Biotechnology Division
Bangladesh Sugarcrop Research Institute (BSRI)
Ishurdi-6620, Pabna, Bangladesh

Biotechnological Research Activities and Achievements of Biotechnology Division

1. Background information

In 1933, Sugarcane Seedling Testing Laboratory (SSTL) was established at Monipuri farm, Dhaka and it functioned up to 1974 and also was financed by the Royal Imperial Council of Agriculture of India. In 1947, The Ministry of Agriculture erstwhile Government of East Pakistan established the Sugarcane Research Station (SRS) at Ishwardi, Pabna. It was actively involved in selecting improved varieties of sugarcane for the country with limited manpower. The ministry of Agriculture handed over to Bangladesh Sugar and Food Industries Corporation (BSFIC) which took over the control of SRS in February, 1973 and upgraded it as Sugarcane Research Institute (SRI) and then was approved by ECNEC as Sugarcane Research and Training Institute (SRTI) in 1980-81 fiscal year. The Bangladesh Sugarcane Research Institute (BSRI) was established as a follow up of Cabinet decision was taken in April, 1996. Besides, Government transferred it from Ministry of Industry to the Ministry of Agriculture to upgrade as a national institute. Bangladesh Sugarcrop Research Institute (BSRI) former Bangladesh Sugarcane Research Institute is one of the oldest research institute of Bangladesh conducting research on Sugarcane-the raw material for sugar, goor and cane juice. Recently, new dimension is added in its research by adding other sweetener crops such as Sugarbeet, Date palm, Palmyra palm, Golpata, Stevia and other sugar related crops hence the name of institute became as “Bangladesh Sugarcrop Research Institute (BSRI)” on 9 November 2015 through Government Order. BSRI is proud to serve the nation attaining self-reliance in the sugar and goor sector with its limited resource and manpower. Two basic functions are performed by this institute a) Development of Sugarcrop varieties as well as improved production technologies and b) Dissemination of varieties and technologies to the farming community. Consequently biotechnological research activities have been strengthened of the institute to overcome the barrier and limitation of conventional research activities. Biotechnological research activities of BSRI started establishing its own Laboratory in 1997. The Biotechnology Laboratory of BSRI was established as Biotechnology Division on 27 February, 2011. Since 1997 to date protocol development and optimization for micropropagation of Sugar crops such as sugarcane and Stevia and also somaclonal techniques for Sugarcane variety development, genetic transformation for stress tolerant variety development are achieved. Molecular characterization of released varieties and some of elite germplasms was performed through genetic Fingerprinting using RAPD

and SSR markers. Molecular markers technique for Marker Assisted Selection (MAS) of sugarcane varieties is in practice.

2. Achievements

i. Tissue Culture

- Protocols have been optimized for high quality seed/sett production of Sugarcane through micropropagation. Micropropagated plants of Sugarcane gave the 1.4 times higher yield than three budded setts.

- Protocol has been optimized for somaclonal plant production through callus culture for Sugarcane variety development. Six thousand somaclones have been produced from salt and drought tolerant as well as from normal callus of sugarcane varieties Isd 16, Isd 18, Isd 20, Isd 28, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38 and Misrimala. Forty eight drought and 61 salinity tolerant somaclones have been developed through callus culture method. One somaclone of Isd 18 has been released as BSRI Akh 43.

- One red rot disease resistant somaclone (Isd 37SC1) from variety Isd 37 has been identified.

- For short duration 50 somaclones of varieties Isd 16, Isd 20, Isd 28, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37 and Isd 38 have been developed.

- Protocol has been optimized for micropropagation of Sugarbeet for vegetative seed production.

- Protocol has been optimized for micropropagation of Stevia-an elite sweetening medicinal which is 200-300 times sweeter than sugar with no calorie. Stevia is being successfully produced using micropropagated plants in the field. For versatile utilization of Stevia, Ready Tea Bag, Stevia Tablet and Stevia powder have been produced.

- Easy method of mushroom seed production using tissue culture has been developed and sugarcane bagasse as substrate has been optimized for mushroom production.

Figure1. Shoot produced through tissue culture technique

ii. Genetic Engineering

- Protocol for *Agrobacterium*-mediated genetic transformation of Sugarcane varieties of Bangladesh has been optimized. Salt and drought tolerant genes has been transformed in sugarcane variety Isd 34 which was able to survive on 150mM (21.66dS/m) salt and 7.5% PEG under *in vitro* contained condition and are being multiplied regularly.

iii. Molecular Breeding

- Easy and efficient method for DNA isolation of Sugarcane for DNA Fingerprinting has been optimized using simple equipment and chemical without liquid nitrogen.
- Molecular characterization for all released Sugarcane varieties including 4 chewing germplasm has been completed.
- DNA Fingerprinting of 16 Mushroom Strains has been completed and supplied to Bangladesh Mushroom Development Institute.
- One Red rot disease resistant somaclone of Sugarcane has been characterized using RAPD marker.

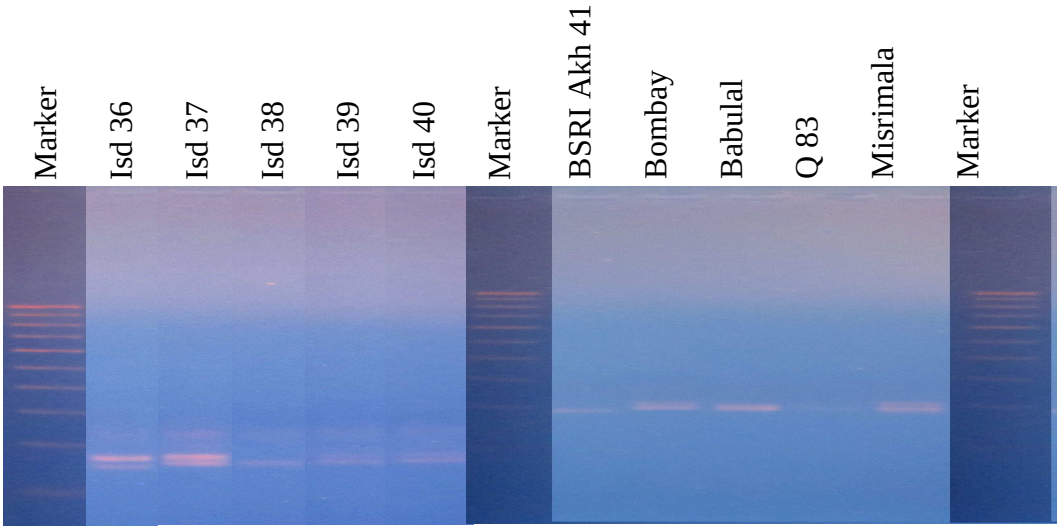

Figure 2. DNA fingerprinting of five bred variety one bred chewing variety and four chewing germplasm using SSR marke

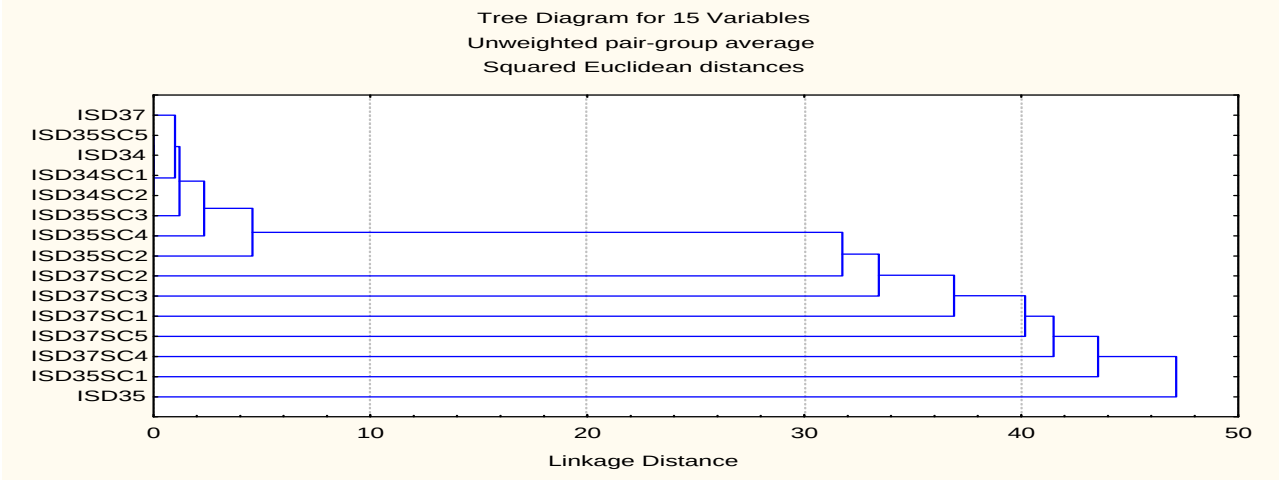

Figure 3. Tree diagram based on Unweighted pair-group average Squared Euclidean

3. Facility developed/available

a) Infrastructure/laboratory

Through the project "Strengthening Biotechnological Research of BSRI", a well-equipped laboratory has been developed having necessary modern equipment are shown as follows:

Sl No	Name of Item	Quantity
01	DNA Quantifier	01
02	UV/VIS Spectrophotometer	01
03	Sequi-Gen GT Sequencing Systen (38 x 30 cm) Sequi-Gen GT Nuclecic Acid Electrophoresis Cell with power pac HV power Supply and all accessories and fittings	02
04	Gel Documentation System-bioDoc Analyze System	02
05	PCR Machine	01
06	Laminar Flow	01
07	Gel Electrophoresis Unit (Horizontal with power supply and accessories)	01
08	Gel Electrophoresis Unit (vertical, dual with power supplyu and accessories)	01
09	Bench Top Centrifuge (Heavy)	01
10.	Multimedia Projector with Laptop computer	01
11.	Fax Machine	01
12.	Real time PCR with Laptop Support and Accessories Necessaries like Automated Nucleic Acid and Protein Extraction System, Fireboy, Fluorometer, Block Incubator, Dispenser, Micropipettes, Sample Handling System Accessories for Real time PCR: (i) Automated Nucleic Acid and Protein Extraction System- 01 (ii) Fireboy (Bunsen burner)-02 (iii) Fluorometer for DNA, RNA and Protein-01 (iv) Block Incubator-01 (v) Dispenser-02 (vi) Micropipettes-03 (vii) Micropipettes with CARROUSEL stand Adaptor-04 (viii) Sample Handling System-01 Additional Accessories: (i) Digital Vortex Mixer-02 (ii) 96 Well Flipper Rack with Lid-100 (iii) Cryovial 1.8ml, Sterile, Internally Threaded-04 (iv) 1.5 Micro Centrifuge Tube-10 (v) 0.5 Micro Centrifuge Tube-10 (vi) 0.2mL Flat Cap PCR Tubes-10 (vii) Sterile Syringe Filter-20	01
13.	Ultra low Temperature Freeze (-80/86°C)	01
14.	Magnetic Stirrer with Hot Plate	02
15.	Scanner	01
16.	Air Conditioner Split Type	08
17.	Refrigerator (10-12 CFT)	02
18.	Autoclave 80-100L Gass/Electric Compatible	01
19.	Centrifuge Temperature Controlled	01
20.	Cryocan (Large)-Liquid Nitrogen Container	01
21.	Deep Freeze -5°C to -20°C	01
22.	Digital Balance	02

23.	Computer with all Accessories	02
24.	Laminar Flow	01
25.	Distillation Plants with all accessories	02
26.	Micro-wave Oven	01
27.	Hot Plate	01
28.	Dispenser	02
29.	UV-Eye Protection	04
30.	Generator	01
31.	Micropipette	05
32.	Photocopier Machine (color)	01
33.	MiniSpin Plus Centrifuge 12x1.5/2.0 ml of tube	01
34.	Digitally controlled water bath with shaker	01
35.	pH Meter: Precision pH meter	02
36.	Orbital Shaker	01
37.	Fume Hood	01
38.	Vortex Mixture Unit	01
40.	De-ionizer	02
41.	Ice Maker	01
42	Color Laser Printer	02
42.	Micropipette- Research Pipette	05

b) Manpower

Through the Agriculture Research Management Project (ARMP) one scientist (Dr. Md. Amzad Hossain former CSO and Head of the Biotechnology Division) completed Ph.D. degree from Japan on Biotechnology and Molecular Breeding and acting as Director (Research). Under the BARC-NATP (Phase-I) SPGR supported project. Dr. Kuasha Mahmud completed his Ph.D, degree from BAU on Somaclonal Breeding using Mutagens and Molecular Techniques and acting as Principal Scientific Officer and also Head of the Biotechnology Division. Dr. Nadira Islam has completed her Ph.D degree under "Strengthening Biotechnological Research of BSRI" Project on Transformation of *BT* Gene into Sugarcane *(Saccharum officinarum*) and Cloning of Antisense *SCLIM* Gene from Kasetsart University, Thailand. She is acting as Senior Scientific Officer. Mr. Asish Kumar Ghose with MS in Biotechnology on Molecular Biology is acting as Scientific Officer.

4. Current Research Progress

i. Tissue Culture:

- Studies with regeneration and micropropagation protocol development of newly released Sugarcane varieties using leaf segments via callus culture, shoot tip and meristem culture.
- Protocol development for regeneration and micropropagation of Date palm, Palmyra palm, Palm leaves (Gol pata) and Sugarbeet.

ii. Genetic Engineering

Genetic transformation for development of stress (salt and drought) tolerant transgenic sugarcane.

iii. Molecular Breeding

- Working on to develop improved varieties of Sugarcane for sugar, goor and chewing using biotechnological tools such as DNA Fingerprinting, Molecular Marker Assisted Selection (MAS) and Quantitative Trait Loci (QTLs) determination.

Academic Activities

- Six Ph. D. research students (including 3 university teachers) are being carried out their Thesis works at BSRI Biotechnology Division. So far two Ph. D. and 27 Master students have successfully been completed their research works.

Future Thrust

- Development of Marker Assisted Selection (MAS) for Sugarcane.
- QTL determination for Sugarcane improvement.
- Gene Construction for Our Own Use.
- Genome Analysis of Our Sugarcane Varieties for Specific Use.

Present Manpower (Scientists)

- Dr. Kuasha Mahmud, Principal Scientific Officer & Head
- Dr. Nadira Islam, Senior Scientific Officer
- Asish Kumar Ghose, Scientific Officer