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THE EFFECT OF FINE LIQUOR COLOUR ON REFINING COST

Vawda, A.S, Sarir, E. M, Donado, C. A. & M. Wajid Ijaz
Environment Protection Agency, Punjab, Pakistan

Abstract

In today’s competitive sugar refining environment, refiners are spending more time and attention to improve their conversion costs. This means energy, maintenance and chemical usage are constantly being measured and improved. As sugar refining consists of a series of separation processes, any inefficiency has a knock on an effect on operating costs.

Introduction

The major conversion cost of raw sugar to refined sugar includes the following:
- Labour
- Repairs and Maintenance
- Utilities
- Process Chemicals
- Environment Protection
- Sugar Losses

Control: In order to control it, one has to measure it. This means that full control of every production detail from raw goods to final product. There are certain important items which if left unchecked can eat up substantial profits and occasionally, turn profits into losses. The following areas will be discussed with respect to process control efficiency and the corresponding financial gain or loss:
- Affination
- Clarification
- Decolourization
- Crystallization
- Centrifugation

Affination

Affination is the first separation process in the sugar refining process. It is applied to raw sugar with a colour higher than 1800 ICU. It takes place by the mingling of raw sugar with warm syrup, which removes the molasses coating from the sugar crystal to form magma. This magma is centrifuged to separate the crystals from the syrup thus removing the greater part of the impurities from the input raw sugar and leaving the crystals ready for the next stage, namely the melter. The control of the affination process is critical as over washing dissolves additional sugar which must be boiled multiple times at the recovery house before the sugar can be recovered. Each time sucrose is dissolved, it is impossible to fully recover it. Typical improvement is about 50-60% colour removal and also ash and suspended matter removal.

Carbonatation

The mechanism of carbonatation is by impurity entrapment within the growing calcium carbonate crystal.

\[ \text{Ca(OH)}_2 + \text{CO}_2 = \text{CaCO}_3 + \text{H}_2\text{O} \]

The process at consists of adding milk of lime (an aqueous slurry of calcium hydroxide) to the raw melt solution prior to entering a reaction vessel.

Phosphatation

The mechanism of phosphatation is primarily the flocculation of impurity particles. The reaction produces a precipitate of tri-calcium phosphate, to which is added a flocculent to coagulate it.

\[ 3\text{Ca(OH)}_2 + 2\text{H}_3\text{PO}_4 = \text{Ca}_3(\text{PO})_4 + \text{H}_2\text{O} \]

The precipitate is very fine and is difficult to filter; therefore, the liquor is aerated by dispersed air and subject to flotation in a clarifier.
Decolourization

There are basically three types of decolourization systems:
1. Activated Carbon
2. Ion Exchange
3. High Performance Adsorbent (HPA) and PAC.

**Activated Carbon**

The principal mechanism is that of adsorption. Activated carbon has an enormous surface area. Colourants are physically adsorbed onto the carbon. Not specific removes all colour including colour precursors, organics, odours etc. Requires substantial amount of heat for regeneration thereby releasing gases to the atmosphere.

**Ion Exchange**

The principal mechanism is that of ion exchange. Anionic bodies on colourants displace the chloride ions on the resin matrix. Requires sodium chloride for regeneration.

It generates large amount of brine and other polluting liquids. Ion exchange competes with phosphate for the same colourants.

**The Cost of Poor Colour Removal**

We have briefly studied clarification and decolourization processes. Both processes have certain decolourization efficiencies:
- Phosphatation 25 – 45%
- Carbonatation 35 – 55%
- Granular Activated Carbon 65 – 85%
- Ion Exchange 55 – 75%
- High Performance Adsorbents (HPA) 85%

If the final product is EU specification of max 50ICU colour, the final colour of fine liquor has a financial implication.

I.e. The cost of processing a fine liquor of ICU 500 colour will be much more expensive compared to a fine liquor of 100 ICU colour.

The following work was done at refineries in Africa and Europe. Experimental work done to compare the effectiveness of washing showed a general equation $y = 151.14x - 0.479$ where $Y$ is the sugar colour and $x$ the wash time. See figure 1.

This was done using R1 massecuites between 450 and 550 ICU. In this particular case, the colour bottomed out at 20ICU indicating no further benefit beyond 25 litres of wash, i.e. 2.5% on this particular massecuite.

![Figure 1. Sugar colour vs Wash for R1 Massecuite between 450 and 550 ICU](image)
The following graph, figure 2, shows the wash water usage for massecuite of different colours, collected from various refineries. The wash times were converted to volume based on the centrifugal manufacturer’s nozzle data. Despite the refineries having different massecuite colours, different clarification and decolourization processes, a definite trend is clear where darker massecuites demanded more wash water.

It can be seen that as fine liquor colour increases, the wash water demand increases too. In order to compute the cost of water addition at the centrifugals, a mathematical model was built using the following assumption.
### Item

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery capacity tpd</td>
<td>1000</td>
</tr>
<tr>
<td>Sugar colour ICU</td>
<td>40</td>
</tr>
<tr>
<td>Steam cost mt</td>
<td>US$ 15</td>
</tr>
<tr>
<td>Water cost m3</td>
<td>US$ 1.1</td>
</tr>
<tr>
<td>Sugar per mt</td>
<td>US$ 500</td>
</tr>
<tr>
<td>Number of White Boilings</td>
<td>4</td>
</tr>
<tr>
<td>Refinery Overall Yield</td>
<td>97%</td>
</tr>
<tr>
<td>Centrifugal Capacity kg</td>
<td>1250</td>
</tr>
</tbody>
</table>

### Worksheet 1 showing the various aspects measured (FL 100ICU)

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery Capacity</td>
<td>tpd</td>
<td>1000</td>
<td>500</td>
<td>250</td>
<td>125</td>
</tr>
<tr>
<td>Days operation</td>
<td>d</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>Recycle</td>
<td></td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Massecuite Brix</td>
<td></td>
<td>91</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Wash Time</td>
<td>sec</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Volume H20</td>
<td>L/cyc</td>
<td>3.63</td>
<td>7.25</td>
<td>10.88</td>
<td>16.92</td>
</tr>
<tr>
<td>Temp Mcte</td>
<td>C</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Brix Sat</td>
<td></td>
<td>78.0</td>
<td>78.0</td>
<td>78.0</td>
<td>78.0</td>
</tr>
<tr>
<td>Sugar Dissolved</td>
<td>kg/cycl</td>
<td>12.82</td>
<td>25.65</td>
<td>38.47</td>
<td>59.84</td>
</tr>
<tr>
<td>Centrifugal Capacity</td>
<td>kg/cycl</td>
<td>1250</td>
<td>1250</td>
<td>1250</td>
<td>1250</td>
</tr>
<tr>
<td>Filling</td>
<td>%</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Massecuite</td>
<td>kg/cycl</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Crystal Content</td>
<td>%</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Max Theoret Sugar</td>
<td>kg/cycl</td>
<td>600</td>
<td>600</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Actual Sugar Yield</td>
<td>kg/cycl</td>
<td>1587.18</td>
<td>574.35</td>
<td>561.53</td>
<td>540.16</td>
</tr>
<tr>
<td>New Cent Yield</td>
<td>%</td>
<td>58.72</td>
<td>57.44</td>
<td>56.15</td>
<td>54.02</td>
</tr>
<tr>
<td>Massecuite</td>
<td>tons</td>
<td>430,769</td>
<td>215,385</td>
<td>107,692</td>
<td>53,846</td>
</tr>
<tr>
<td>No. of Cycles</td>
<td>cycles</td>
<td>430769</td>
<td>215385</td>
<td>107692</td>
<td>53846</td>
</tr>
<tr>
<td>Water Usage</td>
<td>tons</td>
<td>1,562</td>
<td>1,562</td>
<td>1,171</td>
<td>911</td>
</tr>
<tr>
<td>Price of Steam</td>
<td>$/t</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Price of Water</td>
<td>$/m3</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

### Summary showing various consumption of water, steam and sucrose recycle

<table>
<thead>
<tr>
<th>Fine Liquor Colour ICU</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash Time</td>
<td>lit/cycle</td>
<td>38.7</td>
<td>54.4</td>
<td>70.1</td>
<td>116.0</td>
</tr>
<tr>
<td>Water Usage</td>
<td>m3</td>
<td>5.205</td>
<td>7.743</td>
<td>10.345</td>
<td>16.396</td>
</tr>
<tr>
<td>Sucrose Dissolved</td>
<td>tons</td>
<td>18.413</td>
<td>27.389</td>
<td>36.595</td>
<td>58.000</td>
</tr>
<tr>
<td>Cost of Steam</td>
<td>$/ton</td>
<td>81.712</td>
<td>121.546</td>
<td>162.402</td>
<td>257.392</td>
</tr>
<tr>
<td>Cost of Water</td>
<td>$/m3</td>
<td>5.726</td>
<td>8.517</td>
<td>11.380</td>
<td>18.036</td>
</tr>
<tr>
<td>Cost of Sucrose Loss</td>
<td>$</td>
<td>276.189</td>
<td>410.831</td>
<td>548.925</td>
<td>869.994</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$</td>
<td>363,626</td>
<td>540,894</td>
<td>722,707</td>
<td>1,145,422</td>
</tr>
</tbody>
</table>

The previous table shows clearly the negative impact of high colour and high washing inside the centrifugal. While crystallization is a very efficient separation process, over-washing can undo the good work done in the pans. High wash is required to remove the surface layers of the crystal where the colourants reside.
Comparing 100ICU vs 500ICU

Case 500ICU: 536 k

Excessive washing due to high fine liquor colour is the root cause for the following problems:
Less sugar directly to the silo
Smaller crystals due to dissolution
Loss of sugar to molasses due to repeated re-crystallization
Increased energy consumption due to reprocessing and evaporation.
Loss of process capacity due to high recycle.

So what is the effect of 500ICU fine liquor compared to 100ICU?

One day:
171 mt of sugar is dissolved daily, which could have been sent to the silo
48.3 m3 additional water is used daily.
50.6 tons of additional steam is used daily.
4.6 tons of additional sugar lost into molasses daily

So what is the effect of 500ICU fine liquor compared to 100ICU?

One year:
59,850 mt of sugar is dissolved annually, which could have been sent to the silo
16,900 m3 additional water is used annually.
17,710 tons of additional steam is used annually.
1,610 tons of additional sugar lost into molasses annually (0.46%)

The Solution to High Colour

How does a refinery overcome these huge losses?
Start with a low raw sugar colour
Achieve optimum colour removal using existing processes
Phosphatation 25 – 45%
Carbonatation 35 – 55%
Granular Activated Carbon 65 – 85%
Ion Exchange 55 – 75%
High Performance Adsorbents (HPA) 85%

If the colour removal performance targets are not being met, then some new technologies should be considered to enhance the colour removal process. Backend refineries could apply colour transfer inhibitors to reduce raw sugar colour. Refineries could apply special adsorbents to remove up to 50% more colour in phosphatation and carbonatation.

Conclusion

The model has shown that darker syrups result in darker massecuites, which requires extra washing in the centrifugal.

The cost of extra washing has a well proven disadvantage in terms of cost:

More sugar dissolved in the centrifugal basket, resulting in low yield and high recycle.
Extra washing increases heating and evaporation load.
Dissolved sucrose contribute to higher molasses loses due to repeated re-crystallization.
Sucrose recycling, is a loss of capacity of the crystallization and centrifugal stations.

Recommendation

There are huge savings to be made when low
massecuite colours are achieved.
Strive to reduce massecuite colour which leads to a reduction in massecuite volume due to less recycling, reduces sucrose losses in molasses and reduces energy due to evaporation.

If current colour removal process is underperforming, use high performance adsorbents to achieve targets.
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SCREENING OF DIFFERENT SUGARCANE GENOTYPES AGAINST SUGARCANE WHITE FLY
Awais Rasool*, Muhammad Asad Farooq, Muhammad Zubair and Sagheer Ahmad
*National Agricultural Research Centre, Islamabad.

ABSTRACT
Nine sugarcane genotypes were screened against sugarcane whitefly at National Agricultural Research Centre, Islamabad. Highest infestation was observed in sugarcane genotype CSSG-239 followed by HSF-240 and US-240. Minimum infestation was recorded in sugarcane genotypes US-272 and CSSG-212. None of the sugarcane genotypes was free from white fly infestation.

Keywords: Screening, sugarcane, genotypes, whitefly

INTRODUCTION
Sugarcane (Saccharum officinarum L.) is an important cash crop of Pakistan and grown throughout the tropical and subtropical parts of the world (Khaliq, 2002). Its share in value addition to agriculture and GDP is 3.2 and 0.7 percent, respectively. Sugarcane crop was cultivated on an area of 1124 thousand hectares, 6.2 percent more than last year’s area of 1058 thousand hectares. The production of sugarcane for the year 2012-13 is reported at 62.5 million tonnes, against the target 59 millions tonnes set for 2012-13 shows a healthy performance of 5.9 percent and to compare last year which was 58.4 million tonnes, depicts an increase of 7.0 percent (Anonymous, 2013). In Pakistan, average yield of sugarcane is much lower than that of world average, which is 75.89tha⁻¹ (FAOSTAT, 2012). Sugarcane plant during their different growth stages are attacked by a number of insect which are major constraints in getting low yield (Iqbal et al., 2012). Due to heavy infestation of the pests, serious decline (86.00% reduction in cane yield; 1.4-1.8% reduction in sugar recovery) has been reported. Among various sugarcane pests, the whitefly is considered one of the most dreaded pests responsible of sucking cell sap from leaves and sometimes it became an endemic to the sugarcane crop. The population of this specie flare-up very fastly and reaches up to economic threshold level (10 per leaves) enormously under water logged condition and nitrogen deficient areas (Ahmed et al., 2004; Mann et al. 2006; Arain et al., 2011). The adults of whitefly are small pale yellow about 3 mm long, ovate in outline with black and grey coating on the body. Only the nymphs are found on the underneath of the leaves and cause the damage by sucking the cell sap and it became pale and dry afterword. Ultimately, the leaves turn black in lieu of the development of fungus and render the crop unfit as fodder (Parsana et al., 1995; Mann and Singh, 2003; Ansari et al., 2007). The whitefly as economic pests seems to expanding continuously and insect damage crop by extracting large quantities of phloem sap which can
reduce yield up to 50%. The honey dew excreted by this insect serves as a medium for sooty mold and fungi growth and few species of whitefly serves as vectors of several economically important viral plant pathogens (Byrne and Bellows, 1991). Due to high reproduction as well as damage potential, sucking cell sap and acquired resistance to most commonly used insecticide, the control of whitefly has become increasingly difficult with insecticide. Moreover, the indiscriminate use of these insecticides since past few decades has led to many serious problems like resurgence of minor pests, destruction of beneficial fauna and environmental pollution. There is a need to explore alternative methods to reduce the use of pesticides and their adverse effects on environment and human health. The researchers are trying to explore the techniques which must be proficient, eco-friendly, clean and affordable to reduce pest infestation on crops. Varietal resistance is an important component of IPM as it is environment friendly, harmless and cost effective methods of pest control therefore, a study was planned to evaluate different sugarcane genotypes against white fly whitefly.

**MATERIAL AND METHODS**

Experiment was conducted at National Agricultural Research Centre, Islamabad. Nine sugarcane genotypes were planted with RCBD during month of September, 2011 with three replications. All standard agronomic practices were followed. Data on pest infestation (nymphs/cm$^2$) was recorded during October, 2012. Three plants were randomly selected from each plot and numbers of insects were counted from an area of one cm$^2$ from upper, middle and lower portion of three leaves of each plant. The data were analyzed statistically by using M-STAT software with the help of an IBM Compatible computer. The means were compared by DMR Test at $P = 0.05$.

**RESULTS**

Results presented in Fig. 1 shows that incidence of white fly differed considerably in various varieties. Highest infestation was recorded in sugarcane genotype CSSG-239 (6.11 nymph cm$^{-2}$) followed by HSF-240 (5.34 nymph cm$^{-2}$) and US-54 (4.59 nymph cm$^{-2}$). The genotypes US-272 and CSSG-212 had minimum infestation as 1.30 and 1.44 nymphs cm$^{-2}$ respectively. Other genotypes showed intermediate degree of infestation. None of genotypes tested were free from whitefly attack. Mann and Singh (2003) also conducted an experiment to screen 32 sugarcane genotypes for their reaction to whitefly (*Aleurolobus barodensis*). A total of 9 genotypes were found highly susceptible. Co 1148 followed by Sel 917/98 and CoPt 84212 rated as least susceptible, while CoS 96258 and Sel 126/92 were most susceptible. None of the genotypes were free from whitefly attack.
Fig. 1: Whitefly infestation cm$^{-2}$ on different sugarcane genotypes.

REFERENCES


زیادہ شاخصی، کم ناوزن دار
زرخیزلاہ بھرہ پر بیداوار
INVESTIGATING SUGARCANE GENETIC MATERIAL INHERITED CAPABILITY FOR AGRONOMIC ATTRIBUTES UNDER AGRO-ECOLOGICAL CONDITIONS OF JHANG

Shahid Afghan1, Muhammad Asad1*, Uzair Farooq2, Muhammad Bilal Anwar3, Aamir Shahzad1 and Fahmeed Ahmad Choudhary4
1 Shakarganj Sugar Research Institute, Jhang 2 Institutes of Pure and Applied Biology, Bahauddin Zakariya University, Multan 3 Pakistan Tobacco Board 4 University of Agriculture, Faisalabad
*Corresponding author e-mail: asadagronomist@gmail.com

Abstract: Inherited production potential of sugarcane genome can only be explored on the availability of favorable environmental conditions. As well as quality genomic material has pivotal role in determining the cane and sugar yield of sugarcane. The study was conducted at Shakarganj Sugar Research Institute, Jhang with five cultivars viz. CSSG-676; CSSG-668; HoSG-795; HoSG-529; NSG-59 and HSF-240 (standard) using Randomized Complete Block Design replicated thrice. NSG-59 superseded all the clones with good germination ability (79.10%) and ultimately produced maximum striped cane yield (124.33 thà⁻¹) with higher harvest index (83.09%) as compared to other test clones. The sugar recovery was higher (12.03%) in HSF-240 (standard) but NSG-59 produced sugar yield (13.20 thà⁻¹) substantially same with standard cultivar, under the agro-ecological conditions of Jhang.

Keywords: Sugarcane, inherited capability, cultivars, agronomic attributes, Jhang.

INTRODUCTION

Sugarcane (Saccharum officinarum L.) is subtropical crop (Babar et al., 2011), globally grown from 37°N to 31°S and thrives best at 34°C with 8-24 months to reach maturity (Nazir 2000). Sugarcane is the major case crop, providing raw material to 2nd largest agro-industry of Pakistan (Rehman 2009) and contributing 0.7 in the GDP of Pakistan (Govt. of Pakistan 2013). The evaluation of new better genome for higher cane and sugar yield for the betterment of growers as well as industrialist and improved production technology with Better Management Practices (BMPs) are the dire need of time (Nasir 2006; Iftikhar et al., 2010; Babar et al., 2011).

The cane and sugar yield of sugarcane is critically clones inherited production potential oriented. However, the good agricultural practices (GAP) along with convenient environmental conditions help in exploring its production potential (Aslam et al., 2014). Similarly the inadequate information about the performance of new cultivars under various climatic conditions causes hindrance to get maximum yield potential of cultivars (Qureshi and Afghan, 2005). On the other hand the rapid deterioration of cultivars over the time is also a big threat to cane productivity (Afghan et al., 2010).

Maximum genetic potential can be explored by better management culture practices and by studying their production potential under different agricultural zone. So this study was conducted with the objective that to explore genetic response of various cultivars under the agro ecological
conditions of Jhang and also suggested the more appropriate cultivars for better cane yield as well as sugar yield.

Materials and Methods:

The proposed research was performed to investigate the response of different sugarcane clones regarding different agronomic attributes i.e. yield contributing parameters as well as sugar recover and sugar yield. The suggested study was plotted at agronomic research area, Shakarganj Sugar Research Institute, Jhang, using Randomized Complete Block Design replicated thrice in 2008-2009. The agronomic performance of six cultivars (V₁ = CSSG-676; V₂ = CSSG-668; V₃ = HoSG-795; V₄ = HoSG-529; V₅ = NSG-59 and V₆ = HSF-240) were studied in the experiment.

Crop was planted during autumn season with the help of double budded setts at 2.5 ft apart row to row distance. After the well preparation of field bed all recommended fertilizer (N-P-K 68-46-46 kg/acre) was incorporated in soil in the form of DAP and SOP, however; remaining nitrogen was applied in two splits 1/3rd at 45 DAS and remaining 1/3rd was applied at earthing up stage in the form of Urea. Herbicides were sprayed at 45 DAS by using “Amitrine+Atrazine” @ 1kg/acre for broad leaves as well as narrow leaves weeds and “Sunstar” 20g/acre for Deela. For the control of borers, granular “Carbufuran” was applied thrice respectively at sowing, 45 DAS and at earthing up stage @ 3bag/acre. However; all other recommended agronomic practices were followed for irrigations and other cultural practices. The data was recorded by using the standard protocol as described under:

- The germination percentage was calculated by counting the no. of germinated buds from known numbers double budded setts at 45 DAS using following formula;

  \[\text{Germination (\%age) = \left( \frac{\text{No. of germinated bud}}{\text{Total no. of buds}} \right) \times 100}\]

- Ten randomly selected canes were harvested from all cultivars to take the readings of plant height, cane length, no. of internodes, cane girth and cane weight than converted to the average value. The un-stripped and stripped cane yield was recorded from 1m² harvested area and converted to tha⁻¹, while the harvest index was determined by this formula

  \[\text{HI} = \frac{\text{Stripped cane yield}}{\text{Un-stripped cane yield}} \times 100\]

The sugar recovery was estimated after the quality analysis of supplied sample to Cane Lab of Shakarganj Sugar Mill, Jhang by using the SJM formula

\[\text{Sugar Recovery (\%)} = \frac{\left( S \times J - M \right) \times \text{Pol\%} \times \text{Juice extraction} \times \text{Boiling house efficiency}}{\left( J \times (S - M) \right)}\]

Where; \( S \) = Sugar 100%, \( J \) = Juice purity, \( M \) = Molasses purity = 35%, \( \text{Pol\%} \) = Pol\% juice (sucrose %), \( \text{Juice extraction} = 0.65 \), \( \text{Boiling house efficiency} = 0.98 \)

The sugar yield was estimated by the following formula

\[\text{Sugar yield} = \left( \text{Sugar recovery} \times \text{Stripped cane yield} \right) / 100\]

The treatment comparison was performed by Fisher analysis of Variance Technique (Steel et al., 1997) and LSD test was applied for comparing all treatment’s means at 5% probability level.

RESULT

Various agronomic parameters were studied for the evaluation of different cultivars in the agro-ecological conditions of Jhang. Data regarding the cultivars depicted that a statistical significant response was reported for mostly agronomic parameters. Data regarding all studied agronomic and qualitative attributes determining the cane and sugar yield are
presented in Table 1. Crop germination was totally influenced by the inherent ability of cultivar as well as its interaction with environment. So the inherent ability along with environment interaction proved HSF-240 substantially better (85.50%) regarding germination followed by NSG-59 (79.10%) that was statistically at par with HoSG-529. However, substantially lowest germination (65.54%) was recorded in CSSG-676. Similarly, HSF-240 remained statistically better regarding plant height and cane length (5.39m & 4.62m respectively) followed by NSG-59 (5.20m & 4.14m respectively). However, CSSG-676 was reported substantially lowest in-term of plant height (4.18m) and cane length (3.12m). Data revealed that no. of internodes in all cultivars showed non-significant response. NSG-59 had statistically higher cane girth (10.40cm) followed by HoSG-795 (9.42cm) and HSF-240 (8.81cm).

Millable cane per hectare and cane weight play indispensable role in stripped cane yield. The substantially higher millable cane (129.95 × 10^3 ha^-1) was reported where NSG-59 was planted followed by HSF-240 (118.65 × 10^3 ha^-1) that was significant lower than NSG-59. While CSSG-676 was statistically low (103.58 × 10^3 ha^-1) than all other cultivars in the production of millable cane. NSG-59 had substantially higher cane weight (1.52kg) as compared to other studied cultivars. The unstrapped cane yield of HSF-240 was greater (149.67tha^-1) but statistically at par with the NSG-59 (144.33tha^-1) and HoSG-529 (144.33tha^-1). While NSG-59 gave substantially higher (124.33tha^-1) stripped cane yield followed by HSF-240 (117 tha^-1). However, the harvest index of NSG-59 was higher (83.09%) but substantially same with HSF-240 (81.10%).

Sugar recovery and sugar yield are the principal attributes that make sugarcane a valuable crop. HSF-240 showed substantially higher sugar recovery (12.03%) followed by statistically low (10.61%) NSG-59. However, the sugar yield was produced substantially same by HSF-240 and NSG-59 (14.08 & 13.20tha^-1 respectively).

**DISCUSSION**

Germination, plant height and cane length are totally based upon the genetic inherent ability of cultivar as well as its healthy environmental interaction. In the agro-ecological conditions of Jhang, HSF-240 proved itself more appropriate regarding the germination percentage, plant height and cane length as compared to other cultivars. Better germination in HSF-240 was due to presence of morphologically healthy bud similarly the good response of HSF-240 in plant height and cane length may be due to its better inherent ability and its healthy environmental interaction. Significant response of germination is dependent upon cultivars inherited ability and these findings were coincided with results already published (Nadeem et al., 2011; Aslam et al., 2014).

The biological yield (unstrapped cane yield) played vital role in final economic yield (Stripped cane yield). Results showed that NSG-59 produced better stripped and unstrapped cane yield as compared to other cultivars. These results were matched with the following published findings (Afghan et al., 2010; Unar et al., 2010; Nadeem et al., 2011; Islam et al., 2013). The better performance of NSG-59 was due to its higher millable cane per hectare (Babar et al., 2011; Nadeem et al., 2011; Aslam et al., 2014) and cane weight (Aslam et al., 2014). However the sugar recovery was more in HSF-240 followed by NSG-59 but the sugar yield was substantially same because the higher cane
yield compensates this gap. Following findings also supported these results (Afghan et al., 2010; Nadeem et al., 2011).

**CONCLUSION**

Sugarcane is a valuable commercial case crop because of its sugar, ethanol and power production. The better site specific genetic material selection in term of higher cane production as well as sugar production might be played key role in the prosperity of growers as well as industrialist. This study provides adequate information about the response of different genetic material in agro ecological conditions of Jhang. The results showed that NSG-59 is more appropriate for higher cane and sugar yield and it is the best alternative of standard HSF-240.
REFERENCES
Nasir, N.M. 2006. Better management practices for cotton and sugar cane. WWF-Pakistan, Ferozepur Road, Lahore - 54600, Pakistan, pp. 117.
### Table 1: Inherited Capability of Sugarcane genotypes for Agronomic Attributes under Agro-ecological Conditions of Jhang

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination (m⁻²)</th>
<th>Plant Height (m)</th>
<th>Cane Length (m)</th>
<th>No. of Internodes</th>
<th>Cane Girth (cm)</th>
<th>Millable Cane (10³/ha)</th>
<th>Cane Weight (kg)</th>
<th>USCY (tha⁻¹)</th>
<th>SCY (tha⁻¹)</th>
<th>HI (%)</th>
<th>SR (%)</th>
<th>SY (tha⁻¹)</th>
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<tbody>
<tr>
<td>V₁</td>
<td>65.54 D</td>
<td>4.18 E</td>
<td>3.12 D</td>
<td>19.96</td>
<td>8.48 C</td>
<td>103.58 E</td>
<td>1.41 B</td>
<td>137.67 C</td>
<td>106.67 C</td>
<td>77.48</td>
<td>8.81 C</td>
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<tr>
<td>V₃</td>
<td>69.68 C</td>
<td>4.67 C</td>
<td>3.72 BC</td>
<td>20.23</td>
<td>9.42 B</td>
<td>109.61 CD</td>
<td>1.36 B</td>
<td>142.37 BC</td>
<td>108.00 C</td>
<td>75.86</td>
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<td>10.09 B</td>
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<tr>
<td>V₄</td>
<td>75.71 B</td>
<td>5.09 B</td>
<td>3.84 B</td>
<td>19.14</td>
<td>8.44 C</td>
<td>113.00 C</td>
<td>1.32 BC</td>
<td>144.33 AB</td>
<td>104.00 C</td>
<td>83.09</td>
<td>8.91 C</td>
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<td>V₅</td>
<td>79.10 B</td>
<td>5.20 B</td>
<td>4.14 B</td>
<td>20.33</td>
<td>10.40 A</td>
<td>129.95 A</td>
<td>1.52 A</td>
<td>149.67 A</td>
<td>117.00 B</td>
<td>81.10</td>
<td>10.61 B</td>
<td>13.20 A</td>
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<tr>
<td>V₆ (Standard)</td>
<td>85.50 A</td>
<td>5.39 A</td>
<td>4.62 A</td>
<td>20.15</td>
<td>8.81 C</td>
<td>118.65 B</td>
<td>1.24 C</td>
<td>124.33 A</td>
<td>110.00 B</td>
<td>12.03</td>
<td>14.08 A</td>
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<tr>
<td>S×</td>
<td>1.52</td>
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<td>0.49</td>
<td>0.18</td>
<td>2.10</td>
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<tr>
<td>LSD 5%</td>
<td>3.39</td>
<td>0.15</td>
<td>0.43</td>
<td>----</td>
<td>0.39</td>
<td>4.68</td>
<td>0.10</td>
<td>6.29</td>
<td>6.25</td>
<td>4.23</td>
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<tr>
<td>Significance</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>NS</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
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<td>**</td>
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<tr>
<td>Mean</td>
<td>73.89</td>
<td>4.81</td>
<td>3.80</td>
<td>19.96</td>
<td>9.02</td>
<td>113.63</td>
<td>1.37</td>
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<td>111.39</td>
<td>78.04</td>
<td>9.89</td>
<td>11.08</td>
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</table>

Means sharing same letter does not differ significantly at p ≤ 0.05.

** & * = Significant at 1% & 5% respectively, NS = Non-significant, V₁ = CSSG-676; V₂ = CSSG-668; V₃=HoSG-795; V₄= HoSG-529; V₅= NSG-59 and V₆= HSF-240, USCY= Un-Stripped Cane Yield; SCY= Stripped Cane Yield; HI= Harvest index; SR= Sugar Yield; SY= Sugar yield;
SUGAR INDUSTRY ABSTRACTS

DYNAMICS OF SUGARCANE HARVEST RESIDUE DECOMPOSITION IN ARGENTINA

P.A. DIGONZELLI, J. FERNÁNDEZ DE ULLIVARRI, M. MEDINA, L. TORTORA, E.R. ROMERO and H. ROJAS QUINTEROS


The aim of this paper was to evaluate the dynamics of sugarcane residue decomposition and to study nutrient release from residue. The trial was conducted in Tucumán-Argentina from 2008 to 2012. The sugarcane cultivars used were LCP 85-384 and RA 87-3. Every 25–35 days we evaluated: 1) residue fresh and dry weight and 2) residue C/N ratios. At the beginning and end of each cycle, we evaluated residue P and K content. LCP 85-384 initial residue amounts ranged from 11.6 t/ha to 15.2 t/ha, whereas decomposition rates were between 43% and 59%. RA-87-3 initial residue amounts ranged from 12.5 t/ha to 18.1 t/ha, with decomposition rates between 36% and 60%. Fresh residue C/N ratios were over 60. The highest initial C/N ratios were 79.2 (in 2008/09) and 102.9 (in 2009/10) for LCP 85-384 and RA 87-3, respectively. At the end of each crop cycle, trash C/N ratios dropped significantly. Residue initial C concentration was between 42%-45.5% and 38.8%-47.5% for LCP 85-384 and RA 87-3, respectively. Residue initial N concentration ranged from 0.53%-0.71% and 0.43%-0.66% for LCP 85-384 and RA 87-3, respectively. Residue final C concentration decreased and residue final N concentration increased, resulting in lower C/N ratios. Residue initial K concentrations ranged from 0.64%-0.75% for LCP 85-384 and 0.56%-0.67% for RA 87-3. At the end of each crop cycle, K release values were high. In conclusion, although the amount of residue left in the field was high after sugarcane harvest, we observed that the decomposition rate increased through the crop cycle. This residue decomposition supplies the agroecosystem with varying amounts of C, N and K, which may help meet fertilisation needs in the medium term.

FROST SEVERITY EFFECT ON SPROUTING AND SEEDLING EMERGENCE OF HIGH QUALITY SEED CANE IN TUCUMAN, ARGENTINA

J.A. GIARDINA, P.A. DIGONZELLI, E.R. ROMERO and D. DUARTE


In Tucumán, Argentina, low temperatures affect most of the sugarcane production area, and plantations suffer the effects of both light and very severe frosts. The impact of frost severity on seed cane sprouting capacity was studied under lab and field conditions. In both studies, a completely randomised design with three replicates was adopted. Samples from three sugarcane varieties were used (LCP 85-384, RA 87-3 and TUCCP 77-2) from different sites where freezes of varying intensity (mild, moderate and very severe) had occurred. Germination under optimal conditions was evaluated in the lab, using uninodal stalk segments placed on trays (45 segments per tray) under controlled humidity at a temperature of 25 oC. Concurrently, emergence dynamics were evaluated in the field. Planting materials were sown in wide-bottom furrows, with a 15 to 20 buds/metre density, and kept under an average temperature of 22 oC without irrigation. Results showed that, under mild frost conditions, the low temperatures did not significantly affect the buds of the three varieties and sprouting percentages of 84% for RA 87-3 and 73% for the two other varieties were recorded. In the field, emergence percentages were 70%, 66% and 57%, for RA 87-3, TUCCP 77-42 and LCP 85-384, respectively. After moderate frosts, buds of RA 87-3 showed higher susceptibility, with only 14% and 19% emergence in the lab and field, respectively. In contrast, the other two varieties had similar emergence levels, with values ranging between 40% and 50%. With very severe frosts, the three varieties suffered significant damage, ranging from 0% to 7% emergence in the lab and field. While frost severity produced significant varietal differences in the sprouting percentages, the emergence dynamics of the three varieties tested were not significantly modified by mild and moderate freezes and responded to a simple exponential model.
EFFECT OF SUGAR CANE TRASH BLANKETING ON THE DEVELOPMENT OF MICROORGANISMS OF AGRONOMIC AND ENVIRONMENTAL INTEREST

M.L. TORTORA, N. GRELLET NAVAL, L. VERA, J. FERNANDÉZ DE ULLIVARRI, P. DIGONZELLI and E. ROMERO

The global sugar industry is progressively moving away from pre-harvest burning to a green-cane harvesting system. It is well known that when harvest residue is returned to the soil, nutrients and organic matter increase and soil structure is improved. However, the effect of trash blanketing on the development of different soil microorganisms has not been evaluated in Tucumán. Hence, the aim of this study was to evaluate changes in microbial populations, especially those of agronomic and environmental interest, which occur with and without trash blanketing. Tests were performed at Finca San Genaro, located in eastern Tucumán (Dpto. Leales, Argentina), using LCP 85-384 sugarcane variety in the fourth ratoon crop. Thus, treatments were imposed four years before sampling. During the 2011/2012 crop cycle, in June, July, and November, 2011 and May, 2012, soil and tissue samples, from sugarcane roots and stems, were microbiologically analysed. Microorganisms were counted using different culture media: LB for mesophilic aerobic bacteria, PGA for fungi and yeasts, CA for Pseudomonas sp., and different N-free semisolid medium for micro aerobic nitrogen fixing bacteria. Trash blanketing increased the number of yeast, fungus and Pseudomonas sp. populations in soil samples during high temperature seasons. Some of these isolated fungi showed ligninolytic activity and some Pseudomonas genus bacteria were able to solubilise phosphorus, thus indicating that these microorganisms may be involved in residue decomposition. Interestingly, trash blanketing also increased the number of nitrogen fixing bacteria associated with the plant root and stem tissues from June to February. The further development of trash-degrading microorganisms and a better colonisation of sugarcane tissues by nitrogen fixing bacteria could improve sugarcane crop growth and development.

OCCURRENCE AND SIMULATION OF NITRIFICATION IN SUGAR CANE VINASSE APPLIED TO SOIL

ALINNE DA SILVA, RAFFAELLA ROSSETTO, PETER THORBURN, JODY BIGGS and TAKASHI MURAOKA

Vinasse is a liquid residue produced during ethanol manufacture. It has high potassium (K) and organic matter concentration and so is widely applied to sugarcane as a fertiliser. It is usually applied at the standard concentration produced during ethanol manufacture. However, there is interest in concentrating vinasse to reduce its volume and hence the cost of transport to farms. Vinasse will affect soil nitrogen (N) reactions because it contains water and easily decomposable organic substances, both of which can stimulate soil microorganisms. Both water content and the nature of the organic compounds are changed during the evaporation process, thus standard concentration (SCV) and high concentration (HCV) vinasse may have different effects on soil N cycling. We investigated N dynamics of soils receiving vinasse in a laboratory incubation experiment under aerobic conditions. The soils were incubated in darkness at 26 °C with three amounts of vinasse at two concentrations (SCV and HCV, produced by evaporation in the sugarcane mill). The samples were analysed after 7, 14, 28, 42, 70 and 98 days of incubation. In five of the six treatments, the concentration of NO₃⁻-N increased in the incubated soils over time indicating that nitrification occurred in the treatments that received vinasse. The exception was with the highest amount of SCV, where there was accumulation of NH₄⁺ -N and the content of NO₃⁻ -N remained low. The large amount of water applied to the soil with the high amount of SCV may have caused anoxic conditions which inhibited nitrification. The temporal trends in NO₃⁻ -N and NH₄⁺ -N concentrations in the incubated soils in all six vinasse treatments were accurately captured by the APSIM-SoilN model. Thus, the model will be able to help study the optimum management of N fertiliser in sugarcane crops receiving different amounts and concentrations of vinasse.
EXPLORING THE WIDE RANGE OF NITROUS OXIDE EMISSIONS FROM SUGARCANE CROPS


Nitrous oxide is a potent greenhouse gas, and emission from soils in some sugarcane crops are among the highest measured from cropping systems. Yet, not all emissions are this large and the reason for the wide range is unclear. The highest emissions come from a site with acid sulfate soils in Australia, and chemo-denitrification in the acid subsoils has been suggested as an important cause of the high emissions. However, emissions from acid sulfate soils are not always at the upper end of the range suggesting this explanation is not general. We used the APSIM model to investigate the degree to which the biological nitrous oxide-generating pathways represented in the model might (1) account for the high emissions measured in some sugarcane crops grown on acid sulfate soils, and hence (2) provide a broader understanding of the basis for the wide range of emissions associated with sugarcane. We found conditions at the site where the highest emissions were measured, particularly a combination of high soil organic carbon (~10%) and large applications of nitrogen fertiliser, gave simulated emissions similar to the high values measured. Sensitivity analyses showed that when soil carbon contents and/or nitrogen applications were lower, predicted emissions reduced to levels closer to those at other sites. Our results suggest that biological pathways are capable of producing the range of nitrous oxide emissions measured in sugarcane crops, and that the contribution of chemical pathways may not be great. The results have important implications for understanding both how nitrous oxide emissions from sugarcane may vary between different environments and how emissions can be mitigated; issues that are particularly relevant to greenhouse gas emissions during the production of biofuels from sugarcane.

NON-DESTRUCTIVE QUALITY MEASUREMENT SYSTEM FOR CANE STALKS USING A PORTABLE NIR INSTRUMENT

EIZO TAIRA, MASAMI UENO, SHIORI TAKASHI, KHO KIKUCHI and YOSHINOBU KAWAMITSU


Sugar content of cane at the farm is important information for farmers and millers in Japan because cane prices are determined by pol in cane. While NIR systems have been used to measure cane quality at the mill, portable measurement systems for cane to detect chemical properties in the field have not been developed, although there are some commercially available instruments for fruits. We investigated direct non-destructive measurements for sugar content using a portable near infrared spectrophotometer. A portable fruit tester comprising a NIR spectrophotometer was modified for use in the transmittance mode and employed to quantify brix and pol levels in cane stalks. Reflectance and transmittance spectra in the 600 to 1100 nm range were obtained from 100 cane stalk samples. Brix and pol values were measured with a refractometer and polarimeter. Potassium (K), calcium (Ca) and other chemical components were also measured by an ICP (Inductivity Coupled Plasma) method. Calibration models using a partial least-squares regression analysis were developed for predicting these parameters in cane stalks from the spectra. Calibration models for brix values using transmittance spectra were more suitable than those from reflectance spectra. The model for pol yielded a correlation coefficient of 0.87 with a root mean square error of cross-validation (RMSECV) of 1.0%. Some calibration models for minerals were also developed, although accuracy of the models was not as accurate as pol models. Based on this study, the portable NIR spectrophotometer will be useful for measuring pol and brix values of sugarcane.
SUGARCANE RESPONSE TO PHOSPHORUS SOURCES AND PLACEMENT IN A VERY CLAYEY OXISOL OF THE BRAZILIAN CERRADO

T.A. REIN and D.M.G. de SOUSA, Embrapa Cerrados, Brasilia, Brazil

The sugar ethanol industry in Brazil has expanded towards the “Cerrado” (savanna) region where sugarcane has replaced pastures on soils with low phosphorus (P) availability. Phosphorus fertilisation on sugarcane in Brazil is largely based on water-soluble fertilisers applied in the planting furrow, leading to high concentration of P in this zone due to high P rates employed and wide row spacings. In this study, alternative placement methods and P sources were evaluated in an experiment established in Brasilia, in a randomised block design with four replications. The soil was a very-fine, mixed, isothermic Rhodic Haplustox with low (1.2 mg/dm3) Mehlich-1 P content in the top 0.0–0.2 m, and treatments were applied only to the plant cane (cultivar RB 867515). Treatments consisted of a P response curve ranging from 0 to 400 kg/ha P2O5 as broadcast triple superphosphate (TSP) incorporated with a disk harrow before planting and the following treatments at 200 kg/ha of P2O5: TSP applied at the bottom of the planting furrow (banded); TSP half broadcast and half banded; a Moroccan reactive phosphate rock (RPR) broadcast and banded; and a combination of broadcast RPR and banded TSP. Cane and sugar yields were evaluated for the plant cane and two ratoon crops. Maximum cane yields (129.9, 92.7 and 96.7 t/ha, respectively, for the three harvests) with broadcast TSP at 400 kg/ha P2O5 were on average 89% higher compared to the control (no P) treatment. Comparing the two P sources at 200 kg/ha P2O5, yields for the broadcast TSP and RPR treatments were similar for the three harvests, but when the fertilisers were band-applied, yields were on average 16% lower for the RPR. Comparing the fertiliser placement methods, average yields for broadcast TSP and RPR were 19% and 42% higher than band application, respectively. Combined broadcast and band application treatments were not significantly different compared to exclusively broadcast applications. Results show that increases in sugarcane yield and P fertiliser use efficiency in low-P Cerrado soils could be attained by increasing the volume of soil fertilised with P.

IRRIGATION REQUIREMENTS AND TRANSPIRATION COUPLING TO THE ATMOSPHERE OF SUGARCANE IN SOUTHERN BRAZIL: SCALING UP FROM LEAF TO FIELD

D.S.P. NASSIF and F.R. MARIN: University of São Paulo – ESALQ, Pádua Dias Av., 11, Piracicaba, SP – Brazil EMBRAPA Agricultural Informatics

In some of the traditional areas growing sugarcane and in most of the expanding regions in Brazil, water deficit stress is a limiting factor and irrigation is usually needed to assure economically viable sugarcane yields. Despite the great social and economic importance of sugarcane irrigation, few studies have been published from Brazil. This research evaluated the water requirements of a drip-irrigated 2nd ratoon sugarcane crop based on three different spatial scales: field, plant and leaf. The Bowen ratio method was used to evaluate the mass and energy exchanges over the field, further computing the field evapotranspiration (ETc). Sap flow by heat balance methods installed in four representative stalks was used to evaluate the water use at the plant scale, and an infra-red gas analyser (IRGA) was used to evaluate leaf transpiration and stomatal conductance at the leaf scale. Comparing ETc and reference evapotranspiration we found that the crop coefficients for dry and wet seasons were 0.81 and 0.98, respectively. Evapotranspiration peaks of 7 mm/day were observed under conditions of strong crop-atmosphere coupling and high net radiation values. The stomatal conductance ranged from 0.09 and 0.19 mmol/m2 s in dry and wet seasons respectively, showing sensitivity to the atmospheric conditions, notably the vapour deficit pressure and wind speed. BRM was from 3.7 to 4.4 mm/day and Tleaf from 3.4 to 4.2 mm/day. This study provides a new theoretical basis to improve crop water management of sugarcane in Brazil.
good milk is a naturally nutritious complete meal. Global Food Guide recommends daily consumption of milk. Whether hot or cold, with coffee or with tea, as a milk shake or on its own, enjoy your good milk daily - it's the best choice.

ROZ ROZ good milk PIYA KARO
healthy life jiya karoo
INTERNATIONAL EVENTS CALENDAR

February 1 -3
ASBF Annual Meeting Long Beach, CA USA ASBF

February 2-4
Louisiana Division of ASSCT, Lafayette, LA USA ASSCT

February 23 -26
ASSBT Clearwater, FL USA ASSBT

May 17-20
Sugar Industry Technologists Annual Meeting Osaka, Japan SIT

June 22 -24
Florida and Louisiana Joint Division of ASSCT New Orleans, LA USA ASSCT

October 19-24
Latin American Sugar Technologist Meeting (ATALAC), Olinda, Pernambuco, Brazil
Art galleries, without a doubt, have a special place in today’s society. In general, a fine art gallery can offer an open, eye appealing space where visitors can view and appreciate art.

Overall then, art galleries contribute immensely to society – whether it is economically – or through art appreciation, education, and inspiring others.

Shakarganj Foundation’s Jhang Art Gallery is a combination of Fine Arts and Fashion Designing segments, since its inception gallery is producing such skilled people who are very talented but are less privileged and belong to poor families. Gallery is focusing female students. It polished their talent and makes them proficient in their respective field work.

Another purpose of Jhang art gallery is to promote art and emerging artists. Jhang art gallery recognizes art talent and promotes this talent to the public at large. In turn, art gallery attendees will be introduced to different perspectives and ways of thinking through the viewing of this artwork. In addition, the viewers of this art may be inspired to endorse a particular cause, change their way of thinking, and or even create their own works of art.

In this connection at the end of April – June session a small exhibition was arranged particularly on students work i.e. fine arts and dress designing. Honorable Civil Judges from the District Judicial Courts were invited to encourage the youth talent. Senior Executive Vice President, General Manager H.R Shakarganj Mills Limited was also the part of the ceremony.

Manager Social Action Program gave a brief introduction of the philanthropic activities of Shakarganj Mills Limited through Shakarganj Foundation to the honorable guests. Later on guests visits the gallery and appraised the fabulous work done by the students. Speaking over the occasion Mr. Waqar Civil Judge said “for me gallery visit is a wonderful experience and a pleasant surprise. I am astonished to see such creative and ideological art work of the young students. I do appreciate Shakarganj efforts to promote art and artist in a backward district of Punjab.”
STORY OF SWEETS

1. Lemon-Scented Blueberry Cupcakes

**Ingredients**

1. Cupcakes:
2. 1 1/2 cups (about 6 3/4 ounces) plus 2 tablespoons all-purpose flour, divided
3. 1/2 cup (2 ounces) 1/3-less-fat cream cheese, softened
4. 2 tablespoons butter, softened
5. 1 large egg
6. 1/2 cup low-fat buttermilk
7. 1/2 cup 2% reduced-fat milk
8. 1 teaspoon grated lemon rind
9. 1/4 cup fresh or frozen blueberries, thawed
10. Frosting:

**Preparation**

1. Preheat oven to 350°.
2. Place 12 decorative paper muffin cup liners into muffin cups.
3. To prepare cupcakes, lightly spoon 1 1/2 cups flour into dry measuring cups; level with a knife. Measure 1 tablespoon flour; level with a knife. Sift together 1 1/2 cups flour plus 1 tablespoon flour, granulated sugar, baking powder, 1/4 teaspoon salt, and baking soda in a large bowl. Combine melted butter and egg in another large bowl; stir with a whisk. Add buttermilk, milk, and 1 teaspoon rind to butter mixture; stir with a whisk. Add buttermilk mixture to flour mixture, stirring just until moist. Toss blueberries with remaining 1 tablespoon flour. Fold blueberries into batter. Spoon batter into prepared muffin cups. Bake at 350° for 25 minutes or until a wooden pick inserted in center comes out clean. Cool in pan 5 minutes on a wire rack; remove from pan. Cool completely on wire rack.
4. To prepare frosting, place cream cheese, 2 tablespoons butter, 1 teaspoon rind, vanilla, and 1/8 teaspoon salt in a bowl; beat with a mixer at medium speed just until blended. Gradually add powdered sugar (do not overbeat). Stir in juice. Spread frosting evenly over cupcakes; garnish with blueberries, if desired. Store, covered, in refrigerator.

2. Bourbon-Pecan Tart with Chocolate Drizzle

**Ingredients**

- 1 cup packed light brown sugar
- 3/4 cup dark corn syrup
- 3 tablespoons all-purpose flour
- 2 tablespoons bourbon
- 2 tablespoons molasses
- 1 tablespoon butter, melted
- 1/2 teaspoon vanilla extract
- 1/4 teaspoon salt
- 2 large eggs
- 1 large egg white
- 2/3 cup pecan halves
- 1/2 (15-ounce) package refrigerated pie dough (such as Pillsbury)

**Preparation**

- Cooking spray
- 1/2 ounce bittersweet chocolate, chopped

- Preheat oven to 350°.
- Combine first 10 ingredients, stirring well with a whisk. Stir in pecans. Roll dough into a 13-inch circle; fit into a 9-inch removable-bottom tart pan coated with cooking spray. Trim excess crust using a sharp knife. Spoon sugar mixture into prepared crust. Bake at 350° for 45 minutes or until center is set. Cool completely on a wire rack.
- Place chocolate in a microwave-safe bowl; microwave at HIGH 1 minute. Stir until smooth. Drizzle chocolate over start.
GUIDELINES FOR AUTHORS

Dear Fellow Author(s),

Pakistan Sugar Journal (PSJ) offers research, analysis, and reviews to keep its local and international readership up to date with latest developments in the sugar industry. PSJ takes into account the application of research and focuses on areas in agriculture related to sugar, milling and processing.

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