technologies for utilization of other by-products for value addition need to be developed for which I look forward towards a better institute-industry interaction. I believe

"Success is not final, failure is not fatal; it is the courage to continue that counts".

Good Luck ! 

(Narendra Mohan)
Director



➤ GLOBAL PROGRAMME:

1. Three months training programme on Sugar Refining for the IInd batch of Chemical Engineers of M/s Yemen Company for Sugar Refining, Hodeida, Republic of Yemen concluded at the Institute. Theoretical as well as practical training was imparted to the trainees during the period on various techniques of raw melt clarification, concentration and crystallization.



2. Three weeks training programme for the distillery personnel of M/s Army Welfare Project Ltd., Bhutan on Boiler Operations, Boiler Water Management, Quality Control and Distillery Operations conducted at the Institute. Theoretical as well as practical training was imparted to the trainees on aspects of Boiler operations, Boiler water management, Quality control and on various distillery operations.



Industrial visit to molasses and grain based distilleries and a brewery was also organized for giving better exposure to the trainees about the operation of various unit operations.

➤ **OUR OCCASIONS:**

➤ **VISITORS FROM ABROAD:**

➤ **INSTITUTE TO HELP ETHIOPIAN SUGAR CORPORATION:**

1. Officials from Ethiopian Sugar Corporation visited Institute on 24-25th April, 2017 and signed a MOU for seeking institute assistance in building a "Sugar Academy", conducting short duration training programme, consultancy on capacity expansion and improvement in technical efficiency of existing plants.



The Ethiopian Sugar Corporation shall also seek institute help in setting up new integrated sugar complexes so as to cope up with their domestic sugar requirements.

➤ **VISIT OF DIGNITARIES:**

The following dignitaries visited the institute and shown their keen interest on the research work relating to production of Bio-CNG from press mud, detergent from bagasse and on treatment of MEE condensate and other activities as well.

1. Shri R C Singhal, Chief Executive Officer, Seksaria Biswan Sugars, Sitapur, U.P.
2. Shri P.P. Mishra, Advisor, R&D, DSCL Sugar, Ajbapur, Shahjahanpur.
3. Shri D.K. Sharma, Whole Time Director, Avadh Sugar & Energy Ltd. Hargaon, Sitapur, U.P.
4. Shri G.R. Sadhale, General Manager, Saf Yeast Company Pvt. Ltd., Distt-Hardoi.
5. Mrs. Vinita Kumari Poddar, Confederation of Indian Industry, Lucknow.
6. Shri Yogesh Kumar Singh, Unit Head, Haidergarh Chini Mills. Barabanki, U.P.

7. Shri V.K. Sharma, Executive Vice President (P), Avadh Sugar & Energy Ltd., Unit-Seohara, Bijnore, U.P.
8. Shri Alok Shukla, Deputy Director & Head UP State Office, Confederation of Indian Industry.
9. Shri Sanjay Sharma, Vice President, DSM Sugar, Meerganj. Bareilly, U. P
10. Shri V.S. Sharma, G.M (Production), Wave Industries Pvt. Ltd., Dhanaura Mandi, U.P.



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➤ OUR RESEARCH AREAS:

The Institute is actively involved in the collaborative endeavors with the sugar and allied industries for their trouble shootings and applied R&D on the following important topics.

➤ RESEARCH:

The Institute during the period took up R&D work on the following:

1. Investigation on microflora in different combination of press mud using different sources for biogas production- The biochemical tests for identification of bacterial strains were carried out with the isolated and purified strains. The tests included catalase production, production of nitrite from nitrate, growth on different sugars, liquefaction of gelatine, starch hydrolysis, indole production, citrate utilization Methyl Red Voges Proskeur test (MRVP) etc. These tests were performed with 0 to 21 days old cultures. The tests for 28 days old strains have also been set for further evaluation.



2. Isolation and purification of yeast strains from saccharine materials and their performance for fermentative production of alcohol- The yeast strain isolated from spoiled sugar cane juice produced best results when diluted molasses was fermented by this strain with a fermentation value of 91.7% and ethanol yield of 218 l/ton. The yeast isolated from rotten grapes also produced good results. The yeasts isolated from other saccharine materials did not give satisfactory performance. Initial work has been completed and further work on purification is in progress.



3. Production of invert syrup from Cane Juice- The study with cane juice has been completed and the analysis for pH, Brix, F:G ratio, acidity, % inversion etc. have been carried out with stored syrup to assess change in quality upon storage. The results showed no major variations in parameters upon storage. Attempts were made to produce invert syrup from sugar beet variety LS-6 juice also but the same were not successful due to darkening of the extracted juice and problems associated with juice extraction.



4. Studies on clarification of cane juice with bagasse derived biochar- The performance of bio char towards treating sugar cane juice is under investigation. The studies are aimed at



utilizing bagasse derived biochar as a possible replacement for active carbons commercially available. Fly ash and boiler ash from different locations shall also be collected to investigate the efficiencies.

5. Studies on synthesis of glycosidic surfactants using by-product resources of sugar industry-

The studies have been taken up to open up a new option for utilization of bagasse to produce value added product with aim to enhance the yield of bagasse derived polypentosides based surfactant along with reducing the purification steps involved thereof, following experiments have been performed:

a. Decrystallization of sugarcane bagasse followed its glycosilation.

b. Distillation of decanol under reduced pressure from mother liquor obtained from hydrolysis followed by glycosilation of bagasse derived pentoses.

The communicated paper entitled “Use of sugarcane bagasse as potential renewable feedstock for production of a bio-detergent” has been accepted towards its publication/presentation in 75th STAI Annual Convention and International Sugar Expo 2017.



6. Improvement in Sugar Quality by clarification of intermediate boiling house products- Experiments were carried out with B & C-double cured sugar melt using different doses of phosphoric acid and hydrogen peroxide. Centrifugation of melt was also carried out to remove suspended impurities & significant removal of colour and turbidity was achieved. Experiments on the samples collected during 2016-17 season have been completed. Compilation & analysis of data collected is in progress. Further plan of work will be taken up on the basis of the results of data analysis during the forthcoming crushing season.

7. Use of Lamella Clarifier for Juice settling – use of super short retention time clarifier having lamella plates inclined at different angles for juice settling is under study. The literature survey has been done and a small model for the experiment is under construction for the actual assessment of mud removal & quality parameters of clear juice. Trials on this new design clarifier will be carried out on laboratory scale first.

➤ **RESEARCH PAPERS/ POSTER PRESENTED / PUBLISHED/ SENT FOR PUBLICATION:**

1. “Site specific nutrient management for maximization of crop yield and sustaining soil health” by Narendra Mohan & Ashok Kumar presented during all India seminar on “Integrated approach for enhancing sugarcane & farm productivity by adopting improved cultivation and analytical practices”, jointly organized by NSI-CSA Agri. & Technical University on 6-7th April, 2017 at NSI, Kanpur.

2. “Moisture Reduction in Bagasse Technological Options” by Narendra Mohan & D. Swain presented during National Workshop on "Reduction in Bagasse Moisture-Technological Options" organized by National Sugar Institute on 17th April, 2017 at NSI Kanpur.

3. “Utilization of Existing Electrical Installation to Reduce Breakdown Time and to save Initial Cost in New Installations” by Vinay Kumar, A.K. Kanaujia & D Swain **“Cane Sugar Industry- Latest Trends for Sustainability”** by Narendra Mohan & A. Bajpai presented during the National Seminar jointly organized by NSI-JPMA on “Sustainability of Sugar Industry- Management of Resources” on 20th April, 2017 at Pune.

4. “Cane Sugar Industry: Latest Trends for a Greener Tomorrow” by Narendra Mohan & Ashutosh Bajpai published in the proceedings of annual convention of NISSTA held on 12-13th May 2017, at Lucknow.

5. “Comparative study of Natural & Chemical flocculants on cane juice clarification” by Narendra Mohan, Dr. (Mrs.) Chitra Yadav & Ashish Kumar Shukla presented during the annual convention of NISSTA held on 12-13 May 2017, at Lucknow.

6. “Effect of the Potassium, Zine Nutrition on Agronomic and Biochemical Traits of Sweet Sorghum (*Sorghum bicolor* L.) Genotype on Ethanol Production” by Narendra Mohan, Ashok Kumar and Lokesh Babar presented during the annual convention of NISSTA held on 12-13th May 2017, at Lucknow.

7. “Comparative Evaluation of Carbonation & Phosphatation Process Keeping In View Industrial Uses of Sugar” by Narendra Mohan presented during the National seminar organized by STAI, New Delhi on 19th May, 2017 at Gangtok, Sikkim.

8. “Biomass Energy: A step towards Economic & Environmental Sustainability in India” by Narendra Mohan, & Anoop Kumar Kanaujia accepted presentation during the forthcoming International Congress on Sugar & Sugarcane Derivatives being organized from 26 to 30th June, 2017 at La Habana, Cuba.

9. “Sugarcane Juice Utilization: Expeditious Green Synthesis of Graphene” by Narendra Mohan & Vishnu Prabhakar sent for presentation during the forthcoming International Congress on Sugar & Sugarcane Derivatives being organized from 26 to 30th June, 2017 at La Habana, Cuba.

10. “Sugarcane Productivity Enhancement-A Holistic Approach” by Narendra Mohan & Priyanka Singh sent for presentation during the forthcoming International Congress on Sugar & Sugarcane Derivatives being organized from 26 to 30th June, 2017 at La Habana, Cuba.

11.“Sugar Quality Determination Keeping in view uses of Sugar” by Narendra Mohan accepted for publication in 63rd Annual Convention of DSTA to be held on 14-15th July at Belgavi, Karnataka.

12.“Use of Sugarcane Bagasse as Potential Renewable Feedstock for Production of Bio-Detergent” by Narendra Mohan, Vishnu P. Srivastava & Anushka Agarwal accepted for publication in 75th Annual Convention of STAI to be held on 3-5th August 2017, at Kochi, Kerala.

13.“Latest Trends in Evaporator cleaning” by Narendra Mohan & Ashutosh Bajapi accepted for publication in 75th Annual Convention of STAI to be held on 3-5th August 2017, at Kochi, Kerala.

14.“A Study on Comparative Advantages of Bagasse Moisture Reduction Vs. Reduction of Steam Consumption % Cane” by Narendra Mohan, D. Swain & Anoop Kumar Kanaujia accepted for publication in 75th Annual Convention of STAI to be held on 3-5th August 2017, at Kochi, Kerala.

15.“Comprehensive study of Suchem DT14- Bio-additive for vapor condensate treatment-Post MEE for distillery” by Santosh Kumar, Seema Paroha & Srikanteshwara accepted for publication in 75th Annual Convention of STAI to be held on 3-5 August 2017, at Kochi, Kerala.

16. “Icing Sugar: Forays the Indian Sugar Market” by Jahar Singh & Vivek Pratap Singh sent for publication in Cooperative Sugar.

17. “Condition based Maintenance – A Methodological Approach” by Sanjay Chauhan & D. Swain sent for publication in Indian Sugar.

18. “Waste to Wealth” by Narendra Mohan & D. Swain accepted for publication in 75th Annual Convention of STAI to be held on 3-5th August 2017, at Kochi, Kerala.

19. “A Process for Purification of Sugar Factory Condensates and Effluent using Electro-Coagulation Technique” by Dr. (Mrs.) Seema Paroha, accepted for presentation International Congress on Sugar & Sugarcane Derivatives organized from 26 to 30th June, 2017 at La Habana, Cuba.

20.“Sugar Warehouse Automation: Minimize Loss & Maximize Output” by Shri Brajesh Singh, accepted for the presentation during 75th STAI Annual Convention of STAI to be held on 03-05th August 2017, at Kochi, Kerala.

➤ OUR PROVISIONS:

➤ BUREAU OF SUGAR STANDARDS:

The Institute on behalf of Bureau of Indian Standards prepares and issues Sugar Standard Grades to the entire Sugar Industry of the country for every sugar season. These Sugar Standard Grades are issued to facilitate quality control and to protect the interest of the common consumers. On the basis of these grades, sugar factories mark their produce accordingly.

On the basis of the approved Standards, Bureau of Sugar Standards took up the sale of these Standards from during the period (April-June, 2017) issued 27 Sugar Standard Grades to 04 Sugar factories and other users.

Price schedule for the sugar season 2016-17:

1	Sugar Standard Grades to be issued	L-31, L-30, M31, M-30, S-31, S-30 & SS-31
2	Set of New Sugar Standard Grades containing 7 grades +3 empty glass bottles + 3 Velvet Cork in packing case	Rs.9375/= each
3	Single Sugar Standard Grades	Rs.1200/= each
4	Empty Sugar Standard Glass Bottle	Rs.175/= each
5	Packing case	Rs.300/= each
6	Velvet Cork	Rs.50/= each
7	Postal expenses, forwarding charges, if any	Extra on actual basis
8	Demand Draft to be sent	In favour of Director, National Sugar Institute, payable at Kanpur
9	Delivery of Sugar Standard Grades	Monday to Friday (10.00 AM to 5.00 PM)
10	Taxes	Taxes Extra as applicable

➤ SEMINAR/WORKSHOP/TRAINING PROGRAMME:

➤ SEMINARS/CONFERENCES:

1. Two days National Seminar jointly organized by NSI-CSA University of Agril. & Technology on "Integrated approach for enhancing sugarcane & farm productivity by adopting improved cultivation and analytical practices" on 6-7th April, 2017 at NSI, Kanpur. Shri Ashok Kumar, Asstt. Prof. Agriculture Chemistry presented paper on "Site specific nutrient management for maximization of crop yield and sustaining soil health" during the seminar.



2. One day National Workshop of "Reduction in Bagasse Moisture-Technological Options" organized by National Sugar Institute on 17th April, 2017 at NSI Kanpur. The delegates from Tamil Nadu, Maharashtra, Karnataka, Bihar, M.P., Punjab, Haryana, Uttarakhand, Gujarat, Andhra Pradesh, New Delhi and U.P attended the seminar. Shri D. Swain Prof. of Sugar Engineering presented paper on "Moisture Reduction in Bagasse Technological Options" during the seminar. During the seminar comparative study with respect to reduction in steam consumption vs reduction in bagasse moisture was also presented. Various technology providers, KCP Chennai & JPMA, Pune also presented details of their technology for reducing moisture % bagasse during milling.



3. One day National Seminar jointly organized by NSI-JPMA on "Sustainability of Sugar Industry-Management of Resources" on 20th April, 2017 at Pune. Shri Narendra Mohan, Director, NSI, Shri D. Swain Prof. of Sugar Engineering, Dr. A. Bajpai Prof. of Sugar Technology and Shri Vinay Kumar, Asstt. Prof. Sugar Engineering presented papers on "Cane Sugar Industry- Latest

Trends for Sustainability” and “Utilization of Existing Electrical Installation to Reduce Breakdown Time and to save Initial Cost in New Installations” during the seminar.



4. Shri Narendra Mohan, Director, National Sugar Institute and Shri Vinay Kumar, Asstt. Prof. Sugar Engineering attended the 6th Technical Seminar organized by U.P. Distillers Association on "Modernization and Improvements in Distillery Industry" on 28th April, 2017 at Noida. Shri Vinay Kumar presented paper on “Zero Spent Discharge RSW Evaporation & Incineration Boiler” during the seminar.



5. Shri Narendra Mohan, Director, National Sugar Institute addressed STAI Seminar as Guest of honour & delivered lecture on “Comparative Evaluation of Carbonation & Phosphatation process keeping in view Industrial uses of Sugar” during the seminar held on 19th May, 2017 at Gangtok, Sikkim.



6. Director, National Sugar Institute also addressed, interactive Session organized by UPSMA at Lucknow on "Adequacy of ETP to meet CPCB guidelines." He tried to put factual situation before the gathering and efforts required to be carried out by the Sugar industry keeping in view the CPCB/SPCB guidelines. He emphasized upon formulating separate norms for discharge from conventional standalone sugar plants, sugar plants with high pressure co-generation & from sugar refineries.



7. Two days Annual Convention & Technical Expo organized by NISSTA in association with ICAR-IISR on 12-13th May 2017, at Lucknow. Shri Ashok Kumar, Asstt. Prof. Agri. Chemistry & Shri Ashish Kumar Shukla, Jr. Technical Officer (Sugar Technology) have presented their papers on "Effect of the Potassium, Zine Nutrition on Agronomic and Biochemical Traits of Sweet Sorghum (*Sorghum bicolor* L.) Genotype on Ethanol Production" and "Comparative study of Natural & Chemical flocculants on cane juice clarification" during the Convention.

➤ INTERNATIONAL YOGA DAY

Institute celebrated International Yoga Day on 21st June, 2017. On the occasion, faculty, staff and students participated in Yoga programme organized at the Institute.



➤ NEW COURSES LAUNCHED AND ENTRANCE EXAMINATION CONDUCTED:

Entrance examination for admission to various Post Graduate Diploma & Certificate Courses viz. Sugar Technology, Alcohol Technology, Sugar Engineering, Quality Control, Sugarcane Productivity & Maturity Management, Industrial Instrumentation & Process Automation and Sugar Boiling was conducted on 11th June, 2017 at six centers, namely, Kanpur, New Delhi, Patna, Chennai, Kolkata & Pune. Results of all the courses have been declared.



Institute has re-structured & up-graded two courses from the academic session 2017-18 i.e. Diploma in Sugarcane Productivity & Maturity Management and Diploma in Industrial Instrumentation & Process Automation.

➤ SWACHHTA PAKHWADA:

Swachhta Pakhwada was observed from 16th to 31st May 2017 at the Institute, as per schedule. Various activities like tree plantation, cleaning activities in & around surroundings, inspiring the primary school students about the importance of cleaning, conducting a drawing competition on Swachhta in a nearby primary school were carried out. An essay/poem competition and Blood Donation Camp was also organized at the institute.



A “Nukkad Natak” was also organized on this occasion to create awareness about importance of person hygiene & its affect on human health.

➤ हिंदी कार्यशाला :

सरकारी कामकाज में हिंदी का अधिक से अधिक प्रयोग कर राजभाषा विभाग के निर्देशों का पालन करने के उद्देश्य से दि. 15.06.2017 को संस्थान के सेमीनार हॉल में हिंदी कार्यशाला का आयोजन किया गया, जिसमें संस्थान के 37 अधिकारियों एवं कर्मचारियों ने भाग लिया।



50TH ADVISORY BOARD MEETING:

50th Advisory Board Meeting of the Institute was held on 16th June, 2017 under the Chairmanship of Joint Secretary (Sugar & Administration), Government of India. The board while expressing satisfaction on the working of the institute, stressed for undertaking more collaborative research projects for developing technologies for value addition through better by-product utilization. The joint Secretary (Sugar & Administrative) called upon the staff of the institute to work on developing cost effective technologies for improving farm & factory productivities after validation & taking almost care in transfer of such technologies from “Lab to Land”. He also visited various laboratories, classrooms, factory, farm and hostels taking keen interest in the present activities of the institute.



➤ OUR ADVISORY:

Besides conducting teaching and training programmes, carrying out research in relevant field, another main function of the institute is:

1. To function as a “Think-tank” to sugar and allied industry for proposing modernization and trouble free functioning of the process on advisory basis / through Extension Services.
2. To formulate strategies and promotes measures for expansion of capacities, energy conservation, co-product utilization etc. for sugar and allied industries.
3. To assist Govt. of India through technical contribution in policy formulation and control of Sugar Industry.

➤ CONSULTANCY SERVICES:

During the period April to June, 2017 consultancy services were provided to the following:

1.	M/s Wave Industries Pvt. Ltd., Dhanaura Mandi, Bijnor, U.P.
2.	M/s Upper Ganges Sugar & Industries Ltd., Seohara, Bijnor, U.P.
3.	M/s Wave Industries Pvt. Ltd., unit- Chandpur, Bijnor, U.P.
4.	M/s D.S.8 Subramaniya Siva Cooperative Sugar Mills Ltd., Gopatapuram, T.N.
5.	M/s Simbhaoli Sugars Ltd., Distillery, Unit- Hapur, U.P.
6.	M/s Simbhaoli Sugars Ltd., unit- Brijnathpur, Distillery, Hapur, U.P.
7.	M/s Triveni Engineering & Industries Ltd., Unit-Khatauli, Muzaffarnagar, U.P.
8.	M/s Dalmia Bharat Sugar & Industries Ltd., Unit- Kolhapur, Maharashtra.
9.	M/s Triveni Engineering & Industries Ltd., unit- Sabitgarh, Hapur, U.P.
10.	M/s Wave Industries Pvt. Ltd., Unit- Amroha, J.P. Nagar, U.P.
11.	M/s Wave Industries Pvt. Ltd., Unit- Saharanpur, U.P.
12.	M/s Wave Industries Pvt. Ltd., Unit- Bijnor, U.P.
13.	M/s Wave Industries Pvt. Ltd., Unit- Bulandshar, U.P.
14.	M/s P B S (Foods) Pvt Ltd., Unit- Chandpur, Bijnor, U.P.
15.	M/s Sasamusa Sugar Works Pvt. Ltd. Gopalganj, Bihar
16.	M/s Mylar Sugar Ltd., Gokul Road, Hubli, Karnataka

17.	M/s Dharamapuri District Coop Sugar Mills Ltd. TamilNadu
18.	M/s Panipat Coop Sugar Mills, Panipat, Haryana.
19.	M/s Sonipat Coop Sugar Mills, Sonipat, Haryana
20.	M/s Kumbhi Chini Mills Ltd., Unit of BCML, Lakhimpur-Kheri, U.P
21.	M/s Avadh Sugar Energy Ltd., Unit- Seohara, Bijnor, U.P.
22.	M/s Rai Bahadur Narain Singh Sugar Mills Ltd., Laksar, Haridwar, Uttarakhand
23.	M/s Akbarpur Chini Mills Ltd., Unit of BCML, Ambedkar Nagar, U.P.
24.	M/s Gularia Chini Mills Ltd., Unit of BCML, Lakhimpur-Kheri, U.P.
25.	M/s Rauzagaon Chini Mills Ltd., Unit of BCML, Barabanki, U.P.
26.	M/s Haidergarh Chini Mills Ltd., Unit of BCML, Barabanki, U.P.
27.	M/s Dewan Sugar Mills Ltd., Moradabad, U.P.
28.	M/s Rosa Sugar Works, Shahjahanpur, U.P.
29.	M/s Wave Distillery, Aligarh, U.P.
30.	M/s Uttam Sugar Mills Ltd., Unit-Barkatpur, Bijnor, U.P.
31.	M/s Uttam Sugar Mills Ltd., Unit- Libberheri, Roorkee, Uttarakhand.
32.	M/s Harinagar Sugar Mills Ltd., West Champaran, Bihar.
33.	M/s New Swadeshi Sugar Mills Ltd., Narkatiaganj, West Champaran, Bihar.
34.	M/s Parle Biscuits Pvt. Ltd. (Sugar Division), Parsendi, Bahraich, U.P.
35.	M/s Bharat Sugar Mills Ltd., Unit- Sidhauli, Saran, Bihar.
36.	M/s Dalmia Bharat Sugar Industries Ltd., Unit-Nigohi, U.P.
37.	M/s Avadh Sugar & Energy Ltd., Unit- Hargaon, Sitapur, U.P.
38.	M/s DSCL Sugar, Unit-Loni, Hardoi, U.P.
39.	M/s DSCL Sugar, Unit- Hariawan, Hardoi, U.P.
40.	M/s DSCL Sugar, Unit- Rupapur, Hardoi, U.P.
41.	M/s DSCL Sugar, Unit- Ajbapur, Lakhimpur-Kheri, U.P.
42.	M/s Maizapur Chini Mills Ltd., Unit of BCML, Gonda, U.P.
43.	M/s Dwarikesh Sugar Industries Ltd., Bijnor, U.P.
44.	M/s Avadh Sugar & Energy Ltd., Unit- Hata, Kushinagar, U.P.

RESEARCH ARTICLE:

“SUGAR CRYSTALLIZATION AND KEEPING QUALITY”

by

Mohamed Mathlouthi

Association Andrew VanHook

Reims, France

Introduction

As a general rule, solving of practical problems always requires some basic concepts. Obtaining good quality sugar crystals and maintaining their quality and stability requires that some rules are adopted. All processing steps should be optimized in order to achieve the crystals quality target. Obtaining of high quality Sugar Crystals requires paying attention to each and every detail not only following crystal science principles (nucleation, growth ...) but also rules of the thumb and instinct: *Crystallization is an art!*

Sugar Crystal behaves as a “*living system*”. It exchanges water with surrounding atmosphere and might dissolve or re-crystallize when environment conditions change.

Stability of crystalline white sugar during storage, handling and conditioning needs good quality of crystals and adapted control of all parameters of relevance.

Sugar Crystals with no defects have relatively high Vickers hardness value (755 Mpa). The defects of sugar crystals formed during the different steps of process: crystallization, centrifugation, drying and handling lead to dust formation and storage instability. Breakage of sugar crystals generally originates from defects such as shape and size, moisture content, inclusion and/or adsorption of impurities, amorphous state, etc ...

Water Vapor Sorption Isotherms and image analysis allow understanding of the origins of the lack of quality and stability of white sugar during storage and to predict its prevention.

1 Sugar Crystallization

1.1- Nucleation and seeding

The first step in crystallization is the obtaining of nuclei. The crystal nuclei need to be grown to a certain size which allows their separation from the mother liquor easily. This first step is very important as regards the quality of the final crystals. It can be achieved either by spontaneous nucleation or by seeding. In the past, spontaneous nucleation was usually applied. However, nowadays, a better control of processes especially as concerns supersaturation measurement, seeding is becoming the universal method, although the seed preparation and other technical details might differ among the sugar factories.

Seeding in sugar crystallization pans has evolved these last 40 years from almost uncontrolled collision (shock) of dry particles (dust) collected in the sugar house and introduced with air in the footings at very high supersaturation (≈ 1.30) to rigorously controlled milled sugar crystals dispersed in isopropanol or another dispersant. Conditions of preparation of seed slurry, especially as concerns the choice of crystals to grind, the wet milling operation, the reproducibility of Mean Aperture (M.A.) and Coefficient of Variation (C.V.) of seed crystals have been established by the crystallization team at G.T.S. (Groupement Technique de Sucreries) in the early 1970's.

It is possible to determine theoretically the weight of seed crystals if the yield of crystals in pan as well as final M.A. is known. This implies knowing of the number of crystals per unit mass. Data from literature like Thieme's Table or also experimental results from image analysis can be used.

The size and number of seed crystals are hardly correlated with size (M.A.) and number of final crystals obtained in the pan. The discrepancy depends on conditions of boiling especially stirring and also the conditions of footings preparation and quality of seed grains. As concerns the technique of making slurry of seed crystals, it is noticed that increasing the milling seed grain, duration increases the number of fine particles ($< 2.5\text{mm}$). An important fraction of these fine particles are dissolved instantaneously at the graining. As a general rule, the higher the size of seeds, the larger is the final crystal.

However, the correlation of C.V. is not evident. Crystal size distribution also depends on washing in the centrifugals and drying and screening processes. Nevertheless, some precautions can be adopted if it is desired to improve the conditions of crystallization and take advantage from the improvements made in slurry preparation and dispersion of seed crystals. The seeding of industrial pans remains a critical step which deserves optimization. The optimal quantity of seed crystals to use needs to be determined precisely, so that the correlation between the number and mass of crystals is known accurately. Supersaturation at seeding should remain in the metastable zone around $1.15 - 1.20$ (Figure 1).

1.2 Crystal Growth

Seed particles grow gradually in supersaturated solution at a controlled pressure and temperature. The faces of the crystal grow individually, with the main faces growing rapidly and the other faces slowly to reach at the end of growth, the regular shape represented in **Figure 2**. The faces with rapid growth may promote mother liquor proplets inclusions as reported in **Figure 3** for the face $q'(011)$.

During crystal growth, number of crystal defects may occur due to increased supersaturation or other boiling practices. At high supersaturation, above 1.3, sugar crystals conglomerates, twins and false grain may be formed. Defects of crystals like a rough surface can be transformed into a flat crystal face with inclusion of mother liquor. Explosion of vapour bubbles at crystal surface promotes the inclusion of mother liquor. The presence in mother liquor of impurities induces modified crystal shapes (needle like crystals in presence of raffinose or dextran or D-shaped crystals in presence of invert sugar).

1.3 Washing of crystals in centrifugals

Centrifugation of massecuites takes place after crystallization as the final step of purification to remove non-sugar from the surface of sugar crystals and only leaves traces of water which are evaporated during the drying process. However, this ultimate stage of removal of non-sugar cannot remedy defects occurring in earlier stages. The quality of white sugar depends on all the steps of beet sugar processing before boiling (storage of beet, extraction, purification, concentration) and also, particularly on crystallization which is preponderant for the determination of crystal size distribution and the repartition of the non-sugars in the crystals.

The importance of the quality of crystals on the stability of white sugar as regards caking was shown above. Hence, the adsorption of water vapor greatly depends on crystal size distribution and on the non-sugar on the surface of crystals, especially for sugars imperfectly washed at the centrifugals as well as twins and conglomerates which retain non-sugar between crystals.

To standardize the conditions of control of industrial centrifugation, a laboratory test has been applied at the G.T.S. (Groupement Technique de Sucreries) since the 1970s. This test consists in applying ideal conditions of washing using a double magmatizing procedure with a saturated pure sucrose solution. Analysis of quality criteria (EU points ash and color) for sugar before and after the test made possible the detection of the defects in the running of industrial centrifugals.

The volume of water used for washing depends on the quality of the massecuite (viscosity, crystal size distribution). Conversely to the generally accepted idea, the volume of wash water is not proportional to the quantity of centrifuged sugar. It is necessary not to confuse between a centrifugal and a “washing machine”. An excess of water leads to a loss of sugar (approximately 1 kg of sugar per kg of water in excess). For a given water volume, the quality of washed sugar may vary depending on the washing position in cycle. It is necessary to establish the optimal conditions for each type of centrifugal. A spray washer (sward or multi-nozzle) should provide a homogeneous repartition of wash water. However, the limiting step remains the thickness of the sugar layer in the centrifugal basket.

It is sometimes difficult to correctly wash the lower part of basket. It happens that sugar is accumulated at the bottom and prevents the evacuation of run-offs. Such a defect may be visually observed when traces of yellow color are present on white sugar at the end of unloading. This shows that good basket washing is necessary.

1.4 Drying and Screening of sugar

Water activity plays the critical role in evaluating the rate of water migration in the process of sugar drying and conditioning, especially when the rate is controlled by diffusion phenomena taking place within the film of concentrated syrup surrounding the sugar crystal. Due to molecular solvation and association effects occurring in the sucrose-water system, the driving force for water transfer across this film should be expressed in terms of water activity rather than the nominal concentration of water in solution. According to the presented chemical model of water activity, however, the latter is equivalent to the true mole fraction of water monomer. Therefore, the future attempts at modeling and controlling the process of sugar drying/conditioning should account for the distribution of monomer water in the syrup film.

2 Keeping Quality of Sugar Crystals

The quality of sugar crystals is defined commercially by the so-called European points based on the determination of aspect, colour in solution and ash. Other parameters are often listed among the specifications like moisture content and grain size distribution (M.A. and C.V.). All these quality parameters depend on the way crystallization was conducted, washing was made in the centrifugals as well as drying, cooling, handling and storage conditions.

The quality of white sugar might be acceptable according to specifications but it can evolve during storage to instability of colour, size and sometimes caking. We have used water vapour sorption isotherms and image analysis of crystals to understand the origins of white sugar instability and especially to explain the conditions of breakage of sucrose crystals and dust formation.

Sucrose crystal defects

Defects of sugar crystals can be classified as internal and external defects. Among internal defects inclusions are the most important. External defects are those visually observed like twins, conglomerates, agglomerates and fragments of crystals obtained by the breakage of the most fragile needle-like single crystals.

Inclusions

The presence of impurities inside the crystal lattice has important effects on the sugar quality especially as concerns colour and ash content as well as the included fraction of moisture which may be released during storage and provokes in certain conditions the caking. The study of inclusions is well documented (Vaccari and Mantovani, 1995). The origin of inclusions is mainly the capture of mother liquor droplets during fast growth of sugar crystals. In fact, the various faces of sucrose crystal have different rates of growth and the most rapid faces include mother liquor more rapidly than the others. It happens that inclusion is not visible in the crystal. In such case; heating at 105°C in the oven can reveal the colored drop included in the crystal lattice. The inclusion phenomenon can be limited by controlling the supersaturation of mother liquor to master growth kinetics.

2.1.2. External defects

The defects of crystals easily detected visually or under microscope are morphological. External habits of sugar crystallized under various conditions are described in Vavrinecz Atlas of sugar crystals (1965). Among the forms which are different from the simple 15 habits characterized by their Miller's indexes (Vavrinecz, 1965), there are different twins, conglomerates and elongated shapes.

A Twins

In case of twins, 2 single crystals have a junction along a different plane depending on the type of twin (Vavrinecz, 1965)

- (a) Type 1 twin crystals have their left poles turned towards each other while the right poles point outwards
- (b) Type 2 twin crystals have their right poles grown together while the left poles are pointing outwards
- (c) Types 3 twin crystals have both single crystals placed behind each other and are grown together along the a face.

The junction zone between the single crystals in a twin is, from the mechanical point of view, a weakness point where crystals can separate into fragments. Moreover, mother liquor retained between the crystals is not eliminated by washing in the centrifuge (Vaccari and Mantovani, 1995). Formation of twins depends on supersaturation, and the presence of impurities (Figure 4).

B Conglomerates

In such assembling of crystals, the junctions are random. Many crystals attached to each other grow together. This phenomenon happens when very high supersaturation is obtained locally in boiling pans. The consequences of this defect are the increase of colour in solution and included moisture as well as friability.

C Agglomerates

After drying of sugar crystals, it happens that an amorphous layer of dry sugar is formed at the surface above a thin film of saturated solution. This phenomenon together with the heterogeneity in moisture and the presence of fine particles lead to the agglomeration of two or more crystals. Here again the junction between particles includes moisture and can break during handling.

D Other defects

Chalky white sugar crystals are observed when the amount of dust is high. This originates in case of abrasion by metal screens and scrolls or scratching in drum- dryers.

Irregular shapes especially needles are observed when sucrose is grown in presence of specific impurities (kestose, raffinose, dextran, invert...). **Figure 5** reports the elongated shape of sucrose crystal in presence of dextran and the D- shape obtained in presence of invert. A large C.V. of sugar crystals can have as its origin the use of seeds with large size distribution, spontaneous nucleation and rapid changes in vacuum or temperature during the boiling.

Consequences of crystals defects

The consequences of sugar crystal defects are numerous and economically detrimental. They may lead to the formation of fine particles by different breakage mechanisms (Verkoeijen et al., 2002). Depending on the force applied and its direction (i.e.; normal, tangential or any direction, the different breakage mechanisms observed are called attrition, abrasion, wear, fracture, fragmentation and chipping. Attrition and fragmentation are caused by normal forces, Abrasion and chipping by tangential ones and wear and fracture by forces of any direction. The size of particle after attrition, abrasion or wear remains almost the same and the shape becomes rounder. During chipping, small pieces of particles are broken and the particle becomes rougher. Fracture and fragmentation yield small fragments, this reducing the average size of particles.

The formation of fragments of particles and the change in size and shape of crystals makes sugar crystals more reactive towards water vapour. This is directly linked to the aptitude of white sugar to cake. The most detrimental factor on the flowability of sugar was found to be a high amount of fine particles (above 10 %) (Rogé and Mathlouthi, 2003)

On the other hand, sucrose crystals are sometimes defined as hard or soft depending on their friability. In fact hardness of sugar crystals is not well defined in the literature. A true

hardness could be defined by objective test such as Brinnell index. Hardness according to Vickers for sucrose crystals is equal to 755 MPa (Bubnik et al., 1997). It seems that boiling at low temperature yields soft crystals as compared to normal or high temperatures. Depending on the size of crystals, the large crystals appear to be hard and sharp and the small crystals feel to be soft by comparison.

All these defects end at an increased instability of bulk white sugar especially as water vapour pressure is increased.

3 Sugar caking

Caking of food powders, especially crystalline sugar may be considered as a spontaneous agglomeration phenomenon. It is generally caused by the wetting of particle surface which causes its plasticization and sometimes dissolution.

This happens especially for surfaces containing amorphous product. The plasticization may also be obtained by heating above the glass transition temperature. The powder goes through 4 different stages during the caking phenomenon. The 4 stages (see **Figure 6**) are:

- a)** The pendular stage at which the powder is still free flowing,
- b)** The funicular stage corresponding to the establishing of permanent contact between particles,
- c)** The capillary stage reached when moisture is high enough to provoke liquid bridges between particles,
- d)** The drop stage obtained when dissolution of particles is preponderant.

If drying occurs after wetting, the caking phenomenon is observed for a characteristic equilibrium relative humidity (ERH) at which water is released from powder particles which form solid bridges and agglomerates.

The main causes of caking are related to crystal quality:

- The risk of caking is minimized when sugar crystals have a regular shape and size with CV < 30 and fines less than 1%
- To obtain these conditions of crystal quality the work starts in pan boiler
- All steps of crystallization in pan boiler are important to optimize especially for seeding and crystal growth.

4 Analysis of parameters affecting white sugar stability

4.1. Water Content

Water content in sugar crystals was analyzed using an adapted method of Karl Fischer titration. Total water was obtained after complete dissolution of the sugar sample in methanol/ formamide mixture (2/3 - 1/3 (v/v)) at 50°C (Rogé and Mathlouthi, 2000). After

analysis of another sample of sugar and a very short agitation, the titration only allows release of surface water and its determination. This method permitted showing that about 80 % of moisture is located inside the crystal and only 20% at the surface. Moreover, water is not included in the crystal lattice as pure water but in mother liquor droplets observed by oven heating of crystals at 105°C (Figure 6). As already mentioned, included water increases the fragility of sugar crystals and yields fragments and dust.

4.2. Water Vapor Sorption isotherms

The drying and handling of sugar crystals with defects such as conglomerates, twins and inclusions increases the probability of dust formation. Likewise screening of crystals especially when it is repeated to obtain a certain grain size (M.A.) may be at the origin of the abrasion of large crystals and the sticking of fine particles at the surface of these crystals (Figure 7). Although commercial requirements of a certain mean aperture (M.A.) and size distribution (C.V.) are met, the sugar behaves as very hygroscopic and is subject to caking. The role of fine particles in caking phenomenon was already published (Rogé and Mathlouthi, 2003). We report here a series of water vapor sorption curves (Figure 8) showing the role of fine particles added to standard sugar. Moisture content increases at the surface of sugar crystals which are covered with fine particles. These particles rapidly dissolve and recrystallize releasing free water. A chain reaction of dissolution and recrystallization is initiated which ends with the lumping of the whole sample of sugar.

Conclusion

Localization of moisture inside the crystal and the establishing of water vapour adsorption isotherms help in understanding of the role of crystal defects on caking. Storage stability of sugar depends on the quality of crystals (twins, conglomerates, inclusions) as well as on the presence of amorphous or fine particles around the crystals. Analysis of the causes of sugar instability reveals the role of surface water, the fine particles and the origin of dust particles as analysed by image analysis. Image analysis of sugar crystals allows direct observation of the defects. It can help in determining the breakage mechanism by establishing crystal size distribution histograms

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Figures:

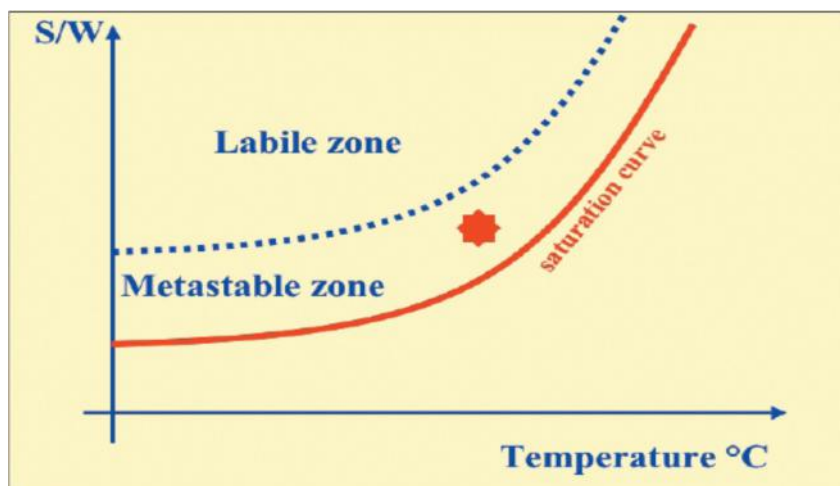


Figure 1: Seed slurry introduced when supersaturation is in the middle of metastable zone (Concentration given by Sucrose/Water ratio vs. Temperature).

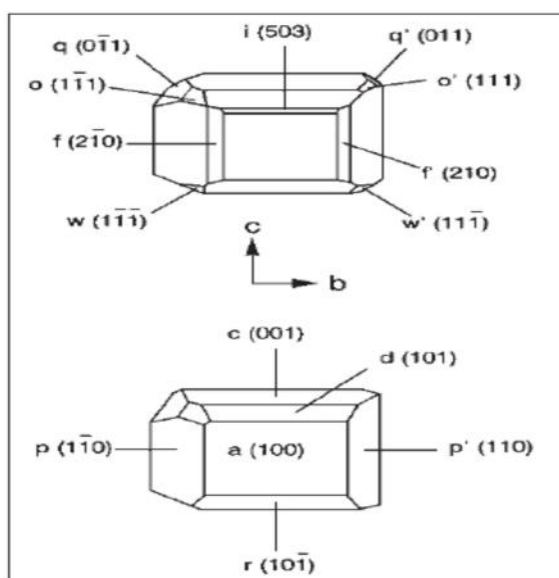


Fig. 2: Regular shape of a sucrose crystal showing 15 faces – the lower figure shows the most important faces: between brackets (Miller indices).

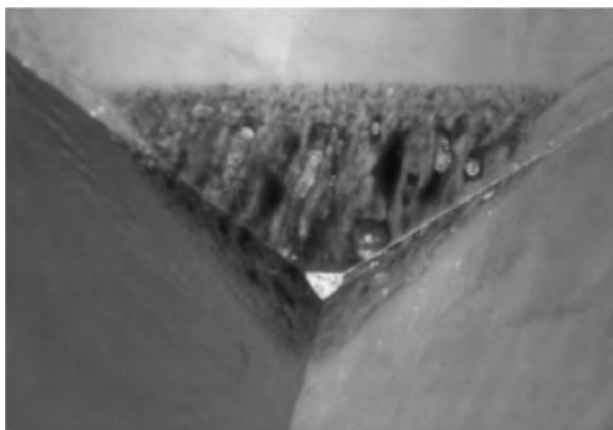


Fig. 3: Inclusion of mother liquor at the face q' (011)

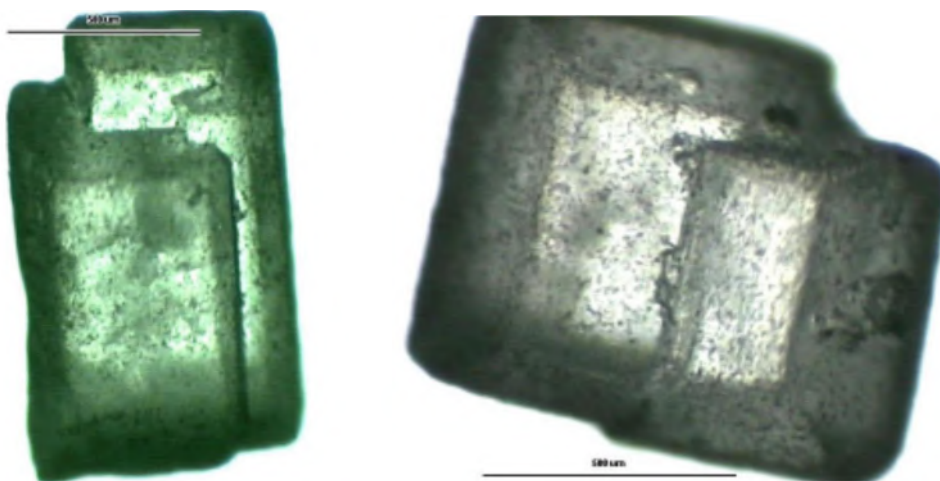


Fig. 4: Twins of sucrose crystals (Type 3: left) Type 2 (right)

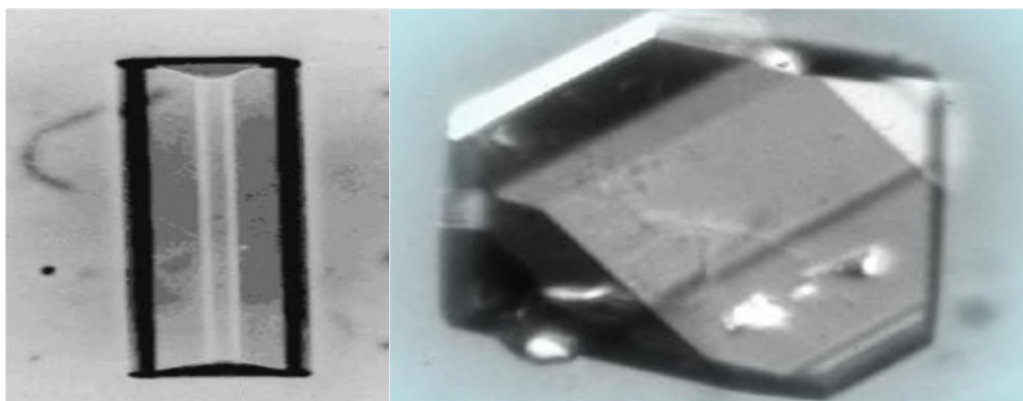
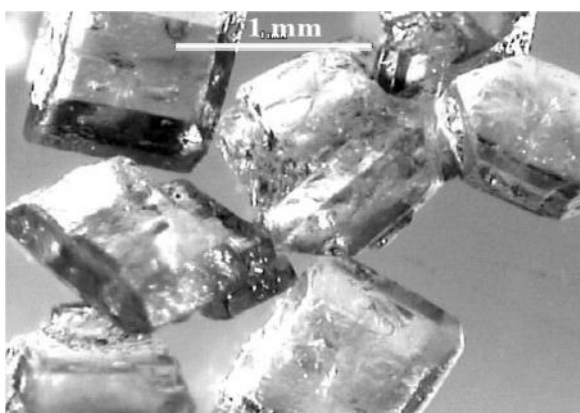
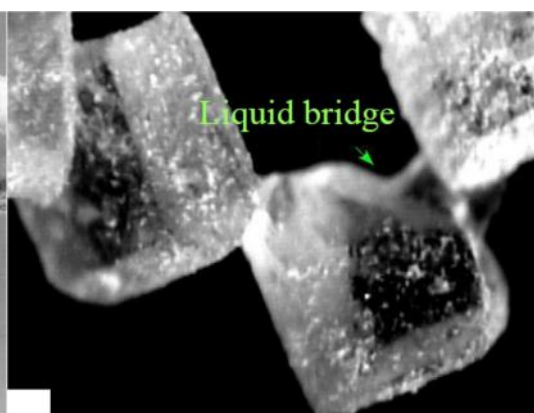


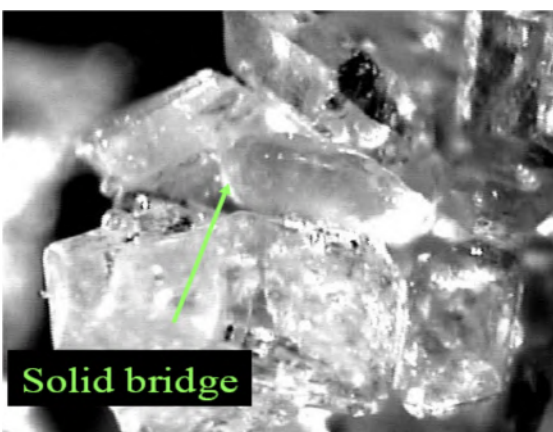
Fig. 5: Sucrose crystals grown in presence of dextran (left) and invert sugar (right)



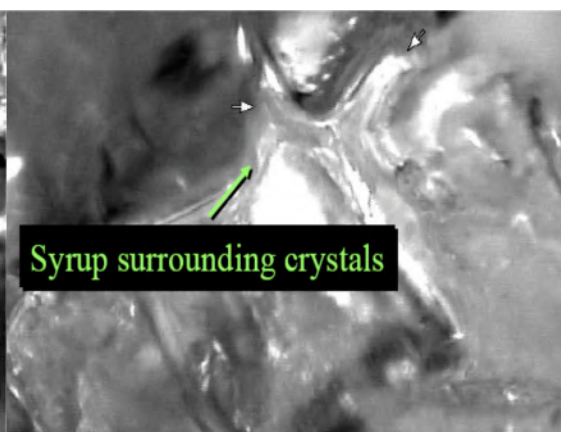
A: pendular step (ERH = 0 - 44%)



B: Funicular step (44% >ERH<75%)



C: Capillary step ((75% >ERH<85%))



D: Drop step (ERH > 85%)

Fig. 6: The four steps of caking at increasing values of ERH from 0 to > 85%

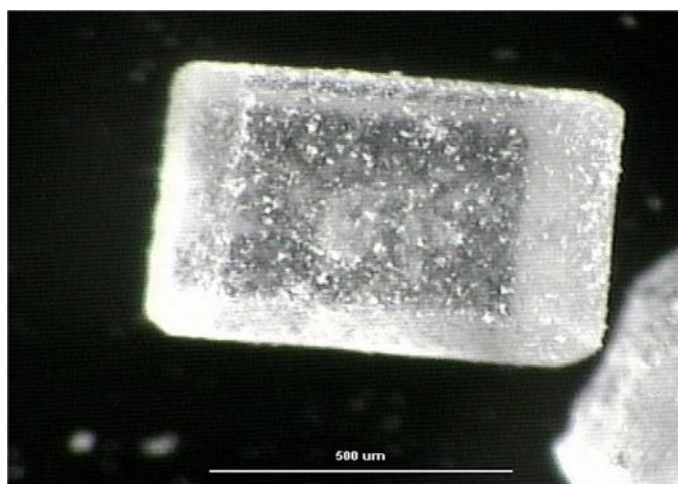


Fig. 7: Fine particles stuck at the surface of a sugar crystal after screening

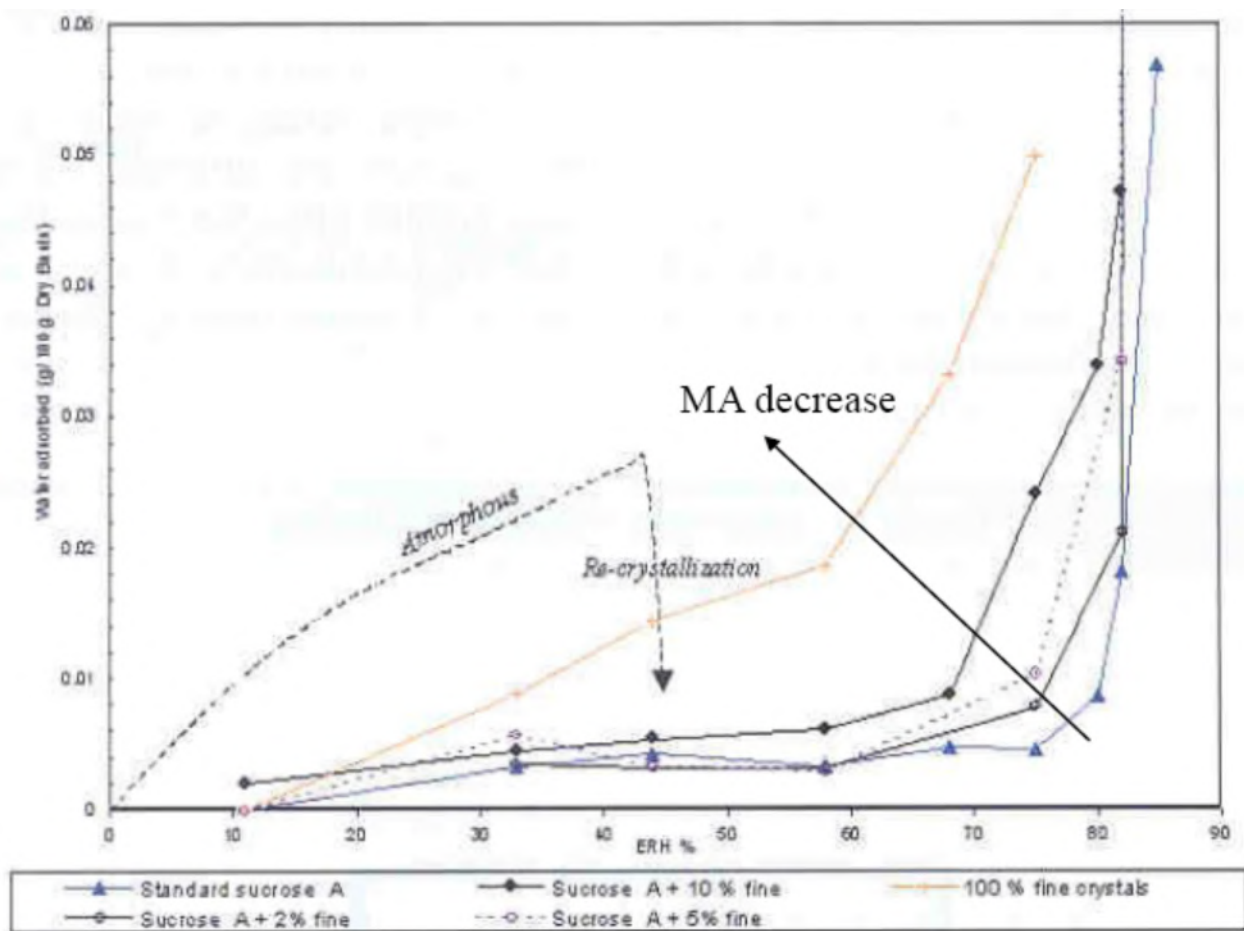


Fig. 8: Water vapor adsorption isotherms of sugar crystals: Water content increases as MA decreases – Adsorption by amorphous sugar shows a rapid increase followed by loss of water and recrystallization.

HAPPENINGS IN THE SUGAR INDUSTRY:

Gamma valerolactone – an effective solvent for converting lignocellulosic feedstocks into high value products.

Researchers at the University of Wisconsin–Madison have developed a new process which they claim triples the fraction of lignocellulosic feedstock converted to high-value products to nearly 80%. The process also triples the expected rate of return on an investment in the technology to 30%.

France – Cristal Union says dry weather will reduce 2017/18 sugar output.

Cristal Union, the European Union's fourth largest sugar producer, stated recently that weeks of dry weather in Europe is expected to hit sugar production and exports, reported Reuters.

Cuba – China to bankroll 25 cogen plants in the sugar sector.

China is supporting the construction of 25 bioelectric or cogen plants in the coming years. Chinese technology will be deployed in the construction, according to Xinhua news agency.

EU – Euroports to expand capacity of its sugar terminals in Antwerp and Le Havre.

The port operator Euroports is investing in the development of its terminals for transshipment sugar in the ports of Antwerp (Netherlands) and Le Havre (France), in anticipation of an increase in the volume of the sweetener following the abolition of sugar quotas in the EU in October.

Australia – 2017/18 sugar output forecast to be 7% lower after cyclone Debbie damage.

Forecast for sugar production for the 2017/18 season is trimmed by 7% after a destructive cyclone destroyed crops in a major producing region according to the Australian Bureau of Agriculture, Resource Economics and Rural Sciences (ABARES).

Biodegradable cellulose microbeads developed by Bath university researchers.

Microbeads are tiny balls of plastic (less than 0.5 mm in size) whose alleged powers of exfoliation have made them a mainstay of cosmetics ranging from facial cleanser to toothpastes. However, they are too small to be removed by sewage filtration systems and so end up in rivers and oceans, where they are ingested by birds, fish and other marine life.

China – Crackdown on smuggling drives down global sugar price.

China will step up its efforts to tackle sugar smuggling, the General Administration of Customs said on 20th June, weeks after Beijing hiked tariffs of up to 95% out-of-quota imports, to discourage imports and to protect local producers.

Anammox bacteria likely to transform wastewater treatment process.

Researchers at the University of Wisconsin-Madison led by professor of civil and environmental engineering Daniel Noguera are confident that ten years from now, wastewater treatment plants will look and function very differently than they do today.

Demo plant uses CO₂ from air, solar power to produce fuels.

Researchers at the Technical Research Institute of Finland (VTT) and the Lappeenranta University of Technology (LUT) have developed a pilot plant that will capture carbon dioxide from thin air and turn it into fuels and other hydrocarbons using LUT's solar power plant in Lappeenranta as the energy source.

Australia – Queensland Premier inaugurates pilot biodiesel plant processing waste.

The Premier of Queensland Annastacia Palaszczuk inaugurated a pilot biodiesel plant in Gladstone on 1st June that will process a variety of feedstocks deemed to be waste products.

Brazil – Raízen wins auction for Tonon Bioenergia's two sugar mills.

Raizen Energia SA, the world's largest sugar maker, won a judicial auction on 16th June for two sugar mills owned by Tonon Bioenergia SA, after its bid of BRL823 million (US\$250 million) was approved by creditors, Raizen said in a securities filing.

Novel drug delivery method to control parasitic nematodes.

Plant parasitic nematodes are a major burden to the global agricultural industry, causing a \$157 billion loss each year in crop production worldwide. Effective treatment requires large doses of nematicides to be applied, putting the environment and human health at risk. Challenges are to treat nematodes that are located deep within the soil, feeding on the roots of plants.

Biobased polycarbonate from sugar and carbon dioxide.

Scientists from the University of Bath have developed a process for producing polycarbonates from sugar and carbon dioxide.

Bosch Projects acquires Booker Tate to create a global market leader.

Bosch Projects Pty (Ltd), a South African-based global engineering consulting and project management company, has acquired Booker Tate Limited, a UK-based international agricultural production and processing consultancy, from RCL Foods.

Sri Lanka – Levy on imported sugar increased to US\$150/tonne.

The Sri Lankan government has increased an import levy on sugar from LKR13 (US\$8) to LKR23 (US\$15) per kg (US\$150/t), according to local press reports.

Brazil – More sugar companies face bankruptcies say Fitch Ratings.

Sugar companies in Brazil face “further defaults and bankruptcies”, according to Fitch Ratings.

UK – Alternative site for Al Khaleej’s new beet sugar plant is also in Yorkshire.

Two planning applications were made in Yorkshire by Al Khaleej International to build a new beet sugar factory.

New insights into LPMOs that could cut cellulosic biofuels costs.

In the production of cellulosic biofuels, finding cost-effective ways to break apart polysaccharides is a key challenge. Using neutron crystallography, a Los Alamos research team has mapped the three-dimensional structure of a protein that breaks down polysaccharides could help bring down the cost of producing cellulosic biofuels.

Mexico – HFCS imports from USA and reducing exports of refined sugar under the trade pact hits some companies.

Imports of HFCS from the United States have not only displaced Mexican sugar, but also caused the closure of at least one Mexican refinery, according to Juan Cortina Gallardo, president of the National Chamber of Sugar and Alcohol Industry (CNIAA).

Scientists create carbon material that is ultrastrong, yet elastic.

Researchers from China (Yanshan University) and USA (Carnegie Inst of Science) have developed a form of ultrastrong, lightweight carbon that has the potential revolutionise to manufacturing.

Researchers discover mechanism timing seed germination.

Researchers at the University of Birmingham has revealed a group of cells that function as a ‘brain’ for plant embryos, capable of assessing environmental conditions and dictating when seeds will germinate.

Brazil – GM cane resistant to cane borer approved for commercial use.

Brazilian biosecurity agency CTNBio approved on 8th June commercial use of genetically modified sugarcane, according to a statement from CTC Centro de Tecnologia Canavieira SA, which developed the technology.

US and Mexico reach sugar deal despite resistance from US producers.

The United States and Mexico reached on 6th June a preliminary agreement in principle that would end a three-year bilateral dispute over sugar trade, and in effect averting a major trade crisis that staves off steep tariffs on imports of Mexican sugar.

Korean researchers engineer E. coli to produce terephthalic acid.

Researchers from the The Korea Advanced Institute of Science and Technology (KAIST) have developed an efficient biocatalytic system to produce terephthalic acid (TPA) from p-xylene (pX) via bioengineered Escherichia coli.

Covestro develops process to produce biobased aniline.

Covestro, formerly Bayer Material Science, has made a research breakthrough making the polyurethane precursor aniline from sugar instead of the petrochemical route.

Pakistan – Cane production tops record 73.6 million tonnes.

Sugarcane production peaked to a record high of 73.6 million tonnes year, a 12.4% increase over 2016, according to local press reports.

UK – Non-centrifuged sugar from Colombia sold at US\$14/kg.

The British supermarket Sainsbury's will be selling across its 284 stores the organically produced non-centrifuged sugar from Colombia in 200 g pouches for £2.20 (US\$14/kg).

India – Government raises sugarcane price millers pay to growers by 11%.

The Indian government's Cabinet Committee on Economic Affairs (CCEA) has fixed the Fair and Remunerative Price (FRP) for cane at INR255 (US\$3.95) per quintal (100 kg) for the 2017-18 season, an increase of 11% compared to the previous year.

Thailand to restructure its sugar regime.

Commencing November 2017, Thailand will be introducing new sugar trading system that's in line with World Trade Organization (WTO) rules.

USA – Novozymes invests US\$36 million in an ethanol plant in Nebraska.

Less than five years after Novozymes opened a state-of-the-art advanced manufacturing facility in Blair, Nebraska, the company has selected the site for its most recent expansion efforts in North America. The company's new US\$36 million investment in the facility will increase the plant's capacity.

Clothing dye from sorghum husk extracts.

Researchers from China and USA report production of natural functional dye for wool fabrics extracted from sorghum husk.

Suedzucker to post increased revenues from sugar as liberalized EU market beckons.

The largest global sugar producer Suedzucker said on 18th May that it was confident that it would secure higher earnings as the EU enters a new era with a liberalised sugar market, reported Reuters.

China – Tariff doubled on third of the sugar imports.

China's Ministry of Commerce announced on 22nd May that it will impose hefty penalties on sugar imports to protect its domestic industry.

Kenya to import 150,000 tonnes sugar to cover deficit.

Kenya will import an additional 150,000 tonnes of sugar this year on top of the 100,000 tonnes announced in early May, to cover the deficit due to drought, according to local press reports.

Philippines – Coca-Cola drops its case against SRA on imports of HFCS.

The sugar industry, including small farmers, hailed the decision of beverage firm Coca-Cola Philippines to drop its case against the Sugar Regulatory Administration for regulating the importation of high-fructose corn syrup.

Indonesia – Government offers incentives to investors to develop sugar industry.

The Indonesian government is offering more than a sweet deal to boost investments in the sugar industry with the introduction of a new regulation, which is open for application till the end of May.

Mozambique – New sugar factory likely to commence operations in October.

A new cane sugar factory is scheduled to start operating in the Chemba district next October, according to a district administrator, reports Macuhub.

EU funds consultancy support to develop Jamaica's sugar industry.

Jamaica's sugar industry is set to benefit from the development of a comprehensive financial and economic model being piloted by an EU-funded technical assistance consultancy programme.

Pakistan – Two sugar mills granted licence to cogenerate 62 MW.

The government has allowed two sugar mills in Punjab to set 62 MW of bagasse-based cogeneration plants, according to press reports in early May, citing a government official.

UK – Al Khaleej planning to build over 500,000 t capacity beet sugar factory in Yorkshire.

Planning application has been submitted to Harrogate borough council for the construction of a new beet sugar factory in north Yorkshire.

India – Policy makers encourage shift to drip irrigation for cane in Maharashtra.

The Maharashtra state government is set to introduce a policy for shifting 50% of sugarcane farming on drip irrigation in the next two years, according to Hindustan Times.

Deinove targets cosmetics sector, drops interest in biofuels.

After biofuels and carotenoids, the French biotech start-up Deinove is now moving forward on the cosmetics front. Its engineered microbes can produce a number of high-value chemicals for skin care, and Deinove plans to bring them to market until the end of 2018.

Transformative potential of “holey” graphene for battery systems.

A new breakthrough in battery technology using nanotechnology and graphene from a team of researchers affiliated with institutions in the U.S., China and the Kingdom of Saudi Arabia could power the next generation of drones, and even create a new branch of engineering.

Guyana – Three sugar factories to close as preferential access to EU market ends.

Guyana, the Caribbean trade bloc's largest producer and exporter of raw cane sugar, is scaling back production and pulling away from the European market for the first time in nearly 400 years ahead of the liberalization of the EU sugar sector that had guaranteed export quantities from its former colonies, according to local press reports.

American Process partner with several companies to exploit its nanocellulose production technology.

The biotech start-up American Process Inc (API) recently signed a Joint Development Agreement with the Netherlands-based companies Will & Co B.V. and P.R.G. B.V. to develop, produce and supply ready-to-use thermoplastic compounds reinforced with nanocellulose. American Process has developed a proprietary, low-cost process to separate nanocellulose from biomass.

Morocco – Rise in agricultural productivity drives sugar production.

An ambitious roadmap in place since 2012 has helped drive agricultural productivity in the sugar sector. Sugar yield per hectare increased from 7 tonnes in 2006 to 12 tonnes in 2016. The industry is targeting 14 t sugar/ha by 2020.

India – Praj opens cellulosic ethanol demonstration plant.

Nitin Gadkari, Union Minister – Road Transport, Highways and Shipping, inaugurated Praj Industries cellulosic ethanol demonstration plant near Pune, Maharashtra on 4th May.

Brazil – Indebtedness amongst mid-sized sugar/ethanol plants still an issue.

A number of Brazilian sugar and ethanol firms still face tough financial conditions as heavy debt loads limit investments that could improve their returns, reports Reuters, noting comments made by mill executives and consultants during F.O. Licht's international sugar seminar in São Paulo on 24th April.

Algeria – New sugar refinery inaugurated by the Prime Minister.

The Tafraoui sugar refinery complex, located in the Oued Tlélat daïra in Oran, was inaugurated on 19 April by the Prime Minister Abdelmalek Sellal, according to local press reports.

France: Sucre Océane to expand capacity of its sugar terminal at Le Havre port.

Ahead of the abolition of sugar quotas in the EU on 1 October, Sucre Océane is investing €12.5 million euros in Le Havre to increase the capacity of its sugar terminal from 45,000 to 60,000 tonnes.

Burrowing seeds mechanisms suggests potential application in robotics.

Researchers from Seoul National University have created mathematical models to describe how seeds burrow into soil in response to humidity. Their findings could help find more efficient methods to penetrate soil, with applications in agricultural robotics.

Novel process to produce biobased butadiene used extensively in plastics and rubber products.

Researchers from the University of Delaware, the University of Minnesota and the University of Massachusetts, all affiliated with the Catalysis Center for Energy Innovation (CCEI), have invented a process to make biobased butadiene from plant sugars.

Brazil – Tariff on US ethanol imports backed by agriculture minister.

Agriculture Minister Blairo Maggi has asked Brazil's foreign trade council to impose tariffs on ethanol imports following a surge in shipments from the United States, an official said on 27th April, reported Reuters.

Brazil considers mandates for fuel distributors to drive biofuels use.

The Brazilian government is evaluating setting biofuel mandates to fuel distributors with the aim of increasing consumption of renewable fuels and cutting carbon emissions, the country's biofuels director Miguel de Oliveira said on 25th April, reported Reuters.

China considering introducing additional import tariffs on sugar.

The Chinese Ministry of Commerce plans to introduce special import duties on sugar for three years, which would be added to the current 50% tariff on purchases in excess of the quotas allocated, reports Bloomberg, citing informed sources.

Malaysia – New sugar refinery on course for completion in 2018.

Malaysia's biggest sugar refinery, which is being constructed in Tanjung Langsat, Johor is approximately 80% complete.

Australia – Mackay Sugar looks to sell one of its mills to reduce debt.

Mackay Sugar recently announced it is considering selling one of its mills to reduce the debt of some AU\$212 million (US\$159.5 mln), according to local press reports.

Bionic leaf breakthrough could revolutionise N fertilizer supply.

Artificial leaves that can make fertilizer directly in the soil around crops could one day help farmers to boost food production in remote locations in the developing world.

EU to consider special measures as sugar shortage looms.

The European Commission plans to appeal to EU member states during the last week in April for special measures to prevent a short-term deficit in sugar supplies, reported Reuters.

Italy – Bio-on to build a plant producing biodegradable microbeads for cosmetics.

The biotech start-up Bio-on recently announced the construction of its new plant near Bologna that will produce biopolymer designed to replace the microbeads in cosmetics, deemed responsible for marine pollution and already banned in some countries.

Philippines – Senators settle HFCS row.

A government order regulating the importation of high fructose corn syrup (HFCS) should stay, the head of the Senate committee on agriculture said on 18th April, according to local press reports.

Meridian Waste and Advanced Lignin partner to produce bioplastics.

Meridian Waste Solutions recently signed a non-binding term sheet with Advanced Lignin Biocomposites LLC to create a joint venture to develop Advanced Lignin's biomaterials technology portfolio.

Brazil – 2016/17 sugar output in Centre-South record at 35.96 mln t says UNICA.

The sugar industry group UNICA recently announced that the 2016/17 (April-March) sugar output in the Centre-South region was a record 35.628 million tonnes, up 14.1% from 31.22 mln t in the previous year.

Thailand – Evonik and Rajburi Sugar partner to produce isomalt for the Asian market.

The specialty chemicals group Evonik is partnering with the Thai company Rajburi Sugar to manufacture isomalt. To this end, they have officially opened a demonstration plant in Ratchaburi, Thailand.

Colombia – Tariff on sugar imports reduced by 5%.

The Colombian government reduced the tariff on imported sugar by 5%, from 15 to 10%.

Pakistan – Exports of 200,000 tonnes sugar approved by government.

The economic coordination committee of the cabinet (ECC) on 25th March allowed sugar mills to export 200,000 tonnes of sugar by 31 May, saying the decision was made in line with the industry's recommendations, according to local press reports.

China extends probe on sugar dumping.

The Chinese Ministry of Commerce announced in mid-March that it will extend the investigation on imports of sugar made by the country between January 2011 and March 2016. The extension of term is due to the complexity of the topic. According to the ministry. The new deadline for the conclusion of the proceedings is 22 May.

EU – Sugar beet acreage on the rise as quotas end.

Sugar beet acreage in the EU this year could be the highest since the 2007/08 marketing year, which coupled with a strong increase in yields could result in sugar output in the bloc reaching a 12-year high.

ADM to acquire French sweetener and starch company.

Archer Daniels Midland (ADM) recently announced that it has been granted exclusivity to purchase the French firm Chamtor which manufactures sweeteners and starches based on wheat.

Graphene-based sieve turns seawater into drinkable water.

The invention of a graphene-oxide membrane developed by a team of researchers from the University of Manchester that sieves salt right out of seawater could give millions of people access to clean water.

Brazil – Unica seeking 16% tax on imported ethanol.

The Brazilian sugar industry group, Unica wants an introduction of an ethanol import tariff of 16%.

India – Government allows duty-free imports of 500,000 t raw sugar.

In an attempt to stem the rise in sugar prices domestically amidst general consensus that the 2016/17 output is likely to be around 20 million tonnes, several million less than the government estimate, India has recently authorized 500,000 tonnes of duty-free raw sugar imports.

USA – Butamax to establish bio-isobutanol plant in Kansas.

Butamax Advanced Biofuels has acquired natural gas supplier Nesika Energy and its state-of-the-art ethanol facility in the US state of Kansas for an undisclosed price.

Brazil – Adecoagro to invest US\$166 mln to increase sugar production.

Agribusiness company Adecoagro is planning to expand production at its Ivinhema and Angelica sugar mills, both in the Mato Grosso do Sul (MS) cluster, within next five years.

Scientists engineer oil producing cane.

A multi-institutional team led by the University of Illinois have proven sugarcane can be genetically engineered to produce oil in its leaves and stems for biodiesel production.

Argentina – New US\$ 80 mln cogen unit that will supply 45 MW to national grid.

La Florida sugar mill, owned by Los Balcanes SA, is to get a new 60 MW cogen unit costing US\$ 80 million, according to local press reports.

Mexico – Sugar export quota to U.S. increase to 1.043 million tonnes.

Mexico's government announced on 31st March that it had increased its sugar export quota to the United States during the current cycle to 1.043 million tonnes, from 870,689 tonnes previously, after Washington agreed to the increase, reported Reuters.

Thailand gets new sugar trading system published in Indian Sugar May, 2017.

Thailand, the world's second-largest sugar exporter, is introducing regulations to govern its sugar trading system for the 2017-18 crop, which commences in November, to bring the system in line with World Trade Organization (WTO) rules. It has been designed to govern Thailand's sugar industry in order to secure domestic sugar supply with the repeal of the quota system after more than three decades. Thailand agreed with the WTO to revoke its quota system, known as Quota A, for 2.2-2.5 million tons a year to secure sugar supply at home, after it was challenged by Brazil, the world's biggest sugar exporter. With the proposed abolition of quota system from November 2017, millers will be asked to keep certain amount of sugar every month for domestic consumption.

China slaps import duties on sugar published in Indian Sugar May, 2017.

China said it will impose hefty penalties on sugar imports after lobbying by domestic mills, but experts said the ruling may not go far enough to stem the flow of lower-priced sweetener into the world's top importer. The ruling, which will affect about a third of China's annual sugar imports, introduces an extra tariff for the next three years on shipments that the Government said had "seriously damaged" the domestic industry. The move could dent imports from top growers such as Brazil and Thailand as it will close the big gap between Chinese and international prices. Chinese sugar prices are around double those on the London market.

Ukraine increases sugar exports.

In the first quarter of 2017, Ukraine's exports of sugar amounted to 267.4 thousand tons worth \$131.5 million, which is 8.6 times more compared to the same period in 2016.

Global sugar situation- estimates by USDA.

The United States Department of Agriculture, Food and Agriculture Services has released its monthly report on overview of global sugar production and consumption in 2017-18 marketing year.

Indonesia-Raw sugar imports permits for new mills.

The Ministry of Industry released a regulation which allows new sugar mills to import raw sugar to help capacity utilization. Its aim is to incentivise the setup of new mills with the licence issued after May'10 & face the insufficient sugarcane supply.

Pakistan- Demand for sugar export quota.

Pakistan's Sugar Advisory Board has recommended the export of an additional 1.2 million mt of surplus sugar, as it wants to reduce oversupply of sugar.

Sugar misses the sweet spot in global trade.

Sugar seems to be losing its sweetness in the global market. The price of Sugar 11, which is the most global benchmark for raw sugar contract, has seen a sharp slide from its October peak of about \$0.23 per pound to about \$0.16 per pound currently.

Sugar prices up Rs. 40-50/quintal in Maharashtra after GST rollout.

With the rollout of GST, demand for sugar has gone up in Maharashtra with most mills working on the switchover to the new system. Mills in Maharashtra have raised prices by Rs 40-50 per quintal over and above the 5% GST on the back of short supply in the markets, according to traders.

Sugar Industry demands hike in import duty.

Stakeholders in sugar industry across Maharashtra have demanded to hike import duty from 40% to 60% for a level playing field in domestic market as prices in international market has come down and there is a potential chance of sugar being imported.

Maharashtra farm loan crisis: Largesse to sugar factories, utter failure of co-op banks and complicity of Congress-NCP.

No doubt, district cooperative banks have performed a great role in the rural economy. About 65 percent of the farmers depended on these institutions for loans. Remaining 35 percent went to nationalised banks.

Sugar prices surge by Rs 70 per quintal on strong demand.

Times of India - 5 July 2017, New Delhi: Sugar prices firmed up by Rs 70 per quintal at the wholesale market in the national capital today following tight arrivals from mills amid robust demand from stockist and bulk consumers.

Sugar Output in Top Consumer Set to Rebound From 7-Year Low.

Bloomberg - 5 July 2017: India's sugar production is set to rebound from a seven-year low as above-normal monsoon rain in the world's largest consumer helps the cane crop that will be crushed from Oct. 1.

Maharashtra sugar factory scam: 'Dead' farmers apply for ₹328 crore loans.

Hindustan Times - 6 July 2017: A sugar factory in Parbhani allegedly used the names of 2,298 farmers from Gangakhed village, some of whom were dead, to apply for loans worth Rs328 crore from six banks.

Aspiration, Debt and Death: The Story of One Sugarcane Farmer is the Tale of Western UP.

The Wire - 6 July 2017, Muzaffarnagar: On the afternoon of January 6, 2017, Meenu Singh (39) was at home in Matheri, a small nondescript village comprising 950 people in Muzaffarnagar district, washing utensils after having served lunch to her family of five – her husband, her two teenaged daughters and her 10-year-old son.

Meghalaya CM slams Centre for not including Sugar under NFSA.

News18 - 21 June 2017: Meghalaya Chief Minister Mukul Sangma on Wednesday slammed the Centre for not including sugar under the National Food Security Act, 2013 and said the state will provide one kg sugar to every household in the state. "The Centre has failed to listen to us and discontinued the distribution of sugar from the programme (NFSA).

Karnataka waives cooperative crop loans up to Rs 50,000.

Business Standard - 21 June 2017: The Karnataka government on Wednesday announced waiving of crop loans of up to Rs 50,000 of over 22 lakh farmers from cooperative banks in the state. "Crop loans of up to Rs 50,000 borrowed by 22,27,506 farmers from cooperative banks in the state will be waived," Chief Minister Siddaramaiah told the assembly.

Compensation of sugarcane farmers is still pending since 5 years.

बिजली निगम के अफसर कितने घाघ हैं, इसका अंदाज इसी बात से लगाया जा सकता है कि करीब पांच साल पहले 11 हजार वोल्ट की लाइन से निकली चिंगारी से जली 80 बीघा गन्ने की फसल का मुआवजा आज तक पीड़ित किसानों को नहीं मिल सका है।

Sugar traders observe strike.

Sugar traders observed a one-day strike on Thursday to protest the 5 per cent GST levy on the industry. Sugar has not attracted any State tax since 1947 except for an excise duty of ₹71 per 100 kg at the factory gate to ensure its availability at an affordable price.

Small sugar eases on subdued demand.

PTI - 17 June 2017: Small sugar prices declined further at the Vashi wholesale market here today following reduced demand from stockists and bulk consumers. Medium sugar prices ended mixed on alternate bouts of buying and selling. Small sugar (S-30) fell by Rs 22/6 per quintal to Rs 3,790/3,885 from Wednesday's closing level of Rs 3,812/3,891. However, medium sugar (M-30) ...

Sugar lobby seeks import duty hike as global prices fall.

Economics Times - 9 June 2017, PUNE: The Indian Sugar Mills Association has demanded an increase in import duty on the sweetener from 40% to 60% to prevent dumping of the commodity following the fall in international raw sugar prices.

Ganga: Meerut distilleries get NGT warning.

The National Green Tribunal has asked distilleries in Meerut not to discharge effluents into nearby drains joining the river Kali East and strictly comply with environmental norms. Kali East originates from Antwada village in Muzaffarnagar district and flows through eight districts of Uttar Pradesh before its confluence with the Ganga near Kannauj.

Bio-fuels can be a 'game-changer'.

The Transport Ministry is keen on tapping agricultural and agro-waste products as sources of renewable fuels that are cost effective and environment-friendly, said Nitin Gadkari, Union Minister for Road Transport & Highways, and Shipping.

Uttar Pradesh cane farmers earn additional Rs 5568 crore in 2016-17: Vipin Kumar Dwivedi.

Sugarcane farmers earned an additional Rs 5,568 crore in 2016-17 thanks to rapid adoption of a new sugarcane variety, which increased the average yield by 8.7% to 723.76 quintal per hectare. "With rise in per hectare productivity, not only sugarcane crushing had increased by 1825 lakh quintal relative to last year but also income ...

Shree Mahaganga Sugar Mills reports standalone net loss of Rs 0.06 crore in the March 2017 quarter.

Net Loss of Shree Mahaganga Sugar Mills reported to Rs 0.06 crore in the quarter ended March 2017 as against net loss of Rs 0.12 crore during the previous quarter ended March 2016. There were no Sales reported in the quarter ended March 2017 and during the previous quarter ended March 2016.

Sugar: Snapping its one-month rising streak, sugar saw.

Fall in its prices by up to Rs 170 per quintal at the wholesale markets in the national capital during the week after the GST Council finalised rates for most of the items last week and an increase in fair and remunerative price (FRP) for 2017-18 season.

Cane growers want better price for sugarcane.

Expressing disappointment over the Fair and Remunerative Price for sugarcane, farmers have demanded a further increase. The Central Government after a gap of one year has raised the Fair and Remunerative Price for sugarcane from ₹ 2,300 per ton to ₹ 2,550 per ton for 2017-18.

UP becomes largest sugar producer with 87 lakh tonnes.

Uttar Pradesh has ended the sugar season 2016-17 as the highest sugar producer in the country by beating Maharashtra, ending the season at 87.5 lakh tonnes, a whopping 22.13% increase as compared to last year. The state also achieved an average yield of 72.37 tonper hectare, which is again the highest.

Sugar mills worried over hike in fair and remunerative price of sugarcane.

The sugar mill industry is worried over the Union Cabinet's Wednesday approval to a 10.87 per cent hike in fair and remunerative price (FRP) of sugarcane to Rs 255 per quintal for the sugar season 2017-18.

Sugar stocks gain after Cabinet's decision of FRP hike.

The Cabinet Committee on Economic Affairs (CCEA) has increased the Fair and Remunerative prices (FRP) from Rs 230 per quintal to Rs 255 per quintal for the new sugar season (October to September). The states which follow FRP prices will be impacted by the Cabinet's decision.

Bajaj Hindusthan Sugars posts Rs 92 cr loss in FY17.

Bajaj Hindusthan Sugars today reported a net loss of Rs 91.98 crore for the 2016-17 fiscal. Its net loss stood at Rs 212.10 crore in the previous financial year. The company's total income also fell to Rs 4,729.75 crore in the last fiscal from Rs 4,979.66 crore in the 2015-16 fiscal.

How sweet is the deal? Sugar mills hail 5% rate, seek clarity on cess.

Sugar industry stakeholders have largely welcomed the 5 per cent GST rate applicable to them, but they await the fine details of the tax structure. Cooperative sugar mills in Maharashtra, one of the largest sugar producers in the country, want clarity on whether the sugar cess that the Centre levies on all sugar.

Sugar remains steady on thin trade.

Sugar millgate (including duty): Mawana Rs 3,730, Kinnoni Rs 3,790, Asmoli Rs 3,760, Doralá Rs 3,740, Budhana Rs 3,730, Thanabhavan Rs 3,725, Dhanora Rs 3,750, Simbholi Rs 3,760, Khatuli Rs 3,760, Dhampur Rs 3,710, Ramala Rs 3,700, Anupshaher Rs 3,690, Baghpat Rs 3,710, Morna Rs 3,700, Sakoti Rs 3,730, Chandpur Rs 3,710.

Cooprative mills seek dual pricing for sugar.

The National Federation of Cooperative Sugar Factories (NFCSE) on Friday asked for dual pricing for sugar to ensure its availability at cheaper prices for household consumption and ensure fair remuneration to cane growers.

Centre restores sugar subsidy under antyodaya scheme.

Union Food and Consumer Affairs Minister Ram Vilas Paswan on Monday said the government had decided to restore subsidy to states on sale of sugar to poor families covered under the Antyodaya Anna Yojana (AAY) through the PDS.

Sugar may not be sweet story, but UP bullish of next crop.

As the sugarcane crushing season of Uttar Pradesh is about to get over with record sugar production, the state and industry is confident that UP's sugar production next year will likely surpass current year's production and cross 9 million tonne.

PNG Minister Dharmendra Pradhan called for greater emphasis on ethanol blending & setting up of 2nd generation bio ethanol refineries.

Petroleum Natural Gas Minister Dharmendra Pradhan chaired a high-level meeting of CMDs of OMCs to discuss the status of initial progress of twelve 2-G Ethanol Bio-Refineries in 11 states. Last week Prime Minister, after the ministerial review of MoPNG, called for greater emphasis on ethanol blending & setting up of 2nd generation bio ethanol.

Sugar closes quiet on scattered demand.

Sugar prices ended quiet at the wholesale market in the national capital today on adequate stocks against scattered demand. Marketmen said ample stocks following increased supplies from mills, mainly kept sweetener prices unaltered. Following are today's quotations (in Rs per quintal) Sugar retail markets – Rs 43.00-45.00 per kg.

Uttarakhand seeks Rs 895 crore for modernising sugar mills.

Uttarakhand Sugarcane Development Minister Prakash Pant has sought a package to the tune of Rs 895 crore for the modernisation of sugar mills in the state. Pant put forward the state's demand before Union Agriculture Minister Radha Mohan Singh when he met him later in Dehradun today.

UP: Yogi promises to open new sugar mill in Basti.

उत्तर प्रदेश के मुख्यमंत्री योगी आदित्यनाथ ने बस्ती की जनता से वादा किया है कि यहां चीनी मिल खोला जाएगा। इस संबंध में बातचीत जारी है। शनिवार को मंडल मुख्यालय पर समीक्षा बैठक करने पहुंचे योगी ने कार्यकर्ताओं से कहा कि अब आप की केंद्र और राज्य में सरकार हैं

AAV to get 1 kg subsidised sugar via ration shops: Ram Vilas Paswan.

The sugar subsidy to AAV and other beneficiaries via PDS was discontinued with effect from March 2017. The Union food and consumer affairs ministry as well as some states had been keen on its continuance for at least AAV families. Sale of cheaper sugar has been restored to 2.5 crore families of Antyodaya Anna Yojana

To save water, Maha govt wants 50% sugarcane crop on drip irrigation in 2 years.

Following criticism over sugarcane crop guzzling potable water, particularly in drought-prone Marathwada, the state government is set to introduce a policy for shifting 50% of sugarcane farming on drip irrigation in the next two years. Statistics revealed that sugarcane fields cover 10 lakh hectares across the state.

Sugar prices up on paucity of stocks, seasonal demand.

Sugar prices strengthened by Rs 30 per quintal in futures trading today following increased offtake by retailers, stockists and bulk consumers, triggered by pause in supplies from mills. Marketmen said strong demand for the ongoing summer and wedding season coupled with speculative buying by stockists mainly pushed up sweetener prices. Besides, fall

Haryana approves Rs 82 cr for setting up ethanol plant.

Haryana government today said about Rs 82.50 crore will be spent for setting up ethanol plant in cooperative sugar mill at Shahabad. The plant, which would be made functional next year, would generate income of about Rs 12-15 crore every year and in about six years, the mill would complete

World sugar-export surplus returns on Indian demand, EU supply.

Global sugar exports will exceed demand this season and the next as India brings in less than expected and the European Union boosts output, according to Tropical Research Services, which advises hedge funds. Exports will beat import demand every quarter through September 2018, TRS estimates.

Praj Successfully Demonstrates its Cellulosic Ethanol Technology.

Mr. Nitin Gadkari, India's Minister for Road Transport, Highways and Shipping, inaugurated Praj's cellulosic ethanol demonstration plant near Pune, India on 7th May 2017. It is India's first integrated bio-refinery, built to showcase Praj's cutting-edge proprietary process technology to produce ethanol from agricultural waste.

Govt lowers cane output estimate to record 306.03 MT for 2016-17.

Buoyed by record output of wheat, rice and pulses, foodgrain production in India is estimated to touch all-time high of 273.38 million tonnes in the 2016-17 crop year ending next month due to good monsoon.

Sugar prices end quiet on scattered demand.

Sugar millgate (including duty): Mawana Rs 3,725, Kinnoni Rs 3,760, Asmoli Rs 3,745, Daurala Rs 3,730, Budhana Rs 3,725, Thanabhavan Rs 3,720, Dhanora Rs 3,740, Simbholi Rs 3,750, Khatauli Rs 3,750, Dhampur Rs 3,710, Ramala Rs 3,660, Anupshaher Rs 3,660, Baghpat Rs 3,680, Morna Rs 3,670, Sakoti Rs 3,720, Chandpur Rs 3,690.

District admin cracks a whip on defaulting sugar mills.

The six sugar mills out of a total of eight defaulter mills in the district have settled the dues of cane growers, district sugarcane officer Omparkash Yadav said today. The remaining defaulters namely Bhesani Mills and Khaikheri Mills will shortly settle their dues, he told reporters here.

Sugar mills turn to Yogi Adityanath, want state power utilities to clear power dues of Rs 800 cr.

With sugar mills in Uttar Pradesh piling up cane arrears of over Rs 3,836 crore for 2016-17, millers are demanding that the state power utility clear their power dues of over Rs 800 crore at the earliest so as to enable them to pay off their cane dues.

Praj scales up second generation ethanol tech.

Praj Industries said it has scaled up its second generation ethanol technology at a cumulative investment of Rs 150-175 crore. The company said this investment was done through internal accruals and has vested over the last seven years.

Sugarcane in parched state.

Politicians controlling sugar cooperatives in Solapur have diverted 70 per cent of water to sugarcane fields, leaving the villagers to deal with the resulting drought Maharashtra is a drought prone state. Much of the Deccan plateau is parched for water.

Sugar mills still owes Rs.119 Cr.

चीनी मिलों का पेराई सत्र समाप्त हुए एक माह होने जा रहा है, लेकिन किसानों का बकाया गन्ना मूल्य भुगतान अभी तक नहीं किया गया है। जिले की एक प्राइवेट और सहकारी मिलों पर 119 करोड़ रुपये बकाया हैं, जिनमें सर्वाधिक 82.36 करोड़ रुपये बरखेड़ा स्थित बजाज चीनी मिल पर है।

Sugarcane farmer commits suicide over crop loss.

Aggrieved over his sugarcane crop affected by wilt owing to drought, a farmer from Anaikudi village near Thiruvaiyaru in Thanjavur district committed suicide at his farm here on Thursday. S Selvaraj, 58, from Mela Street in Anaikudi village, was found hanging from a tree in his sugarcane field in Anaikudi village on.

Agnivesh demands CBI probe into death of two sugar factory workers.

Noted social activist and senior JD (U) leader Swami Agnivesh today demanded CBI probe into the deaths of two sugar factory workers in self-immolation bids in protest against non-payment of outstanding wages to them in East Champaran district.

Kaithal sugar mill made recovery more than the target.

कैथल :दी कैथल सहकारी शुगर मिलने इस बार 20 साल बाद रिकवरी का रिकॉर्ड बनाया है।औसत रिकवरी में मिलने प्रदेश की बड़ी मिलों को भी पीछे छोड़ दिया।लक्ष्य10.10 प्रतिशतरिकवरीकाथा, लेकिन यह 10.15 प्रतिशत तक पहुंच गयाहै।

Yogi Adityanath's crushing burden: Cane talk sells well, but sugar mills paid farmers Rs 19,000 cr extra.

When the 14-day-deadline for clearing sugarcane dues for the current year expires, and Uttar Pradesh chief minister Yogi Adityanath has to start taking action against sugar mills like Bajaj Hindusthan—over 55% of the 4,200 crore dues are on account of Bajaj—who simply do not have the funds to be able to comply with the UP.

Sugar sector balance sheets set to turn sweeter: Crisil.

The credit risk profiles of sugar manufacturers are likely to improve over the medium term with sugar prices expected to remain firm over the current and next sugar seasons (October 1 to September 30).

Sugar mills owe over Rs 400 cr to cane farmers.

Eight sugar mills owe over Rs 400 crore to sugarcane farmers in the district, an official said today. District Cane Officer Omprakash Singh said an amount of over Rs 442 crore are outstanding against the eight sugar mills as cane dues of farmers.

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ABSTRACTS:

Evaluating a fixed-rate fertilization system in sugarcane by Edwin Erazo; Fernando Muñoz and César Arévalo published in 29th ISSCT Congress, 2016.

Errors in fertilizer application using a fixed-rate fertilization system in sugarcane were compared with those of a conventional system (i.e. using a fertilizer without the fixed-rate system). Before the sugarcane growers introduce the technique of Variable Rate Technology (VRT) they need to know that a constant application rate is guaranteed under field conditions. An experiment was conducted in a ratoon sugarcane crop covering 4.0 ha in Colombia. A balanced, multifactorial experimental design was used with four treatment factors: fertilizer application system, rate of application, travelling speed of tractor-fertilizer spreader, and fertilizer product. Response variables were application error, amount of fertilizer accumulated at the end of the furrow, coefficient of variation of fertilizer applied, and trend of under- or over-application rate at the beginning and end of the furrow. Results show that the error of fixed-rate application is lower (-3.9%) than that of the conventional system (5.5%). In addition, the fixed-rate system is more accurate at low rates than the conventional system (error up to 12.9%) and presents less variation in application than the conventional system (error up to 32.9%). A fixed-rate fertilizer application system, therefore, presents lower application error and variation in the rate of application compared with the conventional system of fertilizer application.

Influence of yield and other cane characteristics on cane loss and product quality by S Khawprateep,, TA Jensen, BL Schroeder and S Eberhard published in 29th ISSCT Congress, 2016.

Field and crop conditions affect cane loss, cane-supply quality and the amount of extraneous matter that is mixed with cane billets supplied to the mill. The size of the crop produced also impacts on machine performance and cane loss during harvest. Crop physical properties and the composition of the sugarcane stalk are driven by a wide range of agronomic practices, including nutrition. The objective of this study was to investigate the impact of different crop conditions on sugar loss during harvest, with in-field nutrient practises being the primary driver of the changing cutting pour rates when the ground speed is fixed. The physical properties of the sugarcane (stalk length and diameter, population density and yield) were measured in the experimental plots in Bundaberg in 2014 and Macknade in 2015 that had received a range of different nitrogen (N) application rates before being cut by a chopper harvester. Cane loss during cutting was then determined at harvest by collecting all material (leaves, tops, stalks, etc.) discarded from the harvester. This procedure was performed using a standard 'tarp test' combined with a loss-assessment method based on measuring juice loss on trash to evaluate cane loss, juice loss, etc. The residue samples gathered from the tarp were shredded and frozen for determination of sugar loss by colorimetric method, using a

Glucose and Sucrose Colorimetric Assay Kit. Different N rates resulted in a range of stalk physical properties (stalks per unit area, billet size and stalk weight) and cane yields (t/ha). With the harvester operating at a constant ground speed (and set fan speed) the pour rate was driven by the N applied. As pour rate increased, the ability of the extractor fan to efficiently differentiate trash from billets decreased, resulting in greater sugar loss. Sugarcane sizing influenced by the varying N rates led to the sugar loss differences occurring during the cutting by the harvester.

ECOFI: a new generic database to analyse complex agroecological experimentation

by S Auzoux, J-F Martine, C Poser, P Marnotte and F-R Goebel published in 29th ISSCT Congress, 2016.

Agroecological studies on sugarcane dealing with genotype by environment by management interactions commonly generate complex datasets. Data are collected separately and can be multi-scale (from phytomer to field), multi-species (sugarcane and companion plants), and multi-disciplinary (agronomy, entomology, ecophysiology, weed science, etc), making their use complex in system data analysis. This paper presents a solution to manage these heterogeneous data using database and metadata technology. A relational database, named ECOFI, was designed from the analysis of the content and the structure datasets of multi-disciplinary experiments with sugarcane. The results of this analysis showed that most datasets shared data corresponding to common environmental by management factors and the same measurements, such as

yield, weed occurrence and insect incidence. However, each of them had its own structure. To analyse biology by environment by management interactions efficiently, the structure of ECOFI was built into three parts: the environmental conditions, the agricultural practices, and the impacts observed on biotic and abiotic variables using agronomic measurements. In standard databases, each additional observed variable generally forces an update to the existing database model. The model of the ECOFI database does not require such modification. Taking into account a new variable is very easy, consisting solely of the addition of a new record in a table, after having stored the new variable label and its definition (unit, type, scale) in a generic metadata table. This technology minimizes the number of tables, columns and empty cells and improves database query performance. ECOFI is already used to manage, explore and analyse the data from agroecological experiments, ecophysiological observations and sugarcane modelling in Réunion Island and other sugar-producing countries. ECOFI is a generic database that improves analysis and facilitates access to multi-disciplinary and multi-scale data. Its data model can be applied to any type of project.

The best time to apply N-fertilizer in sugarcane ratoons in the Centre South of Brazil

by SGQ Castro, HCJ Franco, GM Sanches, OT Kolln and PSG Magalhães published in 29th ISSCT Congress, 2016.

The low efficiency of nitrogen (N) from fertilizer is a major concern worldwide, threatening the sustainability of sugarcane

production. Improved N-use efficiency (NUE) by sugarcane and the corresponding reduction in environmental impacts can be achieved by adopting best fertilizer management practices. Our objective was to assess the best time to apply N during the crop season in the Centre South of Brazil. Three experiments were established with the same design and evaluated for two crop seasons. The treatments were different times of N application (0, 30, 60, 90, and 120 days after the harvest - DAH) and different N application rates (0, 50, 100, 150 and 200 kg ha⁻¹ N). Each experiment was harvested at different times during the same crop season: the first was harvested early (April); the second in August (mid-season); and the third in October (late season). The time of harvest and the time of N application both impacted on cane yield. The N applied at 0 to 60 DAH increased yield in the experiment with early harvest. In the August harvest, the best time to apply N was at 60 DAH. Yield differences in the October harvest were associated with the time of N application. Lower yield were obtained when N was applied at 60 DAH. In terms of early and mid-season harvests, the best N rate was approximately 140 kg N ha⁻¹. Nitrogen application had less influence on yield if the cane was harvested late. Finally, it is important to highlight that the best time to apply N in our three experiments was when the soil had a good water content.

Improving the efficiency of the estimation of agricultural and factory yields in Cuba by Alberto N González, Maira Ferrer, Gilda Jiménez and Eduardo Casanova published in 29th ISSCT Congress, 2016.

The Cuban sugarcane needs efficient methods to estimate yields, both from an agriculture and industry perspective. We present a Cuban case study related to this subject. The study used yield data from 2001 to 2013 from 55 mill areas. Four existing models were evaluated and three mathematical models were proposed to predict sugar and potential yields (RPC). The statistical analysis explained more than 88% of the total variance of the data. The results obtained through stepwise regression analysis were validated for the mills using the 2014 sugar harvest and enabled indicators such as Pol % cane, fibre % cane, brix and Pol of the primary juice and factory losses to be used to predict both factory yield and RPC. The yield average of the 2013 harvest differed by as little as 0.9 t/ha from the actual yield obtained. One of the models (Model 3) was considered to best represent the planting and harvesting system used in Cuba. The relatively high regression coefficients indicate that the models can be used by technical staff and the managers of the mills for predictive purposes.

Efficiency of arbuscular mycorrhiza fungal inoculation with rock phosphate on soil-available phosphorus, and drought stress, growth and yield of sugarcane under field conditions by Suchat Juntahum and Sophon Boonlue published in 29th ISSCT Congress, 2016.

A field study was conducted under rain-fed conditions to investigate the effect of arbuscular mycorrhizal fungi (AMF), *Funneliformis mosseae* KKU-BRP-KK6-2 inoculation with rock phosphate (RP) application on soil-available phosphorus (P),

proline content in leaves, major nutrient uptake, biomass, promotion of growth, and productivity of sugarcane. The experiment design was carried out in a randomized complete-block design (RCBD) with three treatments: control, AMF inoculation and applied RP (AMF+RP), and applied RP (RP). Data were recorded every 4 months until harvest (approximately 12 months). Colonization intensity in the sugarcane root was increased by inoculation of AMF. The available P in the rhizosphere soil surrounding the sugarcane roots had the highest increase with the AMF+RP treatment at all growth times. At the period of water stress in the dry season (4 months), the plant with the AMF+RP treatment had the highest leaf proline content, significantly higher than the other treatments. At the major growth phase (8 months), the height and stem diameter of the sugarcane were significantly increased with the AMF+RP treatment. At harvest (12 months), the highest N, P and K uptakes by sugarcane were obtained with the AMF+RP treatment. The plant inoculated with AMF+RP had the highest level of plant dry biomass, cane yield and CCS, significantly higher than the non-inoculated control. Sugarcane plants with AMF+RP increased cane yield by 51%, when compared with the control. The results indicate that using *Fu. mosseae* KKU-BRP-KK6-2 together with RP as a biofertilizer improved soil P status and tolerance to drought stresses, and promoted plant growth and yield production of sugarcane.

Features of sugarcane yield components of the low-yielding area in northeast Thailand by A. Kamiya, O. Yatabe, S Ando, W

Ponragdee, S Ito, Y Terajima and A Sugimoto published in 29th ISSCT Congress, 2016.

Northeast Thailand is the largest sugarcane production area in Thailand despite low yields. Kumphawapi is a typical low yielding area in Northeast Thailand due to poor sandy soil and severe dry periods from November to April. To improve the sugarcane yield in this area with resource/labor saving technologies, we evaluated features of sugarcane growth in Kumphawapi area and considered some key points for improvement. We surveyed 144 plots (7.0 m²/plot) in 24 sugarcane fields for both plant cane and ratoon cane. Cane yield and contributors to yield such as juice quality, number of missing plants, initiation depth of ratoon regrowth, number of underground nodes, length and diameter of underground stems, and total number of roots were investigated. Cane yield was higher in plant cane (96.7 t/ha) than ratoons (67.2 t/ha). Stalk weight of ratoons (1152 g) was significantly lighter than that of plant cane (1594 g), although there was little difference in the number of millable stalks. In high-yielding plots, the number of millable stalks and stalk weight of both plant and ratoon cane were high. Cane yield was positively correlated with the number of millable stalks and stalk weight in low-yielding plots, but only with stalk weight in medium-yielding plots. The number of millable stalks in plant cane and ratoons were positively correlated. The number of missing plant in plant cane markedly affected the number of millable stalks in plant cane. These results indicate better germination and growth at an early stage are necessary to improve the yield in low-yielding plots. Stalk weight was positively

correlated with the depth of bud initiation in ratoons. This suggested that stalk weight of ratoons largely depended on the depth of the germination position. Seed cane should be planted as deep as possible within the planting furrow to improve stalk weight in ratoon crops.

Sugarcane yield and ripening response to chemical ripeners by A Karmollachab, A Bakhshandeh, MR Moradi Telavat, F Moradi and M Shomeili published in 29th ISSCT Congress, 2016.

The effects of chemical ripeners on increasing sugar content (cv. CP57-614) during the sugar-accumulation period were evaluated in Khuzestan province, Iran. Three chemicals, ethephon (2-chloroethyl phosphoric acid), glyphosate and Fitomas®-M (a growth regulator), were each applied as a foliar spray on the crop using a small aircraft. Application of glyphosate increased Brix, Pol%, fibre and recoverable sugar, but application reduced cane length and invert sugars and there was also a marginal decline in cane yield. The improvement in cane quality outweighed the reduction in cane yield. Ethephon application had no impact on cane yield, but showed a marginal improvement in Pol % (3.3%) and recoverable sugar (3.4%) compared to the untreated control. Fitomas-M had no effect on cane yield, but caused a decline in Pol%. Based on the large-scale trials done in Khuzestan province it was demonstrated that 0.5 L/ha of glyphosate increased recoverable sugar by 10.6%, indicating that this treatment was most suitable for increasing sucrose content during the sugar-accumulation period of crop maturity or early stages of harvest.

Exploitation and application of improved farming-systems technologies in sugarcane production in China by Yang-Rui Li, Li-Tao Yang, Hong-Wei Tan, Wei-Zan Wang, Liu Yang and Xiu-Peng Song published in 29th ISSCT Congress, 2016.

This paper summarizes the achievements in exploiting and comprehensively applying modernized sugarcane farming-systems technologies in China. Since the 1980s, China has developed a series of advanced and appropriate farming technologies in commercial sugarcane production, and has adopted these practices since the 1990s. These technologies include deep-ploughing and soil preparation, plastic-film mulching, a prescription fertilizer system, trash retention in fields, water-efficient irrigation, use of pathogen-free healthy seed-cane, rationalised application of vinasse, chemical ripening, in-field machine operation, and comprehensive control of diseases, pests, weeds and rats. The exploitation and comprehensive application of the new sugarcane farming-systems technologies have promoted the Chinese sugar industry to new levels of production every 5 years, and made China the third-largest sugar-producing country. However, the sugar industry has been experiencing difficult times in the recent two milling seasons because of the worldwide low sugar price and the high production cost at the domestic level. This has led to a substantial reduction in sugarcane-growing areas and sugar production. Mechanization and the related sugarcane variety selection and farming technology development have become a bottleneck for sustaining the development of the sugar industry in China.

Modelling energy cane growth in contrasting environments: calibration and validation by J-F Martiné, C Poser, C Roussel, E Gérardeaux and J-L Chopart published in 29th ISSCT Congress, 2016.

Given the worldwide increase in energy demand and its high biomass potential, sugarcane is more and more valued as an energy crop. To cope with this demand, sugarcane needs adapted cropping systems, including cultivars, and requires decision tools such as crop growth models fitted onto energy outputs (aerial dry biomass) from appropriate cultivars. To investigate biomass-energy potentialities and adapt the cane crop growth model Mosicas, experiments comparing the same energy canes cultivars from WICSCBS (Barbados) against local check cultivars were conducted on plant crops in two experiments in two contrasting sites in Réunion (Indian Ocean) and in three experiments at one site in Guadeloupe (Caribbean). Dry biomass and water content were monitored on subplots to determine biomass potentialities and select the best cultivars. Together, the plant-crop results of the two sites in Réunion were used to calibrate two variables in Mosicas: aerial dry biomass and water content. Plant-crop results from Guadeloupe were used to evaluate the model on those two variables. At the three sites, the different temperatures, radiation and rainfall patterns lead to different dynamics of cane water content and dry biomasses and production of 75 t cane/ha. At the two sites in Réunion, using four and three parameters, respectively, for dry biomass and water content calculations, Mosicas predicts those two variables fairly well with respective

root mean square errors (rmse) of 2 to 3.6 t/ha and 1.1 to 1.9% according to cultivars. In Guadeloupe, the model fitted in Réunion predicted reasonably well dry biomass and partially the water content. When only the parameter values are fitted and empirical water content process are added, the modified Mosicas model predicts very different biomass dynamics and cultivar ranks. Given this, Mosicas could be used as decision-making tool to optimize energy production strategies using long-term climate data or future weather scenarios.

Increasing sugarcane yields and decreasing inputs for smallholder growers through improvements in irrigation scheduling in Swaziland by PV Mkhali and NM Dlamini published in 29th ISSCT Congress, 2016.

Smallholder sugarcane growing is essential in Swaziland for poverty alleviation and rural economic development. The area under sugarcane in Swaziland is about 59 000 ha, with about 14 000 ha managed by a large number of smallholder growers. The Swaziland Sugar Association Technical Services conducted a study in 1998 that showed that smallholder growers did not follow any form of irrigation scheduling. Irrigation scheduling is essential to meet crop-water requirements and can help to reduce the cost of electricity usage. This observation led to the initiation of an irrigation scheduling research project in 2011/12 funded by the European Union. At its inception, 63 growers from the three sugarcane-growing areas in Swaziland volunteered to participate. The 'Pin-peg

board' irrigation scheduling method was used in the project because the smallholder growers could easily understand it. The Pin-peg board method required growers to move a pin on a board on a daily basis, depending on the day's evapotranspiration (ET). This method was combined with the 'Profit and loss book', the irrigation scheduling software 'Canesched' and the cellular phone short message system technology to convey daily ET figures to growers and to receive feedback from them. In addition, growers received training to enhance their understanding and implementation of the project. Overall, the project was a success in the 4 years of implementation despite some challenges. More than 80% of the smallholder growers participating in the project implemented the irrigation scheduling methods. The growers benefited by up to about 21% and 30% savings in water and electricity, respectively, and also through improved record keeping. Observed trends showed an improvement of about 2% in yields and 4% in cane quality. Overall, the project was a success as there were water and electricity savings and increased yields. The project has subsequently been rolled-out to 79 further smallholder growers.

Use of cowpea (*Vigna unguiculata*) as a green manure and its effect on nitrogen (N) requirement and productivity of sugarcane by F Muñoz, F Villegas, C Moreno and C Posada published in 29th ISSCT Congress, 2016.

The use of green manure to supplement or to replace the use of industrially synthesized nitrogenous fertilizers has attracted the

interest of farmers worldwide, and sugarcane growers are no exception. Generally, sugarcane is fertilized with high rates of urea, causing a reduced profit and increased risk of pollution to the atmosphere and water bodies. To evaluate the response of sugarcane productivity to the incorporation of cowpea (*Vigna unguiculata*) as a green manure to replace or to complement fertilization with urea, an experiment was conducted during four crop cycles (plant cane and three ratoons) in the Cauca Valley in Colombia. There were six replications and six treatments in which the cowpea was planted in the inter-rows at sugarcane planting (plant cane) or after harvest (ratoons) and incorporated into the soil at flowering. The treatments consisted of an absolute control (no N, no cowpea), four treatments in which the incorporation of cowpea was combined with increasing rates of urea (no urea application, 33%, 66%, 100% standard rates) and a treatment with 100% urea without cowpea. The 100% rate of urea was equivalent to 138 kg/ha N, the commercial rate used by the mill. Quadratic regression models based on the combined productivity of the four crop cycles showed that productivity in terms of cane yield (TCH) was more responsive to an increase in N rate than productivity in terms of sugar yield (TSH). The beneficial effect of manuring with cowpea was clear at the end of the four crop cycles. N rate (119.3 kg/ha) for maximum TCH and N rate (101.3 kg/ha) for maximum TSH were higher than N rates for maximum profit. Overall, the commercial N rate applied at this site is excessive and would cause decreased profit and an increased risk of environmental pollution.

A tool for converting conventional sugarcane trial results into economic terms by S. Ramburan, P. Tweddle, R. van Heerden, P. Ramouthar and N. Miles published in 29th ISSCT Congress, 2016.

Results from sugarcane field trials are conventionally presented in cane and/or sucrose yield terms. The availability of a tool to convert conventional field-trial data into economic terms would enable researchers to rapidly perform economic calculations and routinely include economic considerations into recommendations to end-users. This paper outlines the nature of such a tool that was developed at the South African Sugarcane Research Institute (SASRI), and reports on its performance when tested across a series of sugarcane trials. The MS Excel-based calculator allows for the definition of treatments, together with the input of measured trial cane yields and cane quality defined as recoverable value content (RV%). Production factors and their related costs are listed sequentially from land preparation through to cane delivery to mills. Users are able to activate any given production factor depending on the type of trial being considered. Treatment differences (cost/ha) for that specific factor are then defined further. The tool considers all harvesting, loading, and transport costs associated with higher cane-yielding treatments, together with any product and application cost differences to calculate a gross margin (GM) for all treatments. Data from variety, chemical ripener, nematicide, mulch-retention, harvest-age, and crop-nutrition field trials were analysed using the calculator. Data input consisting of trial parameter set-up and

definition of treatments were completed in under 10 minutes for each trial, and the GM of each subsequent crop in a trial could be calculated in under another 2 minutes. In general, the GMs were well correlated to RV yields when using current production costs. However, sensitivity analyses showed that increases in treatment costs, cane yield and its related harvesting and transport costs may offset future GM benefits of some treatments. Foliar application treatments generally produced much higher GMs compared with controls, even if product and application costs were doubled. Selected examples of the different applications of the calculator are illustrated and discussed. It is envisaged that the calculator will become a useful tool for researchers needing to improve the adoption of best management practices through economic reporting.

Carbon dioxide enrichment effects on the decomposition of sugarcane residues by Nilza Patrícia Ramos, Thiers Alves Vidal, Rebeca Ramos, Raffaella Rossetto and Kátia de Lima Nechet published in 29th ISSCT Congress, 2016.

The aim of this study was to determine the decomposition dynamics of sugarcane residue under conditions of enriched atmospheric CO₂ concentration using a FACE facility (Free-Air Carbon Dioxide Enrichment). The experiment, conducted in Jaguariúna, São Paulo State, Brazil, using the ClimapestFACE facility, received two treatments: elevated CO₂ (550 ± 100 µmol mol⁻¹) and ambient CO₂ (400 µmol mol⁻¹), for a single amount (5 t ha⁻¹) of straw (cane trash), in a randomized-block design with six

replications. Decomposition was determined by using litter bags with sampling at 0, 14, 36, 60, 90, 119, 179, 291 and 362 days after commencement and determining the remaining biomass (kg ha⁻¹), decomposition rate (%), constant k (kg.day⁻¹) and half-life ($t_{1/2}$) of decomposition (calculated by first-order exponential model). Results showed significant statistical interaction among treatments, mainly from 90 to 179 days after the beginning of the experiment when the region had high precipitation and, coincidentally, the highest straw decomposition rate (4%) at the ambient CO₂ concentration (400 μ mol mol⁻¹). After that, there were no statistical differences. Small differences between treatments were not significant to affect the overall behavior of the decomposition dynamic, which followed an exponential behavior, with the same k (0.002929 kg days⁻¹) for both treatments. Decomposition ratio was high (33%) during the first 36 days, but $t_{1/2}$ was 237 days. Final decomposition was 69% with 1.5 t ha⁻¹ of remaining biomass. We concluded that the increase of atmospheric CO₂ concentration (from 400 to 550 \pm 100 μ mol mol⁻¹) does not change the dynamic of sugarcane residue decomposition, which is exponential and has its highest biomass loss in the first 36 days after field deposition.

Isolation and preliminary biochemical characterization of nitrogen-fixing bacteria belonging to three genera obtained from sugarcane in Colombia by Jennifer Roa, Marcela Cadavid, Fernando Muñoz, Héctor A Chica and Carlos A Ángel published in 29th ISSCT Congress, 2016.

Sugarcane is an important crop in Colombia, intensively planted to about 228,000 ha along the Cauca River Valley. To reach profitable yields, high and in some cases excessive nitrogen (N) fertilizers are applied, increasing production costs and risks for environmental and water contamination. Looking for strategies to reduce N applications within a sustainable and integrated crop management, the role of N-fixing bacteria is being explored. The objective of this study was to isolate and characterize native cultures of three recognized N-fixing bacteria and plant growth promoter genera such as *Azospirillum*, *Azotobacter* and *Gluconoacetobacter*, and to determine their association to four of the most important and widely planted CENICAÑA-Colombia (CC) varieties (CC85-92, CC84-75, CC93-4418, and CC01-1940). To cover most environments along the valley, 108 fields were selected using geographical information system ArcGIS®. Individual samples consisted of 20 plants were selected randomly according to a predetermined method, sampling roots, stems, leaves, and rhizospheric soil from each plant and site. Samples were processed at CENICAÑA's Plant Pathology Lab, plating on selective culture media LGI-P, Ashby, and NFB, among others for each bacteria genus. Morphological and biochemical characterization for α and β -proteobacteria were undertaken by triplicate, including aerobic/microaerophilic, motility-helical-shaped rods and cocci, Gram stain, and oxidative-fermentative metabolism of different carbohydrates and organic salts. In addition, production of growth-promoting substances was also evaluated. Comparisons were undertaken against type cultures of *Azotobacter chroococcum* NCBIM 8002,

Azospirillum brasilense NCBIM 11860, *Gluconacetobacter diazotrophicus* NCBIM 12985, among other bacteria. Out of 143 obtained isolates, 111 were characterized. Cluster analysis identified three groups that explained 91% of biochemical and metabolized carbohydrates variation. Quantification of indole-3 acetic acid as growth promoting substance showed also high variation with similar contents between *Azotobacter* spp. and *Azospirillum* spp. isolates, but significant statistical differences ($\alpha=0.05$) to *Gluconacetobacter* spp. with lower production. Sequencing of 16S rDNA to identify species as well as acetylene reduction assays to determine N-fixing performance for these isolates is in progress. Fourteen isolates from the three genera were identified as promising candidates for further studies.

Use of apparent soil electrical conductivity to improve sugarcane nutrient management in Florida by Hardev S Sandhu, Maninder P Singh and James M McCray published in 29th ISSCT Congress, 2016.

Precision agriculture is considered to be one of the most promising approaches for sustainable farming, but it requires efficient methods for accurately measuring within-field variations in soil physical and chemical properties. Apparent soil electrical conductivity (ECa) is a quick indirect measurement of soil EC with a sensor (e.g. EM-38), and the latter is used to determine spatial variations of this parameter in the field without extensive soil sampling. Correlation of ECa values with different soil nutrients in organic and mineral soils in

southern Florida can help in determining its potential use to improve nutrient management in sugarcane. Data on ECa and different soil variables were collected from several 5-15 ha fallow sugarcane fields in Palm Beach (organic soil, Histosols) and Hendry (mineral soil, Entisols) counties of Florida in 2014 and 2015. Soil samples were analyzed for pH, P, Ca, Mg, S and Si in soil testing lab at the Everglades Research and Education Centre, Belle Glade. In organic soils, the bulked soil data showed significant correlations between ECa and each of soil pH ($r=0.72$), Mg ($r=0.62$), Si ($r=0.52$) and Ca ($r=0.35$). In mineral soils, there were significant correlations between ECa and each of pH ($r=0.75$), PMehlich-3 ($r=0.73$), Ca ($r=0.58$), and Si ($r=0.46$). Grouping the fields into different zones based on their location changed the correlations for the tested variables. PC-stepwise regression analysis indicated that soil pH was the major contributor to the variability in soil ECa in both soil types. Results showed that the correlations between ECa and the measured soil parameters were not consistent through all the tested zones or the fields. Therefore, ECa may be more precisely used in management of these parameters at zonal or field level. In bulk soil, the correlations between ECa and soil pH were highest in both soils and that supports the need of further exploration of ECa maps in soil pH management across a wide range of sugarcane fields in Florida. Alternatively, ECa may be used in conjunction with soil sampling to determine the spatial variability of the soil variables and thereafter be used for precise management of different nutrients. Further research is needed to determine the

relationship between ECa and sugarcane yield, and for the use of yield maps in ECa map calibrations.

Historical ENSO-related impacts on sugarcane yields in northeastern Thailand

by Mayura Seechan, Vipaporn Chimnarong, Voraveerukorn Veerachit, Theerawat Jiraphattharasiri, Saravanan Rethinum and Upsorn Pliansinchai published in 29th ISSCT Congress, 2016.

ENSO is the inter-annual fluctuation of the atmosphere-ocean system in the equatorial Pacific. ENSO consists of three phases, warm (El Niño), cold (La Niña), and neutral. The net effect of the rainfall pattern leads to irregular dry or wet seasons in most parts of Southeast Asia. However, the intensity of the ENSO impact on agriculture is difficult to evaluate due to many variable that need to be analyzed for prediction. The major area of Thai sugarcane production, about 40%, is located in the Northeastern part of the country. During 2006-2015, the crop yield was intensively studied by comparing with benchmark yield (average yield of 10 years) with yields of 32,728 sampled fields. The analysis was based on the three phases of ENSO: El Niño, La Niña and neutral. The results showed that El Niño and La Niña have more effect on plant-cane yield than on ratoon-cane yields. Yield decreased by 1-12% in plant cane and by 1-10% in ratoon cane. In contrast, plant-cane yield increased by about 10% above the benchmark yield in neutral years. In addition, ENSO can impact on sugarcane yield regardless of whether the intensity is weak, moderate or strong. In particular, sugarcane yield depends on the

distribution and accumulation of rainfall during the phenological phases of the sugarcane.

Climate-smart agriculture: catalyzing behavior change in sugarcane farmers for water-use efficiency

by Raj Pal Singh, Harsh Vivek, Suparna Jain and Prashant Pastorepublished in 29th ISSCT Congress, 2016.

In India, agriculture contributes one-sixth of the country's gross domestic product (GDP) and provides employment to 56% of the workforce. The growth of commercial crops such as sugarcane has significant potential to promote exports of agricultural commodities and bring about faster development of agro-based industries. India is the second largest producer of sugarcane in the world, after Brazil. In 2013-14, India produced over 340 Gt of sugarcane. Despite the importance of sugarcane in the economy, its cultivation continues to face a number of economic, environmental, and social challenges. A key environmental challenge faced by millions of sugarcane farmers is the declining availability of irrigation water, due to climate change/erratic rainfall and over-exploitation of groundwater. Sugarcane is a water-intensive crop and consumes 500-3000 L of water to produce 1 kg of sugar. Most sugarcane farmers use inefficient water management practices such as flood irrigation, trash burning, etc., leading to over use of water with sub-optimal productivity. With this backdrop, a sustainable sugarcane advisory program focusing on demand-side water management techniques/practices, referred to as the India Sugar Advisory

Farmer Support Program, has been implemented in three leading sugar-producing states of Uttar Pradesh, Madhya Pradesh and Maharashtra. From the research findings, water-efficient technologies /practices such as land leveling, addition of organic manure /compost, furrow irrigation, trash mulching were identified, and farmers were trained to adopt these low cost technologies under this programme. A combination of trash mulch and skip-furrow irrigation though micro-irrigation techniques such as drip irrigation and gated pipes was also demonstrated. Due to the program, around 64 GL of water was saved through good water management practices from January 2014 to May 2015 in Uttar Pradesh, Madhya Pradesh and Maharashtra. We conclude that implementable technologies to improve the economics of water use in sugarcane are available with measurable impact.

Crop diversity in sugarcane: effect of mixed cultivars on the growth and yield of sugarcane by H Takaragawa, K Watanabe, J Thanankorn, M Nakabaru and Y Kawamitsu published in 29th ISSCT Congress, 2016.

Sugarcane is usually grown as a monoculture over a large area of the world. Monoculture of crops such as sugarcane easily destroys the biodiversity of the farmland during cultivation. For sustainable agriculture, we have to consider the concept of biodiversity in agriculture in terms of agro-biodiversity, agro-ecosystem and crop diversity. Recently mixing cultivars has been demonstrated to have potential as a new method to achieve

high and stable yield in some crops. Mixing cultivars with different traits of tolerance to stresses or different growth rates creates cultural breaks in the field to prevent diseases and harmful insects from spreading and uses positive effects of competition and compensation between cultivars to increase growth and yield. Our team is trying to determine the effects of mixed cultivars on the growth and yield in sugarcane. In experiment 1, two cultivars with different canopy structures were selected, one has high stalk weight and the other has many tillers. These were mixed by plant or row in Okinawa, Japan. Light-extinction coefficient was lower in the mixture-by-row and higher in the mixture-by-plant compared with monoculture. Stalk length of one cultivar in the mixture-by-row was shorter, which overall resulted in the better light-intercepting characteristics of this canopy. This was consistent with an increase in the number of millable canes in the mixture-by-row. A productive structure diagram showed that the effect of mixed cultivars on canopy formation depended on the way cultivars were mixed. In experiment 2, two high stalk weight cultivars were mixed by plant in Tokunoshima, Japan. The results showed a reduction in the number of stalks in the mixture due to the reduced establishment of one cultivar. However, the stalk weight in the mixed cane increased and the yield of the mixture was almost equal to that of monocropped cultivar. Our results indicated that habitat segregation and a compensation effect may have occurred in the sugarcane canopy of mixed cultivars.

Screening of phosphate-solubilizing bacteria from sugarcane rhizospheric soil and their abilities to improve growth and yield of sugarcane by C Thongponkaew, N Chittamart, S Tawornpruek and P Pinjai published in 29th ISSCT Congress, 2016.

Phosphorus (P) is one of the three most important mineral nutrients in crop production. Only 0.1% of the total P in soils is available to plants due to its poor solubility and P fixation in soil. Currently, enhancement of microbial activities by biofertilizers in sustainable sugarcane production has become more attractive. Phosphate-solubilizing bacteria (PSB) are interesting microorganisms that transform insoluble P to plant-available P. This study aimed to isolate and screen for bacteria that have high phosphate-solubilizing activity from major sugarcane rhizospheric soils in Sa Kaeo Province, Thailand, and to examine the potential of PSB to promote plant growth. We obtained 1,242 isolates and 1,156 of these (98% of total isolates) enabled tricalcium phosphate to be solubilized. However, only 151 isolates exhibited high phosphate-solubilizing activity. These 151 isolates were then evaluated for nitrogen (N) and carbon (C) source utilization using UPGMA analysis. The results indicated that the bacterial isolates could be categorized into two clusters with a maximum similarity value of 55%. The biochemistry patterns showed that the strains could be divided into 34 unique groups. All of these isolates were characterized for their N-fixing ability, and indole-acetic acid and gibberellin producing ability. Eleven of these isolates (33%) were capable of fixing N, and 34 isolates (100%)

can produce both IAA and GA. Among these isolates, the five highest phosphate-solubilizing isolates are Tpk3-053, Tpk4-083, Wi1-013, Ch1-021 and Mki4-010. They can solubilize phosphate ranging from 447 to 748 $\mu\text{g.mL}^{-1}$, produce IAA ranging between 1.42-11.83 $\mu\text{g.mL}^{-1}$ and GA at 4.29-4.76 $\mu\text{g.mL}^{-1}$. Although these five isolates are suitable for developing as bio fertilizer, the isolates need to be tested for their ability to promote growth in sugarcane under greenhouse and field conditions.

A Study of factors affecting the Sugarcane yield and Sugar recovery by Dr. Mane Vijay Annaso published in Bharatiya Sugar, April, 2017.

The sugarcane yield and sugar recovery both are most important issues in respect of cane growers as well as the sugar industry. As the cane price is paid on the basis of cane weight and not on the basis of sugar content present in cane juice. Therefore, both the aspects as what are the factors affecting the sugarcane yield and the sugar recovery have been described in the paper. The paper has been prepared on the basis of research conducted during last so many years which concludes that both are extremely sugar recovery to the sugar industry, but we have to balance the both. Therefore, our target should be to achieve 100 tonnes per hectare yield and 11.0 percent sugar recovery.

Sugar mill with optimum design parameters & cogeneration facility to suite present day needs by Sura. K. Bhojraj & Sunil Kekal published in Bharatiya Sugar, April, 2017.

The profitability of Sugar Industry in India is under enormous pressure because of closing gap between cane & sugar price leaves hardly any revenue & creates losses for many sugar factories. Even potential states like Maharashtra & Karnataka have huge arrears of cane payment, before start of the current season. Average sugar cane prices have gone up by 20% since 2011-12, whereas the sugar price has only increased by 8% during this period. A fall in sugar recovery from sugar cane has been noticed during the recent years especially in North India & further reduced the profitability.

ICT: A leap forward to improve performance of cooperative sugar factory by R.D. Kumbhar published in Bharatiya Sugar, April, 2017.

Cooperative sugar Industries playing the pivotal role in the socio-economic development of country. India receives the recognition of leading sugar producing and consuming country. Unfortunately modernization and automation of this sector is lagging behind and most of the practices are executed traditionally that is why the sector is not able to keep abreast in this era of globalization. From last two decades cooperative sugar factories in Maharashtra are using computer based system for various business process but they are not getting expected outcomes. With this prospective present study is undertaken to know the present status of computerization and impact of computerization on performance parameter. Requisite information is collected for select cooperative sugar units with the help of structured schedule encompass impact of computerization on performance

parameters. Result of statistical test indicates that there is significant impact of computerization on performance parameter.

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