

## **Physiology and Sugar Chemistry Division**

In Bangladesh, Sugarcane cultivation is being gradually pushed to low-lying Char and marginal lands prone to water-logging, flood, drought and salinity stresses due to increasing demand of cereals and vegetables for the fast growing population. Of the total sugarcane production in the country only 23-27 % cane is utilized for sugar production and about 53-57 % usually utilized for gur manufacturing. Therefore, screening experiments against water-logging, flood, drought and salinity stresses as well as goor manufacturing have been proposed. Programme of cane and juice quality due to water-logging and flood have been undertaken. Studies on sugarcane germination under low temperature has been proposed since majority plantation is done during November to following January in north and south west parts of Bangladesh when ambient temperature remains below 20 °C which affects germination.

In addition to proposed programme on sugarcane cultivation and goor production research programme for Hill areas has also been undertaken to explore cultivation areas and to reduce poverty to the Hill areas people. In the manufacturing of goor, various chemicals hazardous to human health are used by commercial goor makers. In order to recommend a safe and environment friendly products for goor clarificants, experimentation with plants extracts clarificants like Wild Okra has been proposed. Research has also been undertaken to find out effectiveness of various packing devices for granular goor and Date palm syrup preservation and suitability for super market. In addition to those alternate sweetening agent stevia plant cultivation has been introduce in the current programme. Besides, feasibilities of sugar and goor production from sugar beet have also been undertaken.

### **Objectives of the division**

- To select sugarcane clones with superior tolerance to water-logging, flood, drought and salinity and find out morphological and physiological basis for that stresses tolerance to sugarcane.
- Identify parents to use in further crossing programme to develop water-logging tolerant varieties.
- To evaluate BSRI bred advanced sugarcane clones having inbuilt potential to germinate under lower ambient temperature.
- To determine maturity behaviour of sugarcane clones and find out peak maturity period.
- To screen sugarcane clones suitable for Goor production and determine the quality of goor after preparation.
- To prepare syrup at different concentrations (Brix%) and observe shelf life of preserved syrup.
- To optimize the techniques for preservation of ready-to-serve bottled sugarcane juice of consumer acceptability.

- To determine maturity behaviour of sugar beet varieties and find out peak maturity period
- To determine suitable process of goor production from Sugar beet and determine the quality of goor after preparation.
- To study the performance of BSRI developed sugarcane varieties for superior goor production in the Chittagong hill districts and determine the quality of prepared goor from different sugarcane varieties.

## Major Achievements

### Physiology section

#### 1. Screened Drought Tolerant Varieties

- Screening technique for drought tolerant variety screening has been developed.
- Screened 19 drought tolerant varieties such as Isd 20, Isd 21, Isd 22, Isd 24, Isd 25, Isd 26, Isd 27, Isd 28, Isd 29, Isd 31, Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40.
- These varieties are tolerant to highly tolerant to drought stress and give higher yield over existing commercial varieties (Isd 16 & L.J.C.) in drought prone areas of Bangladesh.



**Pictorial view of the experiment conducted under induced drought stress to develop drought tolerant varieties using PEG 6000**

#### 2. Screened Water-logging Tolerant varieties

- Screening technique for water-logging tolerant variety screening has been developed.
- Screened 19 varieties such as Isd 20, Isd 21, Isd 22, Isd 24, Isd 25, Isd 26, Isd 27, Isd 28, Isd 29, Isd 31, Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40.
- These varieties are tolerant to highly tolerant to water-logging stress and give high yield over existing varieties (Isd 2/54, Isd 16 & L.J.C.) in water-logging prone areas of Bangladesh.



**Pictorial view of the experiment conductivity under induced water-logging stress to develop water-logging tolerant varieties**



**Pictorial view of the experiment conductivity under induced water-logging stress to develop water-logging tolerant varieties at BSRI farm**

### **3. Screened Flood Tolerant Varieties**

- Screening technique for flood tolerant variety screening has been developed.
- Screened 20 varieties such as Isd 20, Isd 21, Isd 22, Isd 24, Isd 25, Isd 26, Isd 27, Isd 28, Isd 29, Isd 30, Isd 31, Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40.
- These varieties are tolerant to highly tolerant to flood stress, and give higher yield over existing commercial varieties (Isd 2/54, Isd 16 & L.J.C.) in flood prone char areas of Bangladesh.



**Pictorial view of the experiment conducted under induced flood stress to develop flood tolerant varieties**



**Pictorial view of the experiment conducted under flood stress to develop flood tolerant varieties at farmer's field**

#### **4. Screened Salinity Tolerant Varieties**

- Screening technique for salinity tolerant variety screening has been developed.
- Screened three sugarcane varieties such as Isd 28, Isd 39 and Isd 40.
- These varieties are moderately tolerant to tolerant to salinity stress, and give higher yield over existing local varieties in salinity prone areas of Bangladesh.



**Pictorial view of the experiment conducted under induced salinity stress to develop salinity tolerant varieties**

## **5. Identified Critical Salt Concentration for Sugarcane**

- Critical salt concentration for sugarcane cultivation has been identified.
- Salt concentration above 14 dS/m affects the tillering stage of sugarcane cultivation in the month of April.

## **6. Management of Drought Affected Sugarcane.**

- Management practices of drought affected sugarcane have been recommended for sugarcane cultivation in drought prone areas.
- Deep trench (25-30 cm) method of planting, trash mulching (10-15 cm thick) immediately after planting, application of organic matter in trench during planting, and/or application of additional dose of potash (@ 82 kg/ha) at trench in drought prone areas improve growth condition, and increase cane yield by 10-15%.
- Besides, leaf clipping practice during drought period has also been recommended.

## **7. Improvement of Sugarcane Germination.**

- Critical temperature for germination failure has been identified.
- Minimum ambient temperature below 20<sup>0</sup>C affects sugarcane germination.
- Minimum temperature is more critical for germination compared to maximum temperature. Plantation should not be done beyond 30th October in North-west part of Bangladesh.
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## **8. Tiller and Leaf Management of Sugarcane.**

- Defoliation of old and over mature leaves and late tiller removal has beneficial effects on cane quality and yields.
- Old and over matured leaves and late tillers should be removed leaving 8-10 tillers/clump followed by earthing up in the month of May.
- Tiller and leaf management increases sugarcane yield by 10-15% and sugar recovery by 0.3-1.0 unit.
- The young tillers and green leaves can be used as cattle feed.

## **9. Effects of Flowering on Cane Quality.**

- It has been identified that there are no significant adverse effects of flowering on cane quality up to 60 days of flowering. Quality falls beyond 60 d of flowering.
- It has been suggested to harvest flowering cane within 60 d of flowering.

#### 10. **Screened Chewing Sugarcane.**

- In Bangladesh demand of chewing sugarcane is very high, but only a few very old degenerated varieties are in cultivation.
- Screened chewing sugarcane variety Amrita and Rangbilash. This variety is superior over existing chewing sugarcane.

### **Sugar Chemistry Section**

#### 11. **Prevention of Post Harvest Deterioration.**

- In Bangladesh, sometimes it takes 5-7 d from harvesting to crushing due to poor transportation facilities, and unplanned harvesting. This “time gap” between harvesting and crushing causes deterioration in stale cane. Post harvest deterioration of stale cane might be minimized by spraying of water, 1% formalin solution and/or covering of stale cane with sugarcane trash.

#### 12. **Screened Sugarcane Varieties Based on Maturity Behaviour.**

- Maturity behaviour based variety screening method has been developed.
- Varieties such as Isd-16, Isd-21, Isd-22, Isd-24, Isd-26, Isd-27, Isd-30, Isd-33, Isd-35, Isd-36, Isd-37, Isd-38, Isd-39 and Isd-40 have been screened as early maturing.
- Varieties Isd 2/54, Isd-18, Isd 19, Isd-19, Isd-20, Isd-25, Isd-28, Isd-29, Isd 31, Isd 32 and Isd 34 screened as mid maturing and BS-96 as late maturing.

#### 13. **Screened Sugarcane Varieties for Goor Production.**

- Screened sugarcane varieties such as Isd-16, Isd-18, Isd-22, Isd-24, Isd-27, Isd-30, Isd-34, Isd-35, Isd-36, Isd-37, Isd-38, Isd-39 and Isd-40 for goor production.

#### 14. **Methods of Goor Preservation.**

- Developed improved but cheaper goor preservation technique for house hold as well as commercial use.
- Goor could be preserved for longer period without losing quality in paint coated earthen pitcher with wax sealing of pitcher neck.

#### 15. **Commercial goor preservation technique in cold storage.**

- In cold storage goor is preserved at 36-38<sup>0</sup>F temperature and maximum 85% relative humidity.
- Granular goor, Plate goor and Block goor can be preserved for longer period in polythene packet

## 16. Production and packaging of granular goor

- Prepared goor will be stirred mechanically and protect its solidification and dried in the sun for 1-2 days then packed.
- Hygienic and without harmful hydrose.



Preparation of granular goor



## 17. Vegetative clarificants for goor preparation.

- Extract of wild okra is an effective clarificant for goor preparation.
- 350-500 gm matured plant of wild okra dissolved in 2-3 litre water and used for one pan (200 Kg) of cane juice. This plant has wild adoptability found anywhere surrounding land and houses.



**Pictorial view of Wild Okra plant using as clarificant**



**Mucellaneous substances collected from wild okra**



**Mucellaneous substances collected from wild okra**



**Mixing of wild okra extract with boiling juice**

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### **Importance of date palm, palmyra palm and golpata**

Date palm, palmyra palm and golpata are potential plants for gur/syrup production in the country to reduce gap between demands of sugar/gur and production. Trials on date palm, Palmyra palm and golpata syrup production and preservation have been proposed to explore the maximum economic return from Date palm, Palmyra palm and Golpata as an alternate crop for quality gur/syrup production. In Malayasia and Indonesia 6000 to 20000 litre golpata juice are collected and they produce 20 ton sugar/hectare from golpata juice. Vinegar is produced from golpata juice in that countries. Golpata vinegar contains 2-3% acetic acid.

### **Objectives:**

1. Development of date palm, palmyra palm and golpata varieties and production technologies.
2. Development of date palm, palmyra palm and golpata gur and syrup processing and preservation technologies.

3. Date palm and palmyra palm (Noble & Local) seedling raising, micropropagation, plantation and maintenance.
4. Transfer of newly developed technologies.
5. Create awareness regarding on importance of date palm, palmyra palm and golpata cultivation.

### **Activities:**

#### **Seedling raising programme for dissemination**



**Production of palmyra palm seedling**



**Production of datepalm seedling**

#### **Date palm juice collection and gur preparation**



**Date palm garden**



**Cutting of date palm tree for juice collection**



**Date palm syrup prepared from date palm juice Bottling of date palm syrup**



**Preparation of date palm gur**

**Date palm gur**

**Palmyra palm juice collection and gur preparation**



**Palmyra palm garden at BSRI**



**Collection of juice from female palmyra palm**



**Palmyra palm gur**

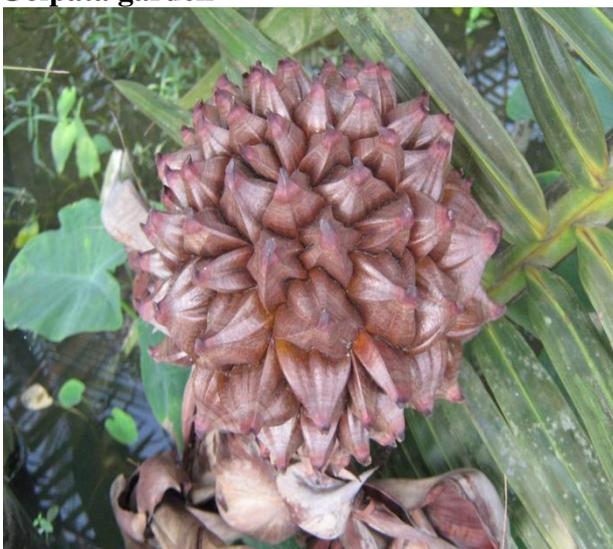
**Golpata juice collection and gur preparation**



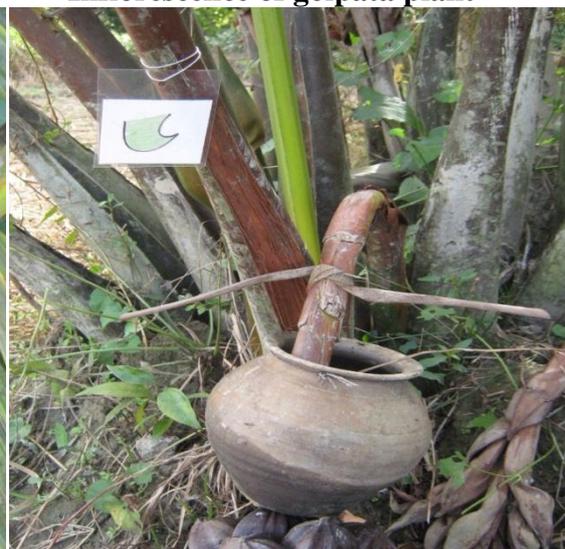
**Golpata garden**



**Inflorescence of golpata plant**



**Fruit of golpata plant**



**Collection of juice from golpata plant**



**Golpata gur**

### **Achievements:**

#### **1. Agronomic Management Practice for Date Palm.**

- Agronomic management practices like irrigation, trash mulching and NPK fertilizers application enhance juice secretion in date palm plant. Juice secretion increased as number of irrigation was increased during juice tapping period.

#### **2. Influence of Size of Cut on Date Palm Juice Secretion.**

- Juice secretion from date palm is influenced by size of cut. Juice secretion is increased as the size of cut is increased in date palm plant.

#### **3. Production and Preservation Technique of Date Palm Syrup**

- Date palm juice is boiled in open pan boiling system up to 70-75<sup>0</sup> Brix and preserved in plastic or glass bottles.
- Syrup could be preserved for longer period without losing quality in plastic or glass bottles.

#### **4. Development and dissemination of gur production technology from golpata plant.**

#### **5. Development talmisri production technology from palmyra palm plant.**

