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ADVANCEMENT IN SUGARCANE PRODUCTION TECHNOLOGY AND FUTURE PROSPECTS

by

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OBJECTIVES OF SRI, FAISALABAD

i. Varietal Development Program

Evolution of varieties having high cane yield & sugar recovery, good ratoonability and tolerant / resistant to abiotic and biotic stresses

ii. Development of Cane Production Technology

- To explore the potential of newly developed varieties
- Economical and efficient use of resources
- Integrated management package to control insect pests, diseases and weeds
- Introduction / development of mechanized system
- Ratoon management
- Intercropping studies

Innovative approaches for development of new varieties

- Acquisition of sugarcane germplasm from local and international sources
- Fuzz production & collection at SBSS, Murree
- Sowing of fuzz, singling and transplanting of seedlings
- Selection of seedling in the field
- Nursery-1, nursesey-2, nursery-3, semi-final varietal trial and final varietal trial
- Zonal testing and NUYT
- Evaluation of varietal resistance against disease and insect pests
- Development and released of high cane and sugar yielding varieties resistant to biotic and abiotic stresses
- Agronomic studies for planting time, seed rate, fertilization, water requirements, time of harvesting, lodging and ratooning potential etc.
- Intercropping of high value crops
- Qualitative studies
- Seed multiplication for provision of healthy and approved sugarcane varieties seed to growers and millers

Collaborative Research in Modern Era: Need & Challenges

Summary of Direct Introduction

Sr.#.	Source	Year	No. of clones	No. of clones ger.	Current status
1.	USA	2017	19	14	01 in Final Stage & 01 line in NUYT and Germplasm
2.	Philippine	2017	12	12	Germplasm
3.	India	2018	02	02	1 Final & Germplasm
4.	France	2018	09	09	01 in Final Stage & Germplasm
5.	Australia	2018	01	01	Germplasm
6.	Philippine	2018	09	09	1 Final & Germplasm
7.	Brazil	2023	19	19	Grown in 1 st year
Total:			71	66	

Summary of Fuzz

Sr.#.	Source	Year	Total Crosses	Cross Germinated	Current status
1.	Sri-Lanka	2018	94	64	N-III
2.	Barbados (W. Indies)	2018	13	13	N-III
3.	Sri-Lanka	2019	100	89	N-II
4.	Sri-Lanka	2020	124	41	N-I
5.	Sri-Lanka	2021	124	62	Seedlings
Total:			455	269	

CHALLENGES

- 1. Yield gap**
 - 2. Climate change**
 - 3. Water shortage**
 - 4. High cost of cane & sugar production**
 - 5. Cane procurement, marketing and supply system**
- **Increase cane yield per unit area**
 - **Lower cost of production for sugarcane & sugar**
 - **More competitiveness in international market to increase sugar export**
 - **Increase profit of growers and sugar mills**
 - **Resource conservation and economization**

YIELD GAP

Impacts

- ❖ Low cane productivity as compared to varietal yield potential
- ❖ Poor economic return to the growers
- ❖ High cost of cane & sugar production

Due to:

- ❖ Low soil fertility
- ❖ Unavailability of healthy seed of approved varieties
- ❖ Poor crop management particularly ratoon crop
- ❖ Lack of sugarcane mechanization
- ❖ Sugarcane growing zones with different characteristics

CLIMATE CHANGE

a. Drought/high temperature

- Increased evapotranspiration causes rapid depletion of water from root zone leads to temporary wilting
- Low germination
- Increased pest pressure: whip smut, white leaf, black bug, red mite/white mites, early shoot borer/stem borer and trouble some vine species of weeds (particularly in ratoon)
- Sun burning
- Depletion of organic matter
- Poor ratooningability

b. Unscheduled rainfalls/floods/long summer/late winter

- Late planting of sugarcane
- Lodging
- Increased weeds infestation
- Increased incidence of diseases like red rot in sugarcane
- Attack of sucking pests e.g. white fly & pyrilla
- Change in sugarcane growing areas

Crop losses due to sugarcane diseases

Disease	Losses (%)	
	Cane yield	Sugar recovery
Red rot	20-83	31-75
Whip smut	9-75	3-7
Pokkah boeng	17-84	7-10
Red stripe	15	-
Rust	40-50	-
Mosaic	8- 40	1-2
Leaf spot	16	1-3
Wilting	65	3-29

Source: Disease of sugarcane and sugar beet by V.P. Agnihotri (Rev. Edi. 1990, India)

Crop losses due to sugarcane insects

Pest species	Extent of losses in terms of	
	% reduction in cane yield	% reduction in juice quality
Shoot borer	33	12 in sugar recovery
Top borer	30.0	46.6 in CCS%
Early shoot borer	31.8	20.4 in sucrose
Stem borer	56.6	39.02 in CCS%
Gurdaspur borer	15	74 in sugar and gur recovery
Pyrilla	28.1	50 in sugar recovery
Whitefly	65.3	7.7 in CCS%

Source: IPM system in Agriculture by Rajeev K. Upadhyay et. al. 1999, vol. 6, Cash crops. PP: 101-121, India

WATER SHORTAGE

- ❖ **Poor germination**
- ❖ **Inhibit seedling establishment and tillering**
- ❖ **Restrict inter-nodal length and plant growth**
- ❖ **Decrease fertilizer use efficiency (FUE)**
- ❖ **Low cane yield per unit area**

HIGH COST OF CANE & SUGAR PRODUCTION

Impacts:

- ❖ Poor export of sugar
- ❖ Poor economic return to growers & millers

Due to:

- ❖ Low sugarcane & sugar production per unit area
- ❖ High cost of inputs and machinery
- ❖ High charges of harvesting and transportation
- ❖ Staling losses
- ❖ Cane procurement and marketing issues
- ❖ Lack of sugarcane bio-refinery

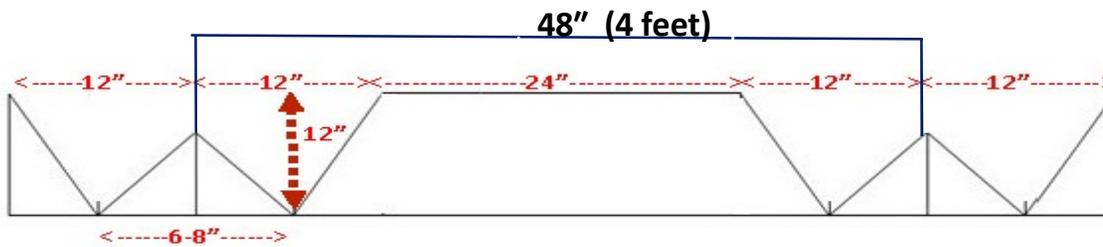
Cont..... HIGH COST OF CANE & SUGAR PRODUCTION

- ❖ Weight based cane procurement system lead to cultivation of non-varieties, lack of cultivation approved varieties as per Int. norms (30:40:30), low sugar recovery, late commencement of sugar mills and unscheduled harvesting & supply to sugar mills
- ❖ Marketing issues result in fluctuation in area, production and cane & sugar yield and late sowing of wheat crop

PRODUCTION TECHNOLOGY OF SUGARCANE

- 1. 4-Foot Apart Dual Row Trench Planting System**
- 2. Integrated weed management**
- 3. Irrigation management**
- 4. Mechanization**
- 5. Earthing-up**
- 6. Ratoon Management & Inter-cropping**
- 7. Integrated insect pest & disease management plan**
- 8. Inter-cropping in sugarcane**
- 9. Fertilizer applications in sugarcane**

4-Footer Apart Dual Row Trench Planting System



Water saved = 47%
Yield increased = 22%

Integrated weed management

- Flooding of pre-emergence weedicides with 1st irrigation.
- Application of post-emergence weedicide only within the rows.
- Cultural practices in between the rows with intercultural / rotary.

Weedicides are used to control weeds within the rows, whereas in between the rows weeds are controlled by cultural practices.



SUGARCANE ROTARY

Irrigation management

- **FYM application**
- **Laser Land Levelling**
- **Deep ploughing with chisel and sub-soiler**
 - Cross chisel ploughing every year
 - Sub-soiler ploughing after 3-4 years (after plant & ratoon crop)
- **4 feet apart trench planting**
- **Early Hill up (early earthing up)**
- **Irrigation scheduling with weather forecast**
- **Integrated weed control**
 - Weedicides are used only within the rows
 - In-between the rows weeds are controlled by cultural practices (Hoeing in 'Watter & dry')
- **Earthing up**
- **Stop irrigation 1 month prior to harvesting**
- **Alternate skip/sprinkler irrigation (Aug - Feb)**
- **Inter-cropping of high value crops**



Mechanization



PESTICIDE APPLICATOR



SUGARCANE PLANTER



SUGARCANE HARVESTER



Conventional
cutter
(Short Handle)



New cutter
(Long Handle)

Earthing-up

- **With special sugarcane ridger after completion of tillering (90-100 DAS).**
- **It control lodging, late tillering & Gurdaspur borer**



SUGARCANE RIDGER



EARTHING UP

Ratoon Management

- 40-50% area under ratoon crop
- Healthy plant crop
- Weed control particularly in plant crop
- Timely harvesting of sugarcane crop



STUBBLE SHAVER

- Stubble shaving
- Trash spreading & management
- Gap filling
- 25 - 30% more fertilizer



DISC RATOONER

Intercropping

- Intercropping of high value crops like oilseeds, pulses and vegetables for efficient resource utilization
- **Oilseed: Canola**, Pulses: Mung, Mash, Lentil, Gram & **Vegetables: Onion, Garlic**

Integrated insect pest & disease management plan

- Resistant varieties
- Healthy fields
 - Cropping Pattern, Crop Rotation, & Sanitation
- Varietal distribution
 - (a) River belts (HSF 240, CPF 237, CP 77-400, SPF 213, CPF-252, CPF-253)
 - (b) Other than river belts (CPF 246, CPF 248, CPF 249, CPF 250, CPF-251)
CPF 234 (Only for Southern Punjab).
- Healthy seed nurseries
- Seed Treatment with Hot water/fungicide Seed Treatment
- Drenching of fungicides in Standing Crop by Applying 400 gm Thiophenate Methyle or Fosetyl-AL in standing crop with shallow irrigation
- Biological , Cultural and chemical control of insect pest in sugarcane



Inter-cropping in sugarcane

Mash
with
Sugarcane



Sugarbeet
with
Sugarcane



Wheat
with
Sugarcane



Mung
with
Sugarcane



Inter-cropping in sugarcane



Sugarcane + Canola



Sugarcane + Onion



Sugarcane + Carrot

FERTILIZER USE IN SUGARCANE

- Recommended dose of NPK = 168-112-112 kg/ha
(68-45-45 kg/acre)
(3 bags Urea + 2 bags DAP + 2 Bags SOP per acre)
- Zinc sulphate (33%) 6-8 kg/acre
- FYM @ 10-12 tones / acre
- Pressmud @ 8-10 tones / acre
- Green manuring of Jantar/Berseem/Guwara after 3-4 years

Cultivation of approved varieties as per recommended plan

Sr. #.	Variety	Maturity	Av. Yield (monds./acre)	Sugar Recovery (%) Nov. to March	Recommended Zone
1.	HSF 240	Medium	1000	11.7	Whole Punjab including River belt
2.	CP 77-400	Early	1000	11.9	do
3.	CPF 237	Early	1000	12.5	do
4.	SPF 213	Medium	1000	10.5	do
5.	CPF 252	Late	1300	11.7	do
6.	CPF 253	Medium	1170	12.54	do
7.	CPF 246	Medium	1050	12.15	Whole Punjab other than River belt
8.	CPF 247	Medium	1050	12.25	do
9.	CPF 248	Medium	1120	12.71	do
10.	CPF 249	Medium	1160	12.46	do
11.	CPF 250	Early	1113	12.72	do
12.	CPF 251	Early	1080	13.2	do
13.	SPF 234	Medium	1100	11.6	South Punjab (Rajanpur, Bahawalpur and RYK) other than river belt

Historical development of sugarcane in Punjab and contribution of SRI, Faisalabad

Increase in sugarcane production in Punjab from 1947-2022

Sugarcane Statistics	1947	2022
No. of sugar mills	01	45
Area under sugarcane (million ha)	0.133	0.869
Average cane yield (t ha ⁻¹)	4.79	74
Production (million tones)	3.91	64

Sugarcane varieties evolved by SRI, Faisalabad

Sr. #.	Period	No. of varieties	Name of varieties	Av. Yield (t/ha)	Increase (%)	Av. Sugar Recov.	Increase (%)
1.	1947 – 1977 (30 Years)	7	CoL-29, 54, 44, BL-4, 19, L-116 & 118	78.0	-	9.65	-
2.	1978-1999 (20 Years)	5	Triton, BF-162, CPF-43-33, CP 72-2086 & CP 77-400	86.0	10.0	11.29	17.0
3.	2000-2018 (18 Years)	12	CoJ-84, SPF-213, CPF-237, HSF-240, SPF-234, SPF-245, HSF-242, CPF-243, CPF-246, CPF-247, CPF-248 & CPF-249	100.0	16.0	11.76	4.16
4.	2019-2020	4	CPF 250, CPF 251, CPF 252 & CPF 253	116.0	16.0	12.5	6.29
5.	Promising lines	4	S2008 Aus-133, CP 00-1101, S2016 SL-284, S016 SL-306	-	-	-	-

Total varieties released = **28**

Characteristics of SRI, Faisalabad varieties

- Development of climate smart sugarcane varieties along with production technology

Variety	Characteristics
CPF 237	Salt tolerant
CPF 249	Salt tolerant
CPF 247	Water efficient, can grow on light soils & limited resources
HSF 240	Resistant to red rot disease
CP 77-400	Resistant to red rot disease
CPF 237	Resistant to red rot disease
SPF 234	Can perform better with limited resources & in dry season (only for Southern Punjab)
CPF 250	Early maturing, fast growing, water & input efficient
CPF 251	Early maturing, fast growing, drought resistant & input efficient
CPF 252	Resistant to all prevailing strains of red rot disease
CPF 253	Resistant to all prevailing strains of red rot disease

- Studies on sugarcane mechanization to overcome labour shortage, resource efficient and decrease cost of production
- Zoning of cane growing areas of the Punjab in 5 zones on the basis of varying soil type, climatic condition and other abiotic & biotic stresses to develop site specific varieties and production technology
- Provision of healthy and approved sugarcane varieties seed to the millers / growers

Periodic quality analysis of sugarcane varieties (CCS %)

Sr.#.	Varieties	October	November	December	January	February	March	Average (Oct-Mar)	Average (Nov-Mar)
1.	SPF-213	9.15	10.10	10.45	10.90	11.25	11.50	10.56	10.84
2.	CP 77-400	10.35	11.40	12.25	12.91	13.15	12.75	12.14	12.49
3.	CPF-237	10.11	11.30	12.35	12.78	12.82	12.25	11.94	12.30
4.	HSF-240	8.90	10.45	11.20	12.00	12.30	12.80	11.28	11.75
5.	SPF-234	8.23	10.50	11.55	11.80	12.10	12.98	11.19	11.79
6.	CPF-246	10.12	11.45	12.60	13.20	13.35	12.15	12.15	12.55
7.	CPF-247	10.20	11.25	12.32	12.80	12.55	12.08	11.87	12.20
8.	CPF-248	9.85	11.15	12.30	12.89	13.10	13.15	12.07	12.52
9.	CPF-249	9.11	10.85	11.55	12.12	12.60	12.85	11.51	11.99
10.	CPF-250	10.25	11.55	12.65	13.45	13.10	12.45	12.24	12.64
11.	CPF-251	10.30	11.45	12.80	13.50	13.18	12.55	12.30	12.70
12.	CPF-252	8.50	8.95	9.55	11.45	12.30	12.85	10.49	11.02
13.	CPF-253	9.85	10.95	11.78	12.85	13.10	12.92	11.81	12.32
Average:		9.56	10.87	11.80	12.51	12.68	12.56	11.66	12.09
Av.(Early maturing)		10.3	11.5	12.5	-	-	-	-	

Future hope / promising lines

Sr. #.	Clone	Av. Yield potential (t/ha)	Avg. Sugar recovery (%)	Remarks
1.	S-2008-AUS-133	140	12.5	<ul style="list-style-type: none"> ▪ Medium maturing variety with high cane & sugar yielding potential ▪ Resistant to red rot ▪ Having good ratooning ability
2.	CP-00-1101	130	12.9	<ul style="list-style-type: none"> ▪ Early maturing variety with high cane & sugar yielding potential ▪ Resistant to red rot ▪ Resistant to lodging with excellent tillering ▪ Having very good ratooning ability
3.	S-2012 SL-284	150	12.2	<ul style="list-style-type: none"> ▪ Medium maturing variety with high cane & sugar yielding potential ▪ Resistant to red rot ▪ Resistant to lodging ▪ Having very good ratooning ability
4.	S-2012 SL-306	150	12.4	<ul style="list-style-type: none"> ▪ Medium maturing variety with high cane & sugar yielding potential ▪ Resistant to red rot ▪ Having very good ratooning ability



Thanks for
Your
Attention

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