ROLE OF SUGAR CANE RESEARCH INSTITUTE FAISALABAD IN ADDRESSING FUTURE THREATS

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By:

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OBJECTIVES

- Variety Evolution
  - Better Cane Yield
  - High Sugar Production
  - Good Ratoon
  - Tolerance to Biotic & Abiotic Stresses

- Cane Technology
  - Production Technology
  - Enhancing WUE & FUE
  - Ratoon Management
  - Harvesting & Post-Harvest Losses
  - Cane By-products

- Disease & Insect Pests
  - Screening against Diseases
  - Screening against Insect-pest
  - Control measures & IPM
### CURRENT STATUS OF SRI

#### SUGARCANE IN PAKISTAN

**2012-13 vs. 2013-14**

<table>
<thead>
<tr>
<th>Provinces</th>
<th>Sugarcane area (000 ha)</th>
<th>Sugarcane production (M.T.)</th>
<th>Sugarcane yield (t ha⁻¹)</th>
<th>Sugar recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td>767.7</td>
<td>723.6</td>
<td>-5.7</td>
<td>42.98</td>
</tr>
<tr>
<td>Sindh</td>
<td>253.7</td>
<td>297.6</td>
<td>17.30</td>
<td>15.96</td>
</tr>
<tr>
<td>KPK</td>
<td>106.7</td>
<td>107.7</td>
<td>0.9</td>
<td>4.77</td>
</tr>
<tr>
<td>Baluchistan</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.31</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1128.8</td>
<td>1129.6</td>
<td>0.1</td>
<td>63.75</td>
</tr>
</tbody>
</table>

*Source: Ministry of National Food Security & Research & PSMA 2013*
AREA UNDER SRI VARIETIES

Punjab = 99%
Sindh = 60%
KPK = 95%

VARIETAL COMPOSITION OF SRI VARIETIES IN PUNJAB
2013-14

Source: Crop Reporting Punjab 2013
SUGARCANE PRODUCERS IN ASIA

<table>
<thead>
<tr>
<th>#</th>
<th>Country</th>
<th>Area (000 ha)</th>
<th>Production (000 t)</th>
<th>Yield (t ha⁻¹)</th>
<th>Crop Duration (Months)</th>
<th>Stripped Cane Yield/Unit time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Philippine</td>
<td>433</td>
<td>30000</td>
<td>69.24</td>
<td>18</td>
<td>69.24</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>5090</td>
<td>347870</td>
<td>68.34</td>
<td>12-18</td>
<td>68.34</td>
</tr>
<tr>
<td>3</td>
<td>Sri-Lanka</td>
<td>13</td>
<td>800</td>
<td>63.49</td>
<td>18</td>
<td>63.49</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>458</td>
<td>26342</td>
<td>57.68</td>
<td>18</td>
<td>57.68</td>
</tr>
<tr>
<td>5</td>
<td>Pakistan</td>
<td>1046</td>
<td>58038</td>
<td>55.49</td>
<td>10-15</td>
<td>79.91</td>
</tr>
<tr>
<td>6</td>
<td>Lao DPR</td>
<td>21</td>
<td>1056</td>
<td>51.52</td>
<td>18</td>
<td>51.52</td>
</tr>
<tr>
<td>7</td>
<td>Nepal</td>
<td>65</td>
<td>2930</td>
<td>45.45</td>
<td>18</td>
<td>45.45</td>
</tr>
<tr>
<td>8</td>
<td>Bangladesh</td>
<td>118</td>
<td>4850</td>
<td>41.10</td>
<td>18</td>
<td>41.10</td>
</tr>
<tr>
<td>9</td>
<td>Cambodia</td>
<td>17</td>
<td>365</td>
<td>21.47</td>
<td>18</td>
<td>21.47</td>
</tr>
<tr>
<td></td>
<td>Ranking</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Ministry of National Food Security & Research 2013

SUCCESS STORY OF VARIETY EVOLUTION AT SRI

International collaboration:

✓ Varieties of CP origin like CPF-246, CPF-247, CPF-248 are very successful in Pakistan, fuzz imported from U.S.A.

✓ Varieties like CP77-400, CP72-2086 & CP43-33 were directly imported from U.S.A.

✓ Varieties of SP origin like SPF-213 is successful in all Punjab and SPF-234, a good performers in Southern Punjab, fuzz imported from Brazil

✓ Several advance lines of SRI, Faisalabad belong to germplasm imported from U.S.A. and Australia

National collaboration:

✓ HSF-240 and HSF-242 are joint collaborative effort of Habib Sugar Mills and SRI Faisalabad
## PROMISING VARIETIES OF SRI, FSD

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Varieties</th>
<th>Year of Release</th>
<th>Av. Yield (t ha⁻¹)</th>
<th>Sugar Recovery (%)</th>
<th>Sugar Yield (t ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SPF-213</td>
<td>2000</td>
<td>90</td>
<td>10.50</td>
<td>9.45</td>
</tr>
<tr>
<td>2.</td>
<td>HSF-240</td>
<td>2002</td>
<td>95</td>
<td>11.70</td>
<td>11.11</td>
</tr>
<tr>
<td>3.</td>
<td>SPF-234</td>
<td>2002</td>
<td>100</td>
<td>11.60</td>
<td>11.60</td>
</tr>
<tr>
<td>4.</td>
<td>CPF-246</td>
<td>2011</td>
<td>105</td>
<td>12.00</td>
<td>12.60</td>
</tr>
<tr>
<td>5.</td>
<td>CPF-247</td>
<td>2011</td>
<td>105</td>
<td>12.25</td>
<td>12.86</td>
</tr>
<tr>
<td>6.</td>
<td>CPF-248</td>
<td>2013</td>
<td>113</td>
<td>12.71</td>
<td>14.32</td>
</tr>
</tbody>
</table>

## OVERALL IMPACT IN PUNJAB

<table>
<thead>
<tr>
<th>Comparison</th>
<th>1999-00</th>
<th>2013-14</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (000 ha)</td>
<td>672.10</td>
<td>756.75</td>
<td>12.59</td>
</tr>
<tr>
<td>Production (million tones)</td>
<td>25.00</td>
<td>43.70</td>
<td>74.80</td>
</tr>
<tr>
<td>Yield (tones/ha)</td>
<td>37.20</td>
<td>62.60</td>
<td>68.28</td>
</tr>
<tr>
<td>Recovery (%)</td>
<td>7.82</td>
<td>9.92</td>
<td>26.85</td>
</tr>
</tbody>
</table>

FUTURE STRATEGIES

FUTURE VARIETIES OF SRI, FSD

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Name of clones</th>
<th>Av. Yield (t ha⁻¹)</th>
<th>Yield potential (t ha⁻¹)</th>
<th>Sugar Recovery (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CPF-249 (S2003-US 704)</td>
<td>107</td>
<td>135</td>
<td>12.80</td>
<td>Medium</td>
</tr>
<tr>
<td>2.</td>
<td>CPF-250 (S2003-US 127)</td>
<td>106</td>
<td>125</td>
<td>12.60</td>
<td>Early</td>
</tr>
<tr>
<td>5.</td>
<td>S2005-US 54</td>
<td>107</td>
<td>135</td>
<td>12.60</td>
<td>Early</td>
</tr>
<tr>
<td>7.</td>
<td>S2006-US 658</td>
<td>106</td>
<td>125</td>
<td>12.40</td>
<td>Medium</td>
</tr>
</tbody>
</table>

INTERNATIONAL COLLABORATION

- Sugarcane Field Station, Canal Point, USA
- Sugarcane Research Institute, Sri Lanka
- Philippine Sugar Research Institute, Philippine
- Mauritius Sugar Industry Research Institute, Mauritius
- South African Sugarcane Research Institute, South Africa
- Bangladesh Sugarcane Research Institute (BSRI), Bangladesh
- West Indies Central Sugar Cane Breeding Station, Barbados
FUTURE THREATS FOR SUGARCANE

BIOTIC STRESSES

ABIOTIC STRESSES

WATER RESOURCES

FUTURE STRATEGIES

- Sugarcane Breeding
- Sugarcane Technology
- Sugarcane Biotechnology & Genetic Engineering
- Enhancing Agronomical aspects
- Sugarcane Entomology
- Sugarcane Pathology
- Adoptability trials
- Production Technology
BIOTECHNOLOGY IN SUGARCANE

Abiotic Stresses

- Salinity
- Drought
- Frost

Biotic Stresses

- Borers
- Weeds

SUGARCANE GENETIC ENGINEERING

Crop Improvement

Several efforts have been made to improve sugarcane yield and recovery by employing biotechnology

PARB Projects

Two PARB projects in collaboration with NIBGE and CEMB

Biotic & Abiotic Stress Tolerance

PARB Projects has theme of biotic and abiotic stress tolerance e.g., Salt, Drought, Frost, Weeds & Borers
# PARB PROJECTS AT SRI

<table>
<thead>
<tr>
<th>Title</th>
<th>Estimated cost (Rs. Millions)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane plant improvement through traditional and modern breeding technologies</td>
<td>27.836</td>
<td>On-going</td>
</tr>
<tr>
<td>Genetic Improvement of Sugarcane for herbicide and borer resistance</td>
<td>22.350</td>
<td>On-going</td>
</tr>
<tr>
<td>Development of transgenic sugarcane (Saccharum officinarum L.) against major abiotic stresses</td>
<td>19.587</td>
<td>Completed</td>
</tr>
</tbody>
</table>

# PARB PROJECTS NO 163

Sugarcane plant improvement through traditional and modern breeding technologies

**Objectives**

- Import of Cane Germplasm
- DNA Fingerprinting at Faisalabad
- Breeding of SRI varieties at Sri-Lanka
- Fuss Production for High Yield & Recovery Varieties
COLLABORATION

- Shakarganj Sugar Research Institute, Jhang
- Agricultural Biotechnology Research Institute, Faisalabad
- Sugarcane Research Institute, Uda Walawe, Sri-Lanka

ACHIEVEMENTS

- Breeding at SRI, Sri-Lanka, 30 varieties of SRI, Faisalabad, 30 varieties of SSRI, Jhang and 30 varieties of SRI, Sri-Lanka were selected based on genetic profiling at ABRI, Faisalabad
- More than 500 crosses have been received from SRI, Sri-Lanka, 50 crosses from South Africa
- 20 genotypes were exchanged with Philippines and 10 genotypes were exchanged with Mauritius. 34 genotypes were exported to Sri-Lanka during 2014
- More than 80,000 seedlings of 293 crosses have germinated, singled and transplanted during 2013-14
- Zonal trials of 9 future lines along with 3 standard varieties were planted at 11 locations across Punjab. Three clones performed better than standard varieties
SEEDLINGS RAISED FROM FUZZ IMPORTED FROM MAURITIUS
SEEDLINGS RAISED FROM FUZZ IMPORTED FROM USA

SEEDLINGS RAISED FROM FUZZ IMPORTED FROM SRI-LANKA
VARIETIES IMPORTED FROM PHILIPPINE

PARB PROJECTS NO 101

Development of transgenic sugarcane (*Saccharum officinarum* L.) against major abiotic stresses

**Objectives**

- Salt Tolerance
- Drought Tolerance
- Frost Tolerance
SALT TOLERANT VARIETIES

DROUGHT TOLERANT VARIETIES

- Water - a scarce commodity
- Costly pumping of water due to rising cost of diesel & load-shedding
Three irrigation levels of 100%, 80% and 60% were applied to 110 clones of CPF-248, CPF-246, HSF-240 and CSSG-668. Seventy seven (77) clones of four varieties performed better on 60% and 80% irrigation.

For frost tolerance, 321 clones of CPF-248, CPF-246, HSF-240 and CSSG-668 were tested. Eighty three (83) were selected based on their comparative performance and sown for further testing.

The salinity tolerance experiment consists of 91 clones of CP-248 CPF-246, HSF-240 and CSSG-668 sown at SSRI, Pindi Bhattian. All the clones were promoted for second year testing.
PARB PROJECTS NO 193

Genetic Improvement of Sugarcane for Herbicide and Borer Resistance

Objectives

- Glyphosate Tolerance
- Borer Resistance

PARB PROJECTS NO 193

RESPONSIBLE GENES

Weeds

GTGene for tolerance against Glyphosate

Borers

CEMB-BT for resistance against Sugarcane Borers
VARIEDIES RESISTANT TO PESTS AND DISEASES

Control measures are not always available or accessible

Pesticides are costly and their use pose environmental threat and human health hazards

BIOLOGICAL CONTROL

✓ Safe and efficient
✓ Long term control
✓ Environment friendly
✓ Cost effective

*Trichogramma* for control of sugarcane borers

*Chrysoperla* for control of whiteflies
REDUCE COSTS OF PRODUCTION

- IRRIGATION
  (Improve WUE)

- FERTILIZERS
  (Improve FUE)

- HARVESTING
  (Reduce Losses)

DEEP TRENCH PLANTING TECHNIQUE

- Water saving ~47%
- Yield increase ~22%
ALTERNATE SKIP IRRIGATION

WATER SAVED = 25%

SOLAR ENERGY—RENEWABLE ENERGY

RIISING COSTS OF DIESEL AND ELECTRICITY

DIESEL

ELECTRICITY

60 m³/h
STRESS MANAGEMENT FOR FARMERS

- Use of biotic & abiotic stress tolerant approved varieties through Biotechnology
- Use of organic fertilizer sources to reduce cost of production
- Use of water conservation technologies
- Use of farm machinery to reduce labor cost to enhance precision & efficiency
- Availability of subsidized farm implements, solar powered tube wells, bio-gas plants, and other inputs
STRESS MANAGEMENT FOR MILLERS

- Varietal Development Program at mill level
- Agro-meteorology studies for site specific variety development
- Establishment of model seed farm at mill level
- Production of organic fertilizer from filter cake
- Strengthening of quality control laboratory

BIO-COMPOSTING

VALORIZATION OF MILL BY-PRODUCTS AND ANIMAL WASTES (Pressmud, Ash, Molasses, Manure)
VALORIZATION OF SUGARCANE BIOMASS

Contribution of Sugarcane

- Enhanced biomass production
- Co-generation

FUTURE STRATEGIES

Continuity of fuzz production from Sri-Lanka of desired characteristics

Varietal exchange program with U.S.A., Brazil, Mauritius, Australia

Import of elite germplasm from U.S.A., Brazil, Australia, Thailand, etc.

Evaluation of site specific varieties

Development of site specific production technology

Establishment of quarantine station at Pail, Murree

Contd...
FUTURE STRATEGIES

Establishment of Sugarcane Breeding Institute in Coastal area

Establishment of Cane Seed Production Farm at Chak Jhumra

Sugarcane maximization program at mill level
MEDIUM TERM OBJECTIVES (5 YEARS)

Target:  
Av. Cane Yield: 90 t ha\(^{-1}\)  
Av. Sugar Recovery: 11.00 %

- Approval of 3 to 5 cane varieties from existing germplasm that are superior to varieties in vogue
- Establishment/ Strengthening of infrastructure for Sugarcane Research and Development in Punjab
- Aggressive efforts in extension work directly with farmers and through sugar mills to attain Yield and Recovery objectives
- Extra emphasis on education with respect to water use efficiency

Contd...
LONG TERM OBJECTIVES (10 YEAR)

Target: Av. Cane Yield: 110 t ha\(^{-1}\) Av. Sugar Recovery: 13 %

- Significantly expand and strengthen Sugarcane breeding and selection program
- Approval of site-specific varieties and development of production technology for different districts of Punjab
- Production of true seed of desired characteristics in Pakistan
- High fiber variety evolution for co-generation

MEDIUM TERM OBJECTIVES (5 YEARS)

Target: Av. Cane Yield: 90 t ha\(^{-1}\) Av. Sugar Recovery: 11.00 %

- Site-specific studies in different agro-ecological zones for variety development and productivity enhancement at mill level
- Extensive efforts for development of seed farms for newly approved varieties
- Valorization of sugar mill by-products for benefit of sugarcane farmers
- Strengthening of international linkages and upgrading subject expertise in Punjab
LONG TERM OBJECTIVES (10 YEAR)

Target:  Av. Cane Yield: 110 t ha\(^{-1}\)  Av. Sugar Recovery: 13 %

- Capacity building of scientists
- Introduction of Genetically Modified (GMO) sugarcane varieties tolerant against abiotic stresses like frost, drought, salinity and biotic stresses like disease and insect pests
- Micro-management practices to enhance productivity
- Farm mechanization for sustainable sugarcane production

THANK YOU FOR YOUR ATTENTION

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