# Government of the Punjab
# Agriculture Department

# SUGARCANE RESEARCH

# ANNUAL REPORT (2019-20)

# Sugarcane Research Institute, AARI, Faisalabad

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# INTRODUCTION

Sugarcane (*Saccharum officinarum)* is an important cash crop of the Punjab province. It belongs to the family Poaceae and native of temperate humid to tropical regions of Asia. All sugarcane species interbreed and the major commercial cultivars are complex hybrids and products like table sugar, molasses and ethanol are directly obtained from sugarcane. The bagasse that remains after sugar cane crushing is burnt to provide heat and electricity. It is also utilized as raw material for paper, chipboard, and utensils, because of its high cellulose content. The sugarcane tops serve as fodder during scarcity of fodder period. The grower's economy and viability of sugar industry is based on this crop. Sugarcane crop plays a pivotal role in our domestic economy next to cotton as a cash crop. It has 0.7% share in Gross Domestic Product (GDP) in 2018-19 In Punjab; during 2018-19, Sugarcane was planted on an area of 710 thousand hectare having production of 44.90 million tones with an average cane yield of 68.51 t/ha, showed a decrease of 17.24 % in cultivated area with decrease of 18.45% in production over the last year.

The Sugarcane Research Station was established in 1934, in Lyallpur. Later on, this section was upgraded as Sugarcane Research Institute; Faisalabad in 1978.The Research work was focused on the main objectives of the evolution of high cane and sugar yielding, disease and insect pest's resistant varieties besides, the development of improved production technology.

The Annual Research Program is prepared to develop the research strategy for the coming crop year. The Research Program includes 42 experiments on various disciplines including Sugarcane Breeding (11), Agronomy (11), Pathology (9), Entomology (6) and Technology (5) in the current research year. The Sugarcane Breeding components includes collection of fuzz and cultivars, raising of seedlings, selection of seedlings, screening and selection of clones at various selection stages and varietal adaptability under different soil and climatic conditions. The research program work also includes cane flowering at Research Sub Station, Pail & Charrapani, Murree. The Annual Program of Research Work for 2018-19 at Khanpur Station includes 08 experiments.

# OBJECTIVES

## General

- Evolution of widely adaptable varieties having desired economic characters.
- To develop package of production technology for optimum cane and sugar yield.
- To evaluate varieties for higher sugar contents.

## Specific

* To produce clones having desired parental characters and to raise seedlings for selection of elite clones.
* To evolve varieties having high yield and quality potential for different soil and climatic conditions.
* To evolve varieties resistant to insect pests, diseases, lodging, drought, frost and soil hazards.
* To determine optimum planting and harvesting schedule of varieties to obtain maximum cane and sugar yield.
* To develop package of production technology to improve cane and sugar yield from plant and ratoon crop.
* To find out most economical fertilizer doses for optimum yield.
* To develop technology to minimize sugar losses during harvesting and processing of cane.

The research work pertaining to varietal evolution program consists of various selection stages from growing of seedlings from the cane fuzz collected from different sources to the final stage of selection. The promising clones are tested in different phases of selection i.e. seedling, nursery, semi-final and final varietal trials. The promising cultivars are further tested under different agro-ecological zones of the Punjab for their adaptability.

The variety development program is based mainly on the imported germ plasm including fuzz and cultivars from Sri Lanka, Mauritius, West Indies, South Africa, canal Point (Florida) USA, Australia and local sources include the collection of open pollinated cane fuzz from Murree.

The work on wider row planting is being concluded and will be an adoptable system for cane mechanization in the province. Studies on irrigation x fertilizer interaction with cane varieties are also important feature of research plan. The work is being carried out on ratoon yield improvement besides the varietal behavior of ratooning.

In variety selection work, main emphasis is laid on disease resistance/tolerance. The studies have helped to give information on reaction of promising lines to various insects. Identified new strains of Red Rot and evaluated resistant lines/clones against the strains.

The low sugar recovery and cane yields of the province can be improved with the introduction of high quality new germ-plasm and advance production technology.

## BUDGET 2018-19

**Budget allocation under different heads.**

| Object Classification | Budget Allocation (Rs.) | Total Expenditure (Rs.) |
|---|---|---|
| A01101-Pay of officers | 2,15,93,704 | 2,16,27,242 |
| A01151-Pay of other staff | 1,55,53,551 | 1,55,02,567 |
| A01201-Regular allowance | 3,04,41,991 | 2,97,02,158 |
| A01202-Other allowance | 8,76,300 | 8,75,951 |
| A03-Operational expenses | 1,49,87,176 | 1,46,80,421 |
| **Total:** | **83,452,722** | **8,23,88,339** |

## RESEARCH AREA

| Sr. No. | Name of Institute/ Station | Total Area | Cultivated Area | Direct Area | Area under Roads & Buildings | Pattadar Area | | Encroached by other than Pattadar |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Legal | Illegal | |
| | | Acres | Acres | Acres | Acres | Acres | Acres | Acres |
| 1. | Sugarcane Research Institute, Faisalabad. | 111.7 | 97.2 | 111.7 | 14.5 | - | - | 0.57 |
| 2. | Sugarcane Research Station, Khanpur. | 46.1 | 39.1 | 46.1 | 5.50 | - | - | 1.50 |
| 3. | Sugarcane Research Station, Murree | 4.75 | 1.30 | 4.75 (Area on lease) | - | - | - | - |
| 4 | Sugarcane Research Station, Sargodha | 8.5 | 5.625 | 8.5 | 2.875 | - | - | - |
| 5 | Sugarcane Research Station, Jhumra. | 401.9 | - | 401.9 | - | Area is saline, water logged and unlevelled | | |
| | **TOTAL** | **572.95** | **143.225** | **572.95** | **22.875** | **-** | **-** | **2.07** |

## RESEARCH STAFF

1. Dr. Naeem Ahmad, Director
2. Dr. Arshad Mahmood, Sugarcane Specialist
3. Mr. Hafiz Muhammad Walayat Ali Khan, Sugarcane Virologist,
4. Mr. M. Ashfaq Nadeem, Sugarcane Agronomist
5. Dr. Muhammad Yasin, Assistant Agronomist
6. Mr. Zaheer Sikandar, Assistant Entomologist
7. Mr. Muhammad Younis, Assistant Botanist (Taxonomy)
8. Dr. Ramooza Rafique Asstt. Agri. Chemist (DGR)
9. Dr. Abdul Majeed, Asstt. Agri. Chemist
10. Dr. Hafiz Bashir Ahmad, Assistant Botanist (Genetics)
11. Dr. Muhammad Azhar Munir, Assistant Research Officer
12. Mr. M. Akhlaq Mudassir, Assistant Research Officer (Study Leave)
13. Mr. Naeem Fiaz, Assistant Research Officer (Study Leave)
14. Dr. Mahmood-ul-Hussan, Assistant Research Officer
15. Dr. Mubashra Yasin, Assistant Research Officer
16. Ms. Salma Niaz, Assistant Research Officer
17. Dr. Wardah Muzaffar, Assistant Research Officer
18. Mr. Muhammad Shahzad Afzal, Assistant Research Officer
19. Dr. Imran Rashid, Assistant Research Officer
20. Mr. Muhammad Aslam, Assistant Research Officer (Khanpur)
21. Mr. Muhammad Farooq Ahmad, Assistant Research Officer (Murree)

# ANNUAL RESEARCH REPORT FOR THE YEAR 2019-2020

## 1. SUGARCANE BREEDING

**Breeding Material**

Normally sowing is practiced in the end of March for flowering purposes. For 2019-20, a total of 175 breeding lines (from plant crop 2019 and first ratoon crop) were available for flowering studies at the start of the flowering season 2019-20. Flowering season at SBSS, Murree starts from November and continue to June or even to July as in 2019.

**Rodents/Insect Attacks at SBSS (Murree)**

**Shoot borer** attack was observed for the first time at this sub-station. A sub-plot and few lines in plant crop was attacked by this insect. The infected lines were suffered bit as late identification of casual insect. All the field was applied with granular (Virtako) for twice with irrigation.

**Termite** attacks occurred sometime, However, this year timely application of Chlorpyrifos avoided such attacks. Rodents like rats, porcupines, wild boars, monkeys and pet animals (cows, goats) attack the sugarcane crop at this sub-station. Barbed wire in check form fence the area, even then these animals get themselves enable to enter the field.

**Rats** usually attack in the month of April to June. In the year of 2018, rat attacks were significant causing some notable damage to the crop. They used to drill burrows across the severely attacked plots through their banks. So, during the field preparation, the rat burrows were kept in mind and deep hoeing was practiced. The plot banks were also dig to demolish such burrows which found deep into the ground through the banks and even in the plots themselves. It was the reason why the Aluminum tablets were not working. In 2019, the rat attacks were found only in ratooning plots but their frequency was much low as compared to the 2018.

**Porcupines** normally attack during the severe winter season. They usually got themselves inside through the fence by digging soil. Single porcupine as observed damage 3 to 5 stalks upon attack. Poisonous baits of potato and guava are normally applied to control this rodent.

**Wild boars** are another group of rodents that cause sometime severe loss to the crop. They usually walk around the fence and upon getting weak points enter the field by pushing and lifting the fence upward. This year their first attack was observed in the mid of October and so far they are causing the loss to the crop. There was a family or group comprising 7 to 8

members which were killed by placing the poisonous baits. Poultry feed prepared with Temik, Zinc Phosphide and Referee (Granular) was used to control their attacks. Another newly emerged group of rodents includes monkeys.

**Monkey** attacks to sugarcane crop were first observed at this sub-station in the January/February last year. They attacked the crop for 8 to 10 times during 7 to 8 weeks. Fire crackers were useful to avoid their attacks. However, this year monkeys turned most dangerous and significant animals causing loss to the crop. They are attacking the crop for last three months and their number has increased to 60 to 80. These pests attack the field from the East of South and sometime from the South. This region is covered with pine trees and Grand Trunk road to Murree runs on this side with a hotel point. In the morning, evening and in cloudy conditions, there is cold on this side and they used to move down towards open warms areas. They normally run away by plucking the stalk and have turned strong pests this years. Firecrackers are not working as they are now turned used to. Slingshot and Chowkidari are only measure being taken to control their attacks.

**Flowering**

Flowering started from the month of November. During this season, 6 lines of sugarcane have developed flags while only one line BJ-6431 has produced arrows (Table-1.1). Severe winter conditions might have retarded the development of differentiated inflorescence. However, at the end of February, progress of flagging was very slow but now some improvement is being seen.

**Table-1.1: Flowering data at SBSS, Murree for 2019-20.**

| Sr.# | Variety/Line | Flags | No. of Arrows | Sr.# | Variety/Line | Flags | No. of Arrows |
|---|---|---|---|---|---|---|---|
| 1 | BJ-6431 | 30 | 12 | 4 | S-95-NSG-45 | 3 | -- |
| 2 | S-05-FD-317 | 39 | -- | 5 | S-95-NSG-60 | 2 | -- |
| 3 | S-3641 | 7 | -- | 6 | S-13-M-45 | 26 | -- |
| **Total Flags** | | **107** | | **Total Arrows** | | **12** | |

In the month of July 2019, flowering season completed for 2018-19 producing 392 arrows among 30 varieties (Figure 1.2). Figure 1.1 showed the flowering of clones at this sub-station.

Figure 1.1: Flowering at SBSS, Murree.

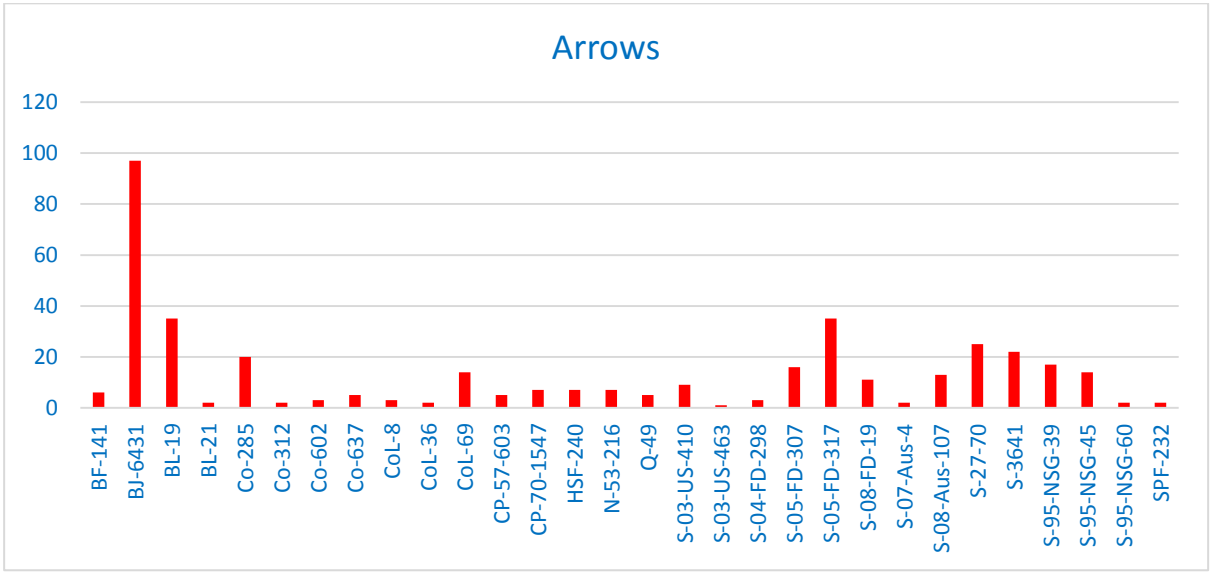



Figure 1.2: Production of arrows during the year 2018-19.

The flowering of sugarcane at SBSS, Murree during the season 2018-19 was very interesting and informative. Important growth control factor, the temperature, played its vital, distinct and prominent role in the control of flowering. Same situation is being observed during this season as much reduced temperature effected the flowering behavior of almost all the varieties/lines except BJ-6431. This lines most probably is from relative *Saccharum* spp. Its flowering behavior depicts that it is purely belong to *Saccharum sinense* or its early generation hybrid. Lower temperature retards the growth of floral primordial turning the emergence of inflorescence late. Response of varieties/lines to flower was unusual, that most of them turned late flowering. Upon categorizing the varieties/lines based on flowering behavior at the end of flowering season, out of 30 flowering clones, 25 produced late (May-June) flowering (Figure 1.3 and Table-1.2).

**Table-1.2: Flowering studies of clones at SBSS, Murree for 2018-19**

| Sr. # | Variety/Line | Behavior | Sr. # | Variety/Line | Behavior |
|---|---|---|---|---|---|
| 1 | BF-141 | Late [a] | 16 | Q-49 | Late |
| 2 | BJ-6431 | Early [b] | 17 | S-03-US-410 | Late |
| 3 | BL-19 | Intermediate [c] | 18 | S-03-US-463 | Late |
| 4 | BL-21 | Late | 19 | S-04-FD-298 | Late |
| 5 | Co-285 | Late | 20 | S-05-FD-307 | Intermediate |
| 6 | Co-312 | Late | 21 | S-05-FD-317 | Intermediate |
| 7 | Co-602 | Late | 22 | S-08-FD-19 | Late |
| 8 | Co-637 | Late | 23 | S-07-Aus-4 | Late |
| 9 | CoL-8 | Late | 24 | S-08-Aus-107 | Intermediate |
| 10 | CoL-36 | Late | 25 | S-27-70 | Late |
| 11 | CoL-69 | Late | 26 | S-3641 | Late |
| 12 | CP-57-603 | Late | 27 | S-95-NSG-39 | Late |
| 13 | CP-70-1547 | Late | 28 | S-95-NSG-45 | Late |
| 14 | HSF-240 | Late | 29 | S-95-NSG-60 | Late |
| 15 | N-53-216 | Late | 30 | SPF-232 | Late |

a: Starts flowering between November and February; b: Flower between March and April; c: flower between May and June.

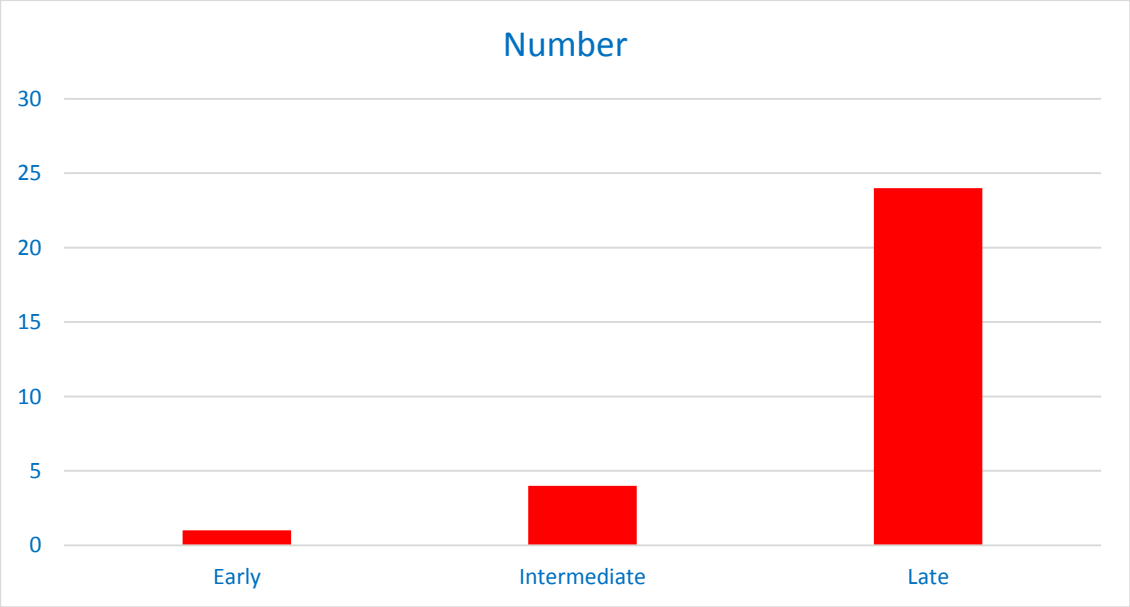



Figure 1.3: Flowering behavior of varieties during 2018-19.

### 1- Fuzz Production

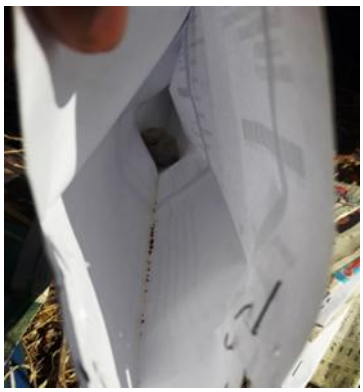
### Open Pollination

During the current season, fuzz has been harvested from a single line BJ-6431 only producing 5gram of it. During previous year, a total 955 gram of fuzz was developed from open pollinating clones.

**Hybridization**

For the current season, the crossing/hybridization was done in April-May. During previous season, twenty bi-parental crosses (Table-1.3) were carried out producing 134 gram of fuzz. In previous season, for first time pollen collection was practiced in the field and shed on female flower (Fig. 1.4). Couple of attempts were also made to collect pollen by subjecting the flower to artificial light (Fig. 1.5).

A



B

C

Figure 1.4: Different stages of pollen collection from flowers in the field. A: covering the flower with paper bag; B: Pollens collected in bag and C: pollens collected using papers bag in the field.

A B

Figure 1.5: Pollen collection under bulb. A: Arrows placed under the bulbs and covered with paper to protect the pollens from drying; and B): Pollens collected under bulb.

By using manual pollination technique, the following crosses were attempted depending upon the flowers available in the field (Table-1.3). Such crosses were attempted till first fortnight of June because the pollen shedding ability of the clones was not as good as in the month of May.

**Table-1.3: Bi-parental crosses at SBSS, Murree for 2018-19.**

| Sr # | Cross Combination | | |
|---|---|---|---|
| 1 | BL-19 | X | S-95-NSG-45 |
| 2 | BL-19 | X | S-95-NSG-39 |
| 3 | BL-19 | X | Co-285 |
| 4 | S-08-FD-19 | X | BL-19 |
| 5 | Co-285 | X | BL-19 |
| 6 | Co-637 | X | S-04-FD-298 |
| 7 | CoL-69 | X | Co-637 |
| 8 | CoL-69 | X | Co-285 |
| 9 | Co-602 | X | S-04-FD-298 |
| 10 | S-05-FD-317 | X | BL-19 |
| 11 | Co-312 | X | Co-285 |
| 12 | S-27-70 | X | Co-602 |
| 13 | Co-285 | X | CoL-69 |
| 14 | S-08-Aus-107 | X | Co-285 |
| 15 | S-95-NSG-60 | X | Co-285 |
| 16 | BL-19 | X | Co-637 |
| 17 | S-05-FD-317 | X | Col-69 |
| 18 | BL-19 | X | S-27-70 |
| 19 | BL-19 | X | S-05-FD-317 |
| 20 | S-05-FD-307 | X | Co-637 |

**Raising of Seedlings**

Fuzz is normally sown in the month of June, July and August. During required season, the fuzz produced sown as mentioned. Fuzz produced in the previous season at the sub-station was also sown here. A total of 257gm of fuzz was sown producing a total of 46 seedlings among 6 varieties/lines. Though the number of seedlings finally developed was low, the germination was very encouraging among few varieties like Co-285 and Co-673 (Table-1.4).

**Table-1.4: Production of seedlings during 2019-20**

| Sr. # | Variety | Seedlings |
|---|---|---|
| 1 | S-95-NSG-60 | 20 |
| 2 | S-95-NSG-39 | 6 |
| 3 | Co-602 | 4 |
| 4 | Co-637 | 1 |
| 5 | S-27-70 | 1 |
| 6 | Co-285 | 14 |
| **Total** | | 46 |

**2- Flowering Induction Experiment**

**Objectives**

This pilot experiment is focused to induce flowering in varieties/lines shy to flower under local environmental conditions. The objective of the experiment is to induce flowering in flowering-shy clones and improve fuzz viability. By inducing flowering shy varieties, it will be possible to include in them in the breeding program in future. Based on the objectives of the experiment, it is divided into two portions:

i. Flower induction in flower shy varieties/lines
ii. Improve or increase the fuzz viability in naturally flowering varieties/lines.

**Selection of Material**

Material selected for experiment is according to each of its each portion. For each of these two portions of the experiment, 10 varieties/lines were selected (Table-1.5). A total of 18 lines are selected individually for both of these portions, two varieties (HSF-240 and S-05-FD-317) being common in both.

**Table-1.5: Varieties/lines selected for both portions of the experiment**

| Flower Induction | | | Fuzz Viability | | |
|---|---|---|---|---|---|
| **Sr. #** | **Variety/Line** | **Category** | **Sr. #** | **Variety/Line** | **Category** |
| 1 | CPF-247 | A | 1 | HSF-240 | Medium to low flowering |
| 2 | SPF-213 | A | 2 | S-05-FD-317 | |
| 3 | S-06-US-658 | A | 3 | BL-19 | |
| 4 | S-02-US-133 | A | 4 | CoL-8 | |
| 5 | CP-43-33 | B | 5 | Col-36 | |
| 6 | CP-77-400 | B | 6 | Co-285 | |
| 7 | CPF-237 | C | 7 | S-08-FD-19 | |
| 8 | HSF-240 | D | 8 | S-95-NSG-60 | |
| 9 | S-05-FD-317 | E | 9 | CP-85-1491 | |
| 10 | S-95-NSG-59 | F | 10 | S-07-Aus-4 | |

*: Based on flowering ability under local natural conditions; A: No flagging; B: Flags only (very low); C: Low flowering; D: Medium Flowering E: High flowering; F: Unknown.

These selected varieties/lines were sown on 20-02-2019 in plastic bags of size 12 x 18''. These were shifted to the iron pots (diameter: 14'' and height: 18inch; volume 45 liter) on 01-04-2019. Two pots for each variety were maintained; one for treatment and other for control. Weekly recommended dose of fertilizers as in Table-1.6 was applied. Water was applied at regular intervals.

**Table-1.6: Concentration of nutrients using Complex[a] and FFC Boron[b]**

| Nutrients | Conct. | Composition [c] |
|---|---|---|
| Nitrogen (N) | 1.42 gm | 20% |
| Potassium (K) | 1.42 gm | 14% |
| Phosphorus (P) | 0.28 gm | 8% |
| Sulphur (S) [d] | 0.54 gm | 9.7% |
| Boron (B) | 0.17 gm | 0.04% |
| Magnesium (Mg) | 16 mg | 2% |
| Manganese (Mn) | 2.08 mg | 0.26% |
| Copper (Cu) | 1.60 mg | 0.2% |
| Zinc (Zn) | 1.12 mg | 0.14% |
| Iron (Fe) | 0.16 mg | 0.02% |
| Molybdenum (Mo) | 0.05 mg | 0.006% |

a: Head Land Complex by Swat Agros; b: 3 Kg packing of Boron by FFC; c: Composition of Headland Complex; d: complimentary

This above mentioned dose as in Table-1.6 was terminated on 02-09-2019 for all pots and a new dose of fertilizers excluding Urea (Nitrogen) was initiated according to the Table-1.7. The purpose to reduce nitrogen levels prior to flowering induction either naturally or artificially was to force the plant from vegetative to reproductive phase.

**Table-1.7: Start of new dose to potted plants excluding Urea Nitrogen**

| Nutrients | New dose [a] | |
|---|---|---|
| Nitrogen (N) | 0.24 | g |
| Potassium (K) | 1.42 | g |
| Phosphorus (P) | 0.28 | g |
| Sulphur (S) [a] | 0.00 | g |
| Boron (B) | 0.17 | g |
| Magnesium (Mg) | 16 | g |
| Manganese (Mn) | 2.08 | g |
| Copper (Cu) | 1.60 | g |
| Zinc (Zn) | 1.12 | g |
| Iron (Fe) | 0.16 | g |
| Molybdenum (Mo) | 0.05 | g |

a: this dose started today. It supplies complimentary nitrogen (mixed in DAP and Complex) to the plants only. along with head

However, the dose as in Table-1.6 (including Urea) was again started on 04-11-2019 to pots for fuzz viability and in control. However, potted varieties selected for induction experiment are still receiving fertilizers as in Table-1.7 (excluding Urea Nitrogen).

**Methodology**

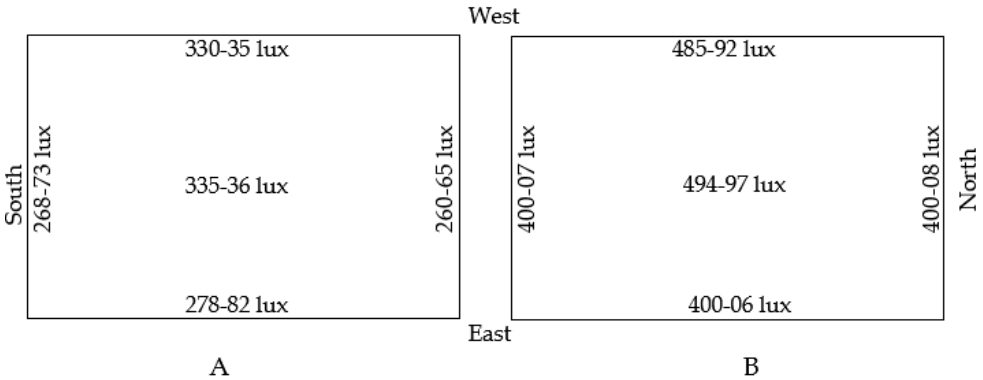
The pots to be subjected to photoperiod and temperature treatments are placed on two trollies. One trolley contains plants for induction experiments while other accommodates the fuzz viability experimental pots (Figure-1.6).

A B

Figure-1.6: Pots to be treated for photoperiod and temperature are placed on trollies. A: pots for fuzz viability experiments; B: pots for flower induction experiment.

## Provision of lights

Photoperiod is controlled before the dawn and after the dusk. The lights are turn on both before the dawn and dusk to extend the photoperiod. Additional light is provided using a combination of incandescent, compact and tube florescent lamps. Figure-1.7 reveals that the light intensity at different height in the PH.




A B

Figure-1.7: Intensity of light provided by the incandescent, compact and tube florescent installed in the PH when all light points are turned on. A: light intensity when recorded at almost 5 feet high from floor; B: intensity of light when recorded at almost 8 feet above floor.

Light data of sunlight are also recorded at dawn and dusk. In the evening the light data are recorded until the intensity of light turned zero on lux meter. Similarly, in the morning, time to appear the first lux on lux meter is taken with subsequent readings. Every time 7 to 10 or more readings are taken. The purpose to record the light data is to facilitate the future photoperiod decisions.

**Provision of temperature**

For temperature control, two temperature control units and two heater blowers are used. To maintain the air moisture, three humidifiers are used.

**Provision of Photoperiod**

At the start of the experiment the photoperiod was maintained according to the plant maturity. Three different strategies were followed for applying the photoperiod. Following three steps are taken for applying the photoperiod.

i. **Decreasing photoperiod at 90s**

According to the plant data recorded on 17-08-2019, 50% of plants both for induction and fuzz viability experiments were mature (Table-1.8). Initially a decline of 90s per day was maintained starting from 14h 23min. The natural photoperiod was rapidly reducing. So some extra time to the plants to get mature was provided by reducing the rate photoperiod.

**Table-1.8: Data of potted plants that will undergo photoperiod and temperature treatments as recorded on 17-08-2019.**

| Experiment | Sr. # | Variety / Line | Pot # | Total | P1/P2 | Healthy | Average / Weak | Injure / Damg. | Naked I. node | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| **Induction** | 1 | CPF-247 | 1.1 | 2 | 1 | 1 | - - | - - | 4 | Mature |
| | | | | | 2 | 1 | - - | - - | 5 | Mature |
| | 2 | SPF-213 | 2.1 | 2 | 1 | $1^G$ | - - | - - | 3 | Immature |
| | | | | | 2 | $1^G$ | - - | - - | 2 | Immature |
| | 3 | S-06-US-658 | 3.1 | 2 | 1 | $1^G$ | - - | - - | 4 | mature |
| | | | | | 2 | $1^G$ | - - | - - | 4 | mature |
| Mature plants [A]: **50 %** | 4 | S-02-US-133 | 4.1 | 2 | 1 | 1 | - - | - - | 2 | immature |
| | | | | | 2 | 1 | - - | - - | - - | immature |
| | 5 | CP-43-33 | 5.2 | 2 | 1 | $1^G$ | - - | - - | 4 | mature |
| | | | | | 2 | $1^G$ | - - | - - | 7 | mature |
| | 6 | CPF-237 | 7.2 | 2 | 1 | $1^G$ | - - | - - | 3 | Immature |
| | | | | | 2 | $1^G$ | - - | - - | 1 | immature |
| | 7 | HSF-240 | 8.1 | 2 | 1 | 1 | - - | - - | 2 | immature |
| | | | | | 2 | 1 | - - | - - | 2 | immature |
| | 8 | CP-77-400 | 9.1 | 2 | 1 | $1^G$ | - - | - - | 5 | mature |
| | | | | | 2 | $1^G$ | - - | - - | 3 | immature |
| | 9 | S-05-FD-317 | 17.1 | 2 | 1 | 1 | - - | - - | 5 | mature |
| | | | | | 2 | 1 | - - | - - | 6 | mature |
| | 10 | S-95-NSG-59 | 20.1 | 2 | 1 | 1 | - - | - - | 2 | immature |
| | | | | | 2 | 1 | - - | - - | 4 | Mature |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fuzz Viability | 1 | BL-19 | 6.1 | 2 | 1 | 1[G] | - - | - - | 5 | mature |
| | | | | | 2 | 1[G] | - - | - - | 6 | mature |
| | 2 | CoL-8 | 12.1 | 2 | 1 | 1 | - - | - - | - - | mature |
| | | | | | 2 | 1 | - - | - - | 1 | mature |
| | 3 | Col-36 | 13.1 | 2 | 1 | 1 | - - | - - | 4 | immature |
| | | | | | 2 | 1 | - - | - - | 3 | mature |
| Mature plants [A]: **50 %** | 4 | Co-285 | 14.1 | 2 | 1 | 1[G] | - - | - - | 4 | immature |
| | | | | | 2 | 1[G] | - - | - - | 3 | mature |
| | 5 | S-08-FD-19 | 15.1 | 2 | 1 | 1[G] | - - | - - | 1 | immature |
| | | | | | 2 | 1[G] | - - | - - | 1 | immature |
| | 6 | S-95-NSG-60 | 16.1 | 2 | 1 | 1[G] | - - | - - | 6 | immature |
| | | | | | 2 | 1[G] | - - | - - | 9 | mature |
| | 7 | S-05-FD-317 | 11.1 | 2 | 1 | 1[G] | - - | - - | 1 | mature |
| | | | | | 2 | 1 | - - | - - | 2 | immature |
| | 8 | CP-85-1491 | 18.1 | 2 | 1 | - - | 1 Ave | - - | - - | immature |
| | | | | | 2 | - - | 1 Ave | - - | 2 | mature |
| | 9 | HSF-240 | 19.1 | 2 | 1 | 1 | - - | - - | - - | immature |
| | | | | | 2 | 1 | - - | - - | - - | mature |
| | 10 | S-07-Aus-4 | 10.1 | 2 | 1 | 1 | - - | - - | 1 | mature |
| | | | | | 2 | 1 | - - | - - | 1 | immature |

A: Plant with minimum four internode is taken as mature; G: Vigorous growth, most of the plant for treatments are showing vigorous growth

On 05-09-2019, a photoperiod of 14h 3m 0s was achieved.

ii. **Decreasing photoperiod at 5m**

According the potted plant data recorded on 03-09-2019, the plants were getting mature quite rapidly and 77% got mature as in Table-1.9 given below. So a decline in photoperiod at rate of 5m per day was decided on 06-09-2019 to reach the starting photoperiod of 13h and 26min.

**Table-1.9: Data of potted plants that will undergo photoperiod and temperature treatments recorded on 03-09-2019.**

| Experiment | Sr. # | Variety / Line | Pot # | Total | P1/P2 | Healthy | Average/ Weak | Injure/ Damg | Naked I. node | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| **Induction** | 1 | CPF-247 | 1.1 | 2 | 1 | 1 | - - | - - | 5 | mature |
| | | | | | 2 | 1 | - - | - - | 7 | mature |
| | 2 | SPF-213 | 2.1 | 2 | 1 | 1[G] | - - | - - | 3 | immature |
| | | | | | 2 | 1[G] | - - | - - | 3 | immature |
| | 3 | S-06-US-658 | 3.1 | 2 | 1 | 1[G] | - - | - - | 4 | mature |
| | | | | | 2 | 1[G] | - - | - - | 5 | mature |
| Mature plants [A]: **70 %** | 4 | S-02-US-133 | 4.1 | 2 | 1 | 1 | - - | - - | 4 | mature |
| | | | | | 2 | 1 | - - | - - | 3 | immature |
| | 5 | CP-43-33 | 5.2 | 2 | 1 | 1[G] | - - | - - | 5 | mature |
| | | | | | 2 | 1[G] | - - | - - | 7 | mature |
| | 6 | CPF-237 | 7.2 | 2 | 1 | 1[G] | - - | - - | 6 | mature |
| | | | | | 2 | 1[G] | - - | - - | 8 | mature |
| | 7 | HSF-240 | 8.1 | 2 | 1 | 1 | - - | - - | 4 | mature |
| | | | | | 2 | 1 | - - | - - | 3 | immature |
| | 8 | CP-77-400 | 9.1 | 2 | 1 | 1[G] | - - | - - | 4 | mature |
| | | | | | 2 | 1[G] | - - | - - | 3 | immature |
| | 9 | S-05-FD-317 | 17.1 | 2 | 1 | 1 | - - | - - | 5 | mature |
| | | | | | 2 | 1 | - - | - - | 5 | mature |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | S-95-NSG-59 | 20.1 | 2 | 1 | 1 | - - | - - | 3 | immature |
| | | | | | 2 | 1 | - - | - - | 4 | mature |
| **Fuzz Viability** | 1 | BL-19 | 6.1 | 2 | 1 | 1[G] | - - | - - | 12 | Mature |
| | | | | | 2 | 1[G] | - - | - - | 9 | Mature |
| | 2 | CoL-8 | 12.1 | 2 | 1 | 1 | - - | - - | 4 | Mature |
| | | | | | 2 | 1 | - - | - - | 5 | mature |
| | 3 | Col-36 | 13.1 | 2 | 1 | 1 | - - | - - | 6 | mature |
| | | | | | 2 | 1 | - - | - - | 4 | mature |
| Mature plants [A]: | 4 | Co-285 | 14.1 | 2 | 1 | 1[G] | - - | - - | 9 | mature |
| | | | | | 2 | 1[G] | - - | - - | 9 | mature |
| | 5 | S-08-FD-19 | 15.1 | 2 | 1 | 1[G] | - - | - - | 4 | mature |
| | | | | | 2 | 1[G] | - - | - - | 5 | mature |
| **85 %** | 6 | S-95-NSG-60 | 16.1 | 2 | 1 | 1[G] | - - | - - | 7 | mature |
| | | | | | 2 | 1[G] | - - | - - | 9 | mature |
| | 7 | S-05-FD-317 | 11.1 | 2 | 1 | 1[G] | - - | - - | 4 | mature |
| | | | | | 2 | 1 | - - | - - | 3 | immature |
| | 8 | CP-85-1491 | 18.1 | 2 | 1 | - - | 1 Ave | - - | 4 | mature |
| | | | | | 2 | - - | 1 Ave | - - | 3 | immature |
| | 9 | HSF-240 | 19.1 | 2 | 1 | 1 | - - | - - | 5 | mature |
| | | | | | 2 | 1 | - - | - - | 6 | mature |
| | 10 | S-07-Aus-4 | 10.1 | 2 | 1 | 1 | - - | - - | 3 | immature |
| | | | | | 2 | 1 | - - | - - | 6 | mature |

A: Plant with minimum four internode is taken as mature; G: Vigorous growth, most of the plant for treatments are showing vigorous growth

It took 10 days (06 to 15-09-2019) to reach a photoperiod of 13h 26min from 14h 3min. To this point, the temperature was not of much concern.

iii. **Decreasing photoperiod at 50s**

Actual photoperiod treatment started from 16-09-2019 starting from 13h 26min. this light regime was continued until the photoperiod of 12h achieved as on 14-12-2019. Then the plants were left under natural conditions except temperature control. Photoperiod regimes practiced are summarized in Table-1.10.

**Table-1.10: Photoperiod regimes used in the photoperiod treatment for flowering induction**

| Photoperiod Regimes | Periods | | Declining Rate[a] | Photoperiod | |
|---|---|---|---|---|---|
| | Starting | Ending | | Starting | Ending |
| I | 23-08-2019 | 05-09-2019 | 90s | 14h 26 min 30s | 14h 3 min 0s |
| II | 06-09-2019 | 15-09-2019 | 5 min | 14h 3 min 0s | 13h 26 min 0s |
| III [b] | 16-09-2019 | 14-12-2019 | 50s | 13h 26 min 0s | 12h 0 min 0s |

a: Declining rate per day

Plants for fuzz viability experiment are receiving natural photoperiod. They are only being subjected to temperature control only.

The temperature mentioned in Table-1.11 above is recorded when the gate of the PH was

opened. However, in the month of November the internal temperature, when the gate of the PH is opened in the evening for light treatments, remains quite below. To cope this situation, the gate of the PH was left open to get it warm with sunlight. Later when the warmth of sunlight reduced, the gate of the PH used to be closed and all light along with BH1 or 2 turned on before closing the gate of the PH. This practice proved fruitful in increasing the internal temperature of the PH. As the optimum temperature at the time of induction is mandatory.

**Table-1.11: Internal temperature and humidity as recorded when the gate of the PH was opened in the morning**

| Period | Temperature [a] | Humidity [b] |
|---|---|---|
| 24-08 to 05-09-2019 | 26.0 | 79.5 |
| 06-09 to 15-09-2019 | 26.78 | 77.2 |
| 16-09 to 31-10-2019 | 22.5 | 89.7 |
| 01-11 to 14-12-2019 | 19 | 75 |

a: Average internal temperature ($^{o}$C) for different time periods when the gate of the PH is opened in the morning; b: Humidity (%) as recorded in the morning.

## CONCLUSION

### Induction Experiment

Various photoperiods at different declining rates have been utilized by the breeders to induce flowering. Photoperiods of 12h 50 min, 12h 45 min, 12h 35 min, 12h 30 min etc. have been taken as starting point. Similarly a declining rate of 60s, 50s, 45s, 40s and 30s have been practiced for artificial induction in sugarcane. However, it is inferred that most of the sugarcane varieties/lines flower between a photoperiod ranges of 12h 26 min to 12h 16 min ±15 minutes. In this experiment, a photoperiod of 13h 26 min was taken as starting point with declining at rate of 50s per day. It was reduced to 12h 0 min till December 14, 2019.

### Fuzz viability Experiment

Plants for fuzz experiment have received their natural photoperiod and their temperature is being controlled.

### 3. NURSERY- I

During 2018-19, 800 clones were tested in a single row non-replicated experiment having a net plot size of 4 x 1.2 m. Keeping in view the desirable characters such as growth vigor, erectness, brix %age, lodging, insect pests and diseases, these clones were compared with two standard varieties i.e. HSF-240 & CPF-249. The brix reading was recorded by hand refracto-meter. After comparing the performance of these clones with check varieties,

188 clones were selected and promoted to Nursery-II, while 612 clones were rejected due to undesirable characters. List of promoted clones is given below (Table-1.12).

**Table-1.12 LIST OF PROMOTED CLONES**

| Sr# | S2018-SLF | Parentage | Brix | Sr# | S2018-SLF | Parentage | Brix |
|---|---|---|---|---|---|---|---|
| **1** | 1 | SL 81 01 x US 165 | 16.8 | **34** | 112 | Co 775 x SL 71 30 | 18.0 |
| **2** | 5 | SL 81 01 x US 165 | 13.7 | **35** | 113 | Co 775 x SL 71 30 | 18.0 |
| **3** | 10 | SL 81 01 x US 165 | 13.7 | **36** | 128 | SLC 08 126 x Co 775 | 19.3 |
| **4** | 13 | SL 81 01 x US 165 | 16.0 | **37** | 133 | SLC 08 126 x Co 775 | 19.7 |
| **5** | 14 | SL 81 01 x US 165 | 17.0 | **38** | 134 | SLC 08 126 x Co 775 | 19.0 |
| **6** | 15 | SL 81 01 x US 165 | 18.2 | **39** | 136 | SLC 08 126 x Co 775 | 20.0 |
| **7** | 16 | SL 81 01 x US 165 | 15.0 | **40** | 138 | SLC 08 126 x Co 775 | 19.0 |
| **8** | 17 | SL 81 01 x US 165 | 19.2 | **41** | 143 | SLC 08 126 x Co 775 | 17.5 |
| **9** | 21 | SL 81 01 x US 165 | 16.3 | **42** | 144 | SLC 08 126 x Co 775 | 15.0 |
| **10** | 28 | H 76 4713 x SLT 8404 | 15.7 | **43** | 147 | SLC 08 126 x Co 775 | 15.3 |
| **11** | 50 | SL 98 2557 x PH 84 1000 | 14.3 | **44** | 162 | Q 73 x SL 96 287 | 14.3 |
| **12** | 51 | SL 98 2557 x PH 84 1000 | 14.7 | **45** | 166 | Q 73 x SL 96 287 | 15.0 |
| **13** | 54 | SL 98 2557 x PH 84 1000 | 18.3 | **46** | 188 | SLC 12 63 x US 312 | 14.7 |
| **14** | 57 | SL 98 2524 x SL 96 724 | 17.7 | **47** | 211 | SL 96 724 x Q 86 | 14.8 |
| **15** | 58 | SL 98 2524 x SL 96 724 | 15.3 | **48** | 235 | HoSG 315 x SL 82 03 | 20.3 |
| **16** | 61 | SL 98 2524 x SL 96 724 | 16.0 | **49** | 239 | HoSG 315 x SL 82 03 | 21.0 |
| **17** | 62 | SL 98 2524 x SL 96 724 | 16.0 | **50** | 249 | CSSG 676 x SL 81 01 | 18.0 |
| **18** | 63 | SL 98 2524 x SL 96 724 | 15.7 | **51** | 251 | CSSG 676 x SL 81 01 | 16.3 |
| **19** | 65 | SL 98 2524 x SL 96 724 | 17.3 | **52** | 252 | CPSH 35 3 x 95 4514 | 19.0 |
| **20** | 66 | SL 98 2524 x SL 96 724 | 17.0 | **53** | 259 | Co 775 x NS 11 | 16.5 |
| **21** | 67 | SL 98 2524 x SL 96 724 | 15.0 | **54** | 260 | Co 775 x NS 11 | 15.7 |
| **22** | 71 | SL 98 2524 x SL 96 724 | 16.5 | **55** | 266 | SL 81 09 x LF 65 3666 | 15.7 |
| **23** | 74 | SL 98 2524 x SL 96 724 | 14.8 | **56** | 268 | SL 81 09 x LF 65 3666 | 17.2 |
| **24** | 75 | SL 81 01 x PH 86 144 | 14.7 | **57** | 271 | SL 81 09 x LF 65 3666 | 15.0 |
| **25** | 88 | SL 81 01 x PH 86 144 | 20.7 | **58** | 275 | SL 95 4443 x US 54 | 15.7 |
| **26** | 90 | SL 96 061 x US 312 | 21.2 | **59** | 276 | SL 95 4443 x US 54 | 19.7 |
| **27** | 91 | SL 96 061 x US 312 | 17.5 | **60** | 279 | SL 95 4443 x US 54 | 15.3 |
| **28** | 92 | SL 96 061 x US 312 | 20.5 | **61** | 282 | SL 95 4443 x US 54 | 18.7 |
| **29** | 94 | SL 96 061 x US 312 | 20.7 | **62** | 284 | SL 95 4443 x US 54 | 16.5 |
| **30** | 100 | SL 96 061 x US 312 | 19.7 | **63** | 289 | SL 89 1673 x SLC 12 02 | 17.0 |
| **31** | 101 | SL 96 061 x US 312 | 20.7 | **64** | 301 | SL 98 2549 x BF 166 | 16.0 |
| **32** | 105 | SL 96 061 x US 312 | 19.3 | **65** | 306 | SL 98 2549 x BF 166 | 14.7 |
| **33** | 106 | SL 96 061 x US 312 | 19.3 | **66** | 307 | SL 92 4918 x LF 63 64 | 15.7 |

| Sr# | S2018-SLF | Parentage | Brix | Sr# | S2018-SLF | Parentage | Brix |
|---|---|---|---|---|---|---|---|
| **67** | 310 | US 718 x SL 98 2549 | 16.7 | **100** | 448 | CSSG 676 open poly cross | 16.2 |
| **68** | 317 | US 718 x SL 98 2549 | 19.0 | **101** | 451 | CSSG 676 open poly cross | 16.5 |
| **69** | 326 | CPSG 1663 x Open poly cross | 15.0 | **102** | 464 | CSSG 676 open poly cross | 16.3 |
| **70** | 335 | CPSG 1663 x Open poly cross | 16.5 | **103** | 466 | CSSG 676 open poly cross | 21.7 |
| **71** | 342 | CPSG 1663 x Open poly cross | 15.7 | **104** | 471 | CSSG 676 open poly cross | 20.7 |
| **72** | 347 | CPSG 1663 x Open poly cross | 17.0 | **105** | 473 | CSSG 676 open poly cross | 21.0 |
| **73** | 353 | CPSG 1663 x Open poly cross | 15.3 | **106** | 486 | CSSG 676 open poly cross | 18.2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **74** | 354 | CPSG 1663 x Open poly cross | 18.7 | **107** | 487 | SLC 08 16 open poly cross | 17.2 |
| **75** | 355 | CPSG 1663 x Open poly cross | 17.7 | **108** | 488 | SLC 08 16 open poly cross | 18.0 |
| **76** | 356 | CPSG 1663 x Open poly cross | 17.5 | **109** | 489 | SLC 08 16 open poly cross | 19.7 |
| **77** | 369 | SLC 08 17 open poly cross | 16.5 | **110** | 490 | SLC 08 16 open poly cross | 20.0 |
| **78** | 376 | SLC 08 69 open poly cross | 14.8 | **111** | 491 | SLC 08 16 open poly cross | 19.5 |
| **79** | 381 | SLC 09 02 open poly cross | 18.3 | **112** | 492 | SLC 08 16 open poly cross | 18.8 |
| **80** | 384 | HoSG 315 open poly cross | 16.0 | **113** | 493 | SLC 08 16 open poly cross | 19.7 |
| **81** | 388 | HoSG 315 open poly cross | 17.0 | **114** | 494 | SLC 08 16 open poly cross | 18.2 |
| **82** | 393 | HoSG 315 open poly cross | 17.0 | **115** | 495 | SLC 08 16 open poly cross | 19.8 |
| **83** | 397 | HoSG 315 open poly cross | 18.0 | **116** | 496 | US 694 open poly cross | 18.0 |
| **84** | 398 | HoSG 315 open poly cross | 19.0 | **117** | 506 | SL 6301 x US 165 | 16.3 |
| **85** | 399 | HoSG 315 open poly cross | 17.0 | **118** | 508 | SL 98 2792 x PH 84 167 | 19.0 |
| **86** | 406 | HoSG 315 open poly cross | 19.5 | **119** | 518 | M 438 59 x SL 98 2549 | 17.5 |
| **87** | 407 | HoSG 315 open poly cross | 17.2 | **120** | 522 | M 438 59 x SL 98 2549 | 18.5 |
| **88** | 408 | HoSG 315 open poly cross | 16.2 | **121** | 525 | M 438 59 x SL 98 2549 | 17.3 |
| **89** | 409 | HoSG 315 open poly cross | 19.2 | **122** | 529 | M 438 59 x SL 98 2549 | 17.5 |
| **90** | 418 | HoSG 315 open poly cross | 17.0 | **123** | 532 | M 438 59 x SL 98 2549 | 18.5 |
| **91** | 420 | HoSG 315 open poly cross | 15.7 | **124** | 539 | M 438 59 x SL 98 2549 | 17.3 |
| **92** | 433 | HoSG 315 open poly cross | 19.2 | **125** | 546 | Aus 01 x SL 87 33 | 18.8 |
| **93** | 434 | HoSG 315 open poly cross | 19.3 | **126** | 547 | Aus 01 x SL 87 33 | 19.0 |
| **94** | 435 | HoSG 315 open poly cross | 17.8 | **127** | 551 | Aus 01 x SL 87 33 | 20.7 |
| **95** | 436 | HoSG 315 open poly cross | 18.0 | **128** | 553 | Aus 01 x SL 87 33 | 20.7 |
| **96** | 437 | CSSG 676 open poly cross | 18.5 | **129** | 554 | Aus 01 x SL 87 33 | 19.0 |
| **97** | 438 | CSSG 676 open poly cross | 18.7 | **130** | 558 | Aus 01 x SL 87 33 | 18.3 |
| **98** | 441 | CSSG 676 open poly cross | 19.7 | **131** | 569 | Aus 01 x SL 87 33 | 21.0 |
| **99** | 446 | CSSG 676 open poly cross | 18.7 | **132** | 575 | Aus 01 x SL 87 33 | 18.2 |

| **Sr#** | **SLF 18-** | **Parentage** | **Brix** | **Sr#** | **SLF 18-** | **Parentage** | **Brix** |
|---|---|---|---|---|---|---|---|
| **133** | 577 | Aus 01 x SL 87 33 | 19.2 | **161** | 697 | SL 92 5588 x Co 622 | 17.0 |
| **134** | 581 | Aus 01 x SL 87 33 | 18.7 | **162** | 698 | Co 775 x LF 78 3255 | 17.7 |
| **135** | 582 | Aus 01 x SL 87 33 | 18.3 | **163** | 699 | Co 775 x LF 78 3255 | 19.0 |
| **136** | 595 | Aus 01 x SL 87 33 | 21.0 | **164** | 704 | CPSG 25 x open poly cross | 20.0 |
| **137** | 597 | Aus 01 x SL 87 33 | 16.3 | **165** | 705 | CPSG 25 x open poly cross | 20.2 |
| **138** | 598 | Aus 01 x SL 87 33 | 18.5 | **166** | 707 | CPSG 25 x open poly cross | 21.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **139** | 602 | Aus 01 x SL 87 33 | 20.0 | **167** | 710 | SL 96 128 x CPSG 437 | 16.7 |
| **140** | 603 | Aus 01 x SL 87 33 | 18.7 | **168** | 714 | SL 96 128 x CPSG 437 | 21.0 |
| **141** | 604 | Aus 01 x SL 87 33 | 18.7 | **169** | 715 | SL 96 128 x CPSG 437 | 16.7 |
| **142** | 605 | Aus 01 x SL 87 33 | 20.0 | **170** | 717 | SL 98 2149 x LF 76 5209 | 16.7 |
| **143** | 606 | Aus 01 x SL 87 33 | 19.5 | **171** | 721 | Q 73 x SL 96 276 | 19.8 |
| **144** | 608 | Aus 01 x SL 87 33 | 20.3 | **172** | 722 | Q 73 x SL 96 276 | 18.0 |
| **145** | 609 | Aus 01 x SL 87 33 | 19.7 | **173** | 725 | HoSG 1257 open poly cross | 20.0 |
| **146** | 610 | Aus 01 x SL 87 33 | 19.2 | **174** | 728 | HoSG 1257 open poly cross | 22.2 |
| **147** | 612 | Aus 01 x SL 87 33 | 21.0 | **175** | 739 | US 165 x SLC 70 01 | 18.0 |
| **148** | 614 | Aus 01 x SL 87 33 | 15.5 | **176** | 741 | US 133 x SLC 09 02 | 18.2 |
| **149** | 617 | SL 96 385 x HoSG 1257 | 17.7 | **177** | 742 | US 133 x SLC 09 02 | 16.3 |
| **150** | 620 | SL 96 385 x HoSG 1257 | 16.5 | **178** | 743 | US 133 x SLC 09 02 | 16.3 |
| **151** | 621 | SL 96 385 x HoSG 1257 | 16.7 | **179** | 745 | US 133 x SLC 09 02 | 20.0 |
| **152** | 624 | SL 96 385 x HoSG 1257 | 18.5 | **180** | 748 | US 133 x SLC 09 02 | 18.0 |
| **153** | 631 | SL 96 385 x HoSG 1257 | 20.3 | **181** | 753 | US 133 x SLC 09 02 | 20.5 |
| **154** | 632 | SL 96 385 x HoSG 1257 | 21.7 | **182** | 754 | US 133 x SLC 09 02 | 16.0 |
| **155** | 633 | SL 96 385 x HoSG 1257 | 19.8 | **183** | 760 | US 133 x SLC 09 02 | 20.7 |
| **156** | 657 | SL 96 385 x HoSG 1257 | 15.8 | **184** | 761 | US 133 x SLC 09 02 | 17.8 |
| **157** | 661 | SL 81 09 x LF 65 3666 | 17.8 | **185** | 769 | CPSH 35-3 x open poly cross | 18.7 |
| **158** | 667 | SL 81 09 x LF 63 73 | 15.8 | **186** | 772 | CPSH 35-3 x open poly cross | 14.3 |
| **159** | 675 | SL 81 09 x LF 63 73 | 16.3 | **187** | 784 | SL 63 01 x CPSH 353 | 16.2 |
| **160** | 690 | CSSG 676 x SL 7130 | 16.0 | **188** | 790 | SL 96 128 x NS 15 | 18.7 |

All other clones were rejected due to poor growth & recovery, disease & insect pest, lodging etc.

## 4. NURSERY-II

During 2018-19, 80 clones were tested in a double row non-replicated experiment having a net plot size of 4 x 2.4 m. Keeping in view the desirable characters, such as growth vigor, erectness, brix %age, lodging, insect pests and diseases, these clones were compared with two standard varieties i.e. HSF-240 & CPF-249 (Table-1.13). The brix reading was recorded by hand refracto-meter. After comparing the performance of these clones with check varieties, 14 clones were selected and promoted to Nursery-III, Lists of promoted and retained clones are given below.

**Table-1.13: LIST OF PROMOTEDED CLONES (NURSERY II)**

| Sr.# | S2017-SLF- | Parentage | Brix | Sr.# | S2017-SLF- | Parentage | Brix |
|---|---|---|---|---|---|---|---|
| 1 | SLF 17-11 | SLC 1249 (Offi) x SL 8101 | 17.8 | 8 | SLF 17-211 | M 442 51 x SL 8418 | 16.3 |
| 2 | SLF 17-40 | HSF 240 x Open poly cross | 14.7 | 9 | SLF 17-281 | HSF 240 x SL 88 116 | 15.3 |
| 3 | SLF 17-68 | HSF 240 x Open poly cross | 19.0 | 10 | SLF 17-284 | HSF 240 x SL 88 117 | 17.0 |
| 4 | SLF 17-97 | BL 04 x open poly cross | 15.0 | 11 | SLF 17-290 | SPF 245 x SL 95 4444 | 20.2 |
| 5 | SLF 17-113 | SPF 245 x open poly cross | 16.8 | 12 | SLF 17-292 | SPF 245 x SL 95 4444 | 16.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | SLF 17-123 | SPF 245 x open poly cross | 16.7 | 13 | SLF 17-298 | SPF 245 x SL 95 4444 | 16.8 |
| 7 | SLF 17-200 | M 442 51 x SL 8418 | 18.3 | 14 | SLF 17-310 | NSG 555 x poly cross | 17.7 |
| CPF 249 | | | 19.7 | HSF 240 | | | 19.1 |

Remaining 66 clones were rejected due to poor growth & recovery, disease & insect pest, lodging etc.

## 5. NURSERY-III

During 2018-19, 53 clones were tested at Nursery-III stage (Preliminary yield trials), comprising five (05) sets, each consisted of twelve clones and two check varieties while 5th set was consisted of five clones along with two standard varieties HSF-240 & CPF-249. Among these 53, twenty-seven (27) clones (14 from USA, 12 from Philippine and 01 from India) were from direct introduction. These clones were included in this stage after increasing their seed. 14 clones from USA and one clone from India were provided by SRDB while 12 clones of Philippine were brought by SRI itself. Trial was laid out in RCBD having three replications & net plot size of 4mx3.6m of each replication. Keeping in view the performance 19 clones were promoted to semi-final stage while remaining 34 clones were rejected on the basis of undesirable characters. The observations pertaining to germination %, no of tillers/ plant, no. of canes/ha, sugar recovery and cane yield t/ ha were recorded (Table-1.14) at per growth stages. The results are summarized as under:

**Table-1.14: Nursery-III (Preliminary yield trials)**

**SET-I**

| Sr No | Clone/Variety | Germ (%) | Tillers /plant | Cane count (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | Sugar Recovery (%) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | PSR 00-23 | 44.847 A | 0.7600 B | 78.67 EFGH | 83.33 BCDE | 8.957 E | Rejected due to Red Rot |
| 2 | PSR 98-140 | 31.820 DEF | 0.8867 B | 85.33 CDEFGH | 79.00 BCDE | 10.133 CDE | Rejected due to Smut |
| 3 | PSR 01-232 | 28.940 EF | 0.7933 B | 97.33 CDE | 69.00 DEF | 10.620 BCD | Rejected due to Red Rot |
| 4 | PSR 99-85 | 30.303 EF | 0.6533 B | 76.00 GH | 58.00 FG | 10.270 CD | Rejected due to Red Rot |
| 5 | PSR 98-38 | 39.397 ABCD | 0.7967 B | 104.33 BC | 86.67 BC | 11.223 BC | Rejected due to Smut |
| 6 | PSR 01-46 | 36.213 BCDE | 0.8867 B | 128.33 A | 89.00 B | 11.543 AB | Rejected due to (Red Rot |
| 7 | PSR 99-89 | 36.820 ABCDE | 0.5033 B | 92.67 CDEFG | 68.33 EF | 12.477 A | Rejected due to Red Rot |
| 8 | PSR 01-28 | 30.910 EF | 0.3600 B | 83.67 DEFGH | 74.67 BCDE | 9.400 DE | Rejected due to Smut |
| 9 | PSR 98-11 | 35.303 CDE | 0.8700 B | 98.33 CD | 72.33 CDEF | 9.607 DE | **Promoted** |
| 10 | PSR 98-27 | 44.393 AB | 0.6767 B | 73.00 H | 73.67 BCDEF | 6.980 F | Rejected due to Smut |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11 | PSR 99-182 | 35.457 CDE | 0.4933 B | 73.00 H | 49.67 G | 9.427 DE | Rejected due to Pith |
| 12 | PSR 00-11 | 35.907 CDE | 1.0100 B | 96.33 CDEF | 85.00 BCD | 9.810 DE | **Promoted** |
| 13 | HSF 240 | 23.637 F | 3.8500 A | 118.67 AB | 116.00 A | 11.783 AB | Standard |
| 14 | CPF 249 | 41.817 ABC | 1.0200 B | 78.00 FGH | 83.33 BCDE | 11.147 BC | Standard |
| **LSD at 0.05** | | 8.33 | 1.766 | 19.288 | 16.537 | 1.2335 | |

Twelve clones (12) of Philippine with two check varieties were sown in Set I, PSR 00-11 and PSR 98-11 were promoted to Semifinal. Other clones were rejected keeping in view Red Rot & Smut resistance, pith and lodging behavior etc.

**SET II**

| Sr. No. | Clone/Variety | Germ (%) | Tillers /plant | Cane count (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | Sugar Recovery (%) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | CP 00-1101 | 54.543 A | 1.0600 B | 67.33 GHI | 80.67 BCD | 12.853 AB | **Promoted** |
| 2 | CP 09-1952 | 49.847 A | 1.0467 B | 94.67 CDE | 74.00 BCDE | 12.840 AB | Rejected due to Red rot |
| 3 | CPCL 02-6448 | 42.123 AB | 1.1733 B | 108.67 BCD | 84.33 BCD | 13.267 A | **Promoted** |
| 4 | CP 01-1372 | 54.397 A | 1.0033 B | 93.67 DEF | 84.00 BCD | 12.367 BC | Rejected due to H. Lodg. |
| 5 | CP 03-1912 | 43.787 AB | 1.6933 AB | 30.33 J | 70.00 CDE | 11.390 DEF | Rejected due to Red rot |
| 6 | CPOCL 05-1102 | 43.483 AB | 1.0700 B | 55.67 I | 95.33 AB | 12.033 CD | **Promoted** |
| 7 | CO 05-1526 | 50.760 A | 1.1033 B | 133.33 A | 95.33 AB | 8.163 H | Rejected due to H. Lodg. |
| 8 | CPCL 05-1201 | 39.090 AB | 1.4033 B | 115.67 ABC | 66.00 DE | 11.677 CDEF | Rejected due to Red rot |
| 9 | CP 09-1822 | 39.243 AB | 1.5967 AB | 80.00 EFGH | 68.67 DE | 9.747 G | Rejected due to H. Lodg. |
| 10 | CP 09-1385 | 32.423 B | 4.2667 A | 72.33 FGHI | 80.00 BCD | 11.597 CDEF | Rejected due to Red rot |
| 11 | CP 04-1935 | 46.367 AB | 0.6767 B | 59.67 HI | 55.67 E | 8.977 G | Rejected due to H. Lodg. |
| 12 | CPCL 02-0926 | 40.153 AB | 1.1400 B | 106.33 BCD | 92.67 ABC | 11.003 F | Rejected due to H. Lodg. |
| 13 | HSF 240 | 40.303 AB | 1.6867 AB | 119.33 AB | 112.33 A | 11.783 CDE | Standard |
| 14 | CPF 249 | 41.063 AB | 1.2433 B | 84.00 EFG | 94.33 AB | 11.147 EF | Standard |
| | **LSD at 0.05** | 15.937 | 2.8322 | 21.532 | 23.539 | 0.7722 | |

Twelve clones (12) of USA (Direct Introduction) with two check varieties were sown in Set II, CP 00-1101, CPCL 02-6448 and CPOCL 05-1102 were promoted to Semifinal. Other clones were rejected keeping in view Red rot & Smut resistance, pith and lodging behavior etc.

**SET III**

| Sr. No. | Clone/Variety | Germ (%) | Tillers /plant | Cane count (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | Sugar Recovery (%) | Remarks |
|---|---|---|---|---|---|---|---|
| R1 | S2016-SL-02 | 36.517 ABC | 0.9567 A | 71.67 CDE | 60.00 D | 10.730 GH | Rejected due to Smut |
| 2 | S2016-SL-41 | 32.727 BC | 1.4133 A | 100.33 A | 103.33 A | 11.947 CD | **Promoted** |
| 3 | S2016-SL-80 | 36.513 ABC | 1.4367 A | 52.67 E | 61.00 D | 13.137 A | Rejected due to Red rot |
| 4 | S2016-SL-81 | 35.607 ABC | 1.2400 A | 78.67 BCD | 92.00 ABC | 11.940 CD | Rejected due to Red rot |
| 5 | S2016-SL-83 | 38.790 AB | 1.2833 A | 92.67 AB | 97.67 AB | 11.063 EFGH | **Promoted** |
| 6 | S2016-SL-91 | 35.910 ABC | 1.5167 A | 78.00 BCD | 78.67 BCD | 13.100 A | **Promoted** |
| 7 | S2016-SL-104 | 23.790 C | 0.6867 A | 93.33 AB | 95.67 ABC | 12.563 B | **Promoted** |
| 8 | S2016-SL-109 | 28.483 BC | 1.4767 A | 92.33 AB | 99.33 AB | 10.857 FGH | **Promoted** |
| 9 | S2016-SL-114 | 34.847 BC | 1.2167 A | 79.33 BCD | 91.00 ABC | 11.530 DE | **Promoted** |
| 10 | S2016-SL-124 | 36.363 ABC | 1.0300 A | 63.67 DE | 74.33 CD | 12.103 BC | Rejected due to Red rot |
| 11 | S2016-SL-127 | 39.093 AB | 0.9467 A | 78.00 BCD | 62.33 D | 11.233 EF | **Promoted** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | S2016-SL-128 | 48.333 A | 1.0367 A | 53.67 E | 59.33 D | 10.657 H | Rejected due to Red rot |
| 13 | HSF-240 | 30.457 BC | 1.7867 A | 91.67 ABC | 77.33 BCD | 11.783 CD | Standard |
| 14 | CPF-249 | 34.243 BC | 1.2133 A | 82.67 ABCD | 93.67 ABC | 11.147 EFG | Standard |
| | **LSD at 0.05** | 12.992 | 1.1223 | 20.654 | 22.503 | 0.4788 | |

Twelve clones (12) of SRI clones promoted from Sri-Lankan fuzz along with two check varieties were sown in Set III, seven clones i.e. S2016-SL-41, S2016-SL-83, S2016-SL-91, S2016-SL-104, S2016-SL-109, S2016-SL-114 and S2016-SL-127were promoted to Semifinal. Other clones were rejected keeping in view Red rot & Smut resistance, pith, lodging behavior etc.

**SET IV**

| Sr. No | Clone/Variety | Germ (%) | Tillers /plant | Cane count (000 $ha^{-1}$) | Cane yield (t $ha^{-1}$) | Sugar Recovery (%) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | S2016-SL-131 | 36.363 ABC | 0.5267 BC | 51.00 G | 65.33 DE | 12.973 AB | Rejected due to Red rot |
| 2 | S2016-SL-143 | 31.513 BC | 1.1000 ABC | 59.67 FG | 67.33 DE | 12.903 AB | **Promoted** |
| 3 | S2016-SL-171 | 33.180 BC | 1.2033 ABC | 60.67 FG | 67.33 DE | 12.153 CD | Rejected due to Red rot |
| 4 | S2016-SL-182 | 40.910 AB | 0.6867 BC | 81.00 CD | 91.00 BC | 12.543 BC | Rejected due to Red rot |
| 5 | S2016-SL-218 | 37.577 ABC | 1.1167 ABC | 65.00 EFG | 50.33 E | 11.680 DE | Rejected due to Red rot |
| 6 | S2016-SL-233 | 29.543 BC | 0.4000 C | 79.33 CDE | 79.67 BCD | 11.010 F | Rejected due to Red rot |
| 7 | S2016-SL-234 | 46.363 A | 1.2633 ABC | 119.67 A | 65.33 DE | 12.497 BC | Rejected due to Red rot |
| 8 | S2016-SL-240 | #N/A | 1.3733 AB | 82.67 BCD | 89.67 BC | 12.503 BC | Rejected due to Red rot |
| 9 | S2016-SL-276 | 40.607 AB | 0.9267 ABC | 67.67 DEF | 66.00 DE | 10.920 F | Rejected due to Red rot |
| 10 | S2016-SL-284 | 37.427 ABC | 0.9267 ABC | 90.33 BC | 124.33 A | 13.157 A | **Promoted** |
| 11 | S2016-SL-290 | 33.027 BC | 0.9667 ABC | 74.67 DEF | 92.67 B | 12.123 CD | Rejected due to Red rot |
| 12 | S2016-SL-296 | 38.183 ABC | 0.4267 BC | 74.00 DEF | 68.67 D | 12.850 AB | **Promoted** |
| 13 | HSF-240 | 32.273 BC | 1.8433 A | 63.00 FG | 70.33 D | 11.783 D | Standard |
| 14 | CPF-249 | 27.573 C | 1.1200 ABC | 97.00 B | 75.00 CD | 11.147 EF | Standard |
| | LSD at 0.05 | 12.674 | 0.9599 | 15.199 | 17.287 | 0.5417 | |

Twelve clones (12) of SRI clones promoted from Sri-Lankan fuzz along with two check varieties were sown in Set IV, three clones i.e. S2016-SL-143, S2016-SL-284 and S2016-SL-296 were promoted to Semifinal. Other clones were rejected keeping in view Red rot & Smut resistance, pith and lodging behavior etc.

**SET V**

| Sr No | Clone/Variety | Germ (%) | Tillers /plant | Cane count (000 $ha^{-1}$) | Cane yield (t $ha^{-1}$) | Sugar Recovery (%) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | CO 0238 | 40.357 A | 0.8867 A | 59.667 C | 89.000 A | 11.443 BC | **Promoted** |
| 2 | CP 02-2400 | 49.847 A | 1.2567 A | 75.667 AB | 90.000 A | 11.090 C | **Promoted** |
| 3 | CP 7-2137 | 37.927 A | 1.0867 A | 70.000 BC | 87.000 A | 11.533 BC | Rejected due to Red rot |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | S2016-SL-300 | 46.113 A | 0.6067 A | 67.333 BC | 62.000 B | 13.647 A | **Promoted** |
| 5 | S2016-SL-306 | 46.313 A | 1.4000 A | 86.667 A | 87.000 A | 13.867 A | **Promoted** |
| 6 | HSF-240 | 30.807 A | 0.9733 A | 39.333 D | 46.000 B | 11.783 B | Standard |
| 7 | CPF-249 | 35.200 A | 1.1067 A | 75.333 AB | 84.667 A | 11.147 BC | Standard |
| | LSD at 0.05 | 20.808 | 1.2612 | 13.456 | 18.699 | 0.6802 | |

Five clones (05) consisting of 02 clones from USA (Direct Introduction), 0ne (01) from India (Direct Introduction) and two (02) clones promoted from Sri-Lankan fuzz along with two check varieties were sown in Set V, four clones (04) i.e. CO 0238, CP 02-2400, S2016-SL-300 and S2016-SL-306 were promoted to Semifinal. Other clones were rejected keeping in view Red rot & Smut resistance, pith and lodging behavior etc.

## 6. SEMI-FINAL VARIETAL TRIAL (2019-20)

Two sets of sugarcane clones in semi-final varietal trial, each having ten (10) clones along with two (02) check varieties; HSF 240 and CPF 249, were tested at SRI, Faisalabad (Table-1.15). Experiment was laid out in RCBD on 21.02.2019 with 5 repeats (2 repeat were for qualitative analysis) having net plot size of 4x8.4m. Data regarding germination, tillering, cane count and cane yield were recorded. For quality evaluation, analysis of cane juice was also carried out a sugarcane technology laboratory from October to March on monthly basis.

In set –I, out of 10 clones, two clones PSR 07-145 and S2015-SL-89 having cane yield of 205 and 196.3 t/ha with average sugar contents (CCS%) of 11.29 and 11.12 % respectively, were selected and promoted to final varietal trial. Other eight (08) clones were rejected due to low sugar contents and susceptibility to red rot disease.

In Set-II, three (03) clones; S2015 SL-289, S2015 SL-404 and S2015 SL-444 having cane yield of 214, 174.67 and 153.33 t/ha with average sugar contents (CCS%) of 12.37, 11.37 and 11.38 respectively, were selected and promoted to final varietal trail. Whereas clone S2015 SL-416 was retained in semi-final varietal trial for further observation. Remaining six (06) clones were rejected due to low sugar contents and susceptibility to Red rot disease.

**Table-1.16: Results Of Semi-Final Varietal Trial**

**Set-I.**

| Sr. No. | Clone Name | Germination % | Tillers/ Plant | 000 canes/ha | Cane yield t/ha | Ave. CCS % (Oct-2019 to Jan-2020) | Remarks |
|---|---|---|---|---|---|---|---|
| 1. | PSR-07-145 | 61.52 A | 1.726 F | 180.33F | 205.00 A | 11.29 | **Promoted** |
| 2. | S2014-SL-1322 | 57.36 B | 1.686 G | 210.67 A | 180.40 F | 10.07 | Rejected due to low recovery |
| 3. | S2014-SL-1700 | 47.89 C | 1.780 E | 188.67 D | 187.51 D | 10.60 | Rejected due to low recovery |
| 4. | S2014-SL-2006 | 48.65 C | 1.463 J | 152.67 I | 144.43 J | 11.00 | Rejected due to Red rot disease |
| 5. | S2015-SL-10 | 40.84 F | 1.406 K | 166.67 G | 173.13 H | 10.87 | Rejected due to low recovery |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6. | S2015-SL-89 | 56.83 B | 1.510 I | 202.33 B | 196.30 C | 11.12 | **Promoted** |
| 7. | S2015-SL-101 | 47.65 C | 2.150 C | 160.67 H | 183.00 E | 09.86 | Rejected due to low recovery |
| 8. | S2015-SL-108 | 45.32 D | 1.560 H | 146.00 K | 166.00 I | 10.58 | Rejected due to low recovery |
| 9. | S2015-SL-158 | 40.24 F | 2.040 D | 160.67 H | 176.92 G | 10.75 | Rejected due to Red rot disease |
| 10. | S2015-SL-244 | 33.90 G | 2.026 D | 186.00 E | 180.44 F | 10.47 | Rejected due to low recovery |
| 11. | HSF-240 (Std.) | 42.56 E | 2.340 A | 150.33 J | 174.30 H | 11.26 | Check Variety |
| 12. | CPF-249 (Std.) | 45.04 D | 2.206 B | 193.00 C | 199.22 B | 12.50 | Check Variety |
| | LSD value | 1.40 | 0.01 | 1.07 | 1.29 | | |

**Set-II**

| Sr. No. | Clone Name | Germination % | Tillers/Plant | 000 canes/ha | Cane yield t/ha | Ave. CCS % (Oct-2019 to Jan-2020) | Remarks |
|---|---|---|---|---|---|---|---|
| 1. | S2015-SL-289 | 41.600 F | 2.040 F | 163 F | 214.00 B | 12.37 | **Promoted** |
| 2. | S2015-SL-290 | 30.607 I | 2.403 B | 170 E | 144.00 K | 10.13 | Rejected due to low recovery |
| 3. | S2015-SL-302 | 48.613 C | 2.016 G | 174 D | 181.00 E | 10.47 | Rejected due to low recovery |
| 4. | S2015-SL-404 | 64.510 A | 2.230 E | 196 B | 174.67 G | 11.37 | **Promoted** |
| 5. | S2015-SL-416 | 24.763 J | 2.010 G | 131 I | 138.67 L | 11.02 | **Retained** |
| 6. | S2015-SL-444 | 50.680 B | 1.280 J | 128 J | 153.33 H | 11.38 | **Promoted** |
| 7. | S2015-SL-540 | 40.380 G | 1.660 I | 144 H | 177.67 F | 10.42 | Rejected due to low recovery |
| 8. | S2015-SL-547 | 43.800 E | 1.816 H | 152 G | 147.33 J | 11.06 | Rejected due to Red rot disease |
| 9. | S2015-SL-574 | 46.170 D | 2.260 D | 180 C | 203.00 C | 11.04 | Rejected due to Red rot disease |
| 10. | S2015-SL-636 | 31.533 I | 2.360 C | 143 H | 186.33 D | 10.61 | Rejected due to Red rot disease |
| 11. | HSF-240 (Std.) | 25.353 J | 2.680 A | 127 J | 150.67 I | 11.88 | Check Variety |
| 12. | CPF-249 (Std.) | 34.017 H | 2.350 C | 211 A | 230.67 A | 12.20 | Check Variety |
| | | 1.03 | 0.02 | | | | |

## 7. Final Varietal Trial (2019-20)

A field varietal trial was conducted to check performance of eight (08) sugarcane clones based on biometric performance and qualitative characteristics against two check varieties CPF 249 and HSF 240 at final selection stage of varietal development program of SRI, Faisalabad (Table-1.17). The experiment was laid out in RCBD with five repeats (2 for periodic juice analysis) having a net plot size of 4 m x 8.4 m**.** Planting was done on 19 February, 2019 using standard seeding rate of 50,000 TBS $ha^{-1}$ and recommended dose of fertilizer was applied @ 168-112-112 kg NPK $ha^{-1}$. Data on germination, tillering were recorded at 50 and 90 days after planting, respectively. The cane count and cane yield were recorded at harvesting. Juice analysis was done in Sugarcane Technology Laboratory, Sugarcane Research Institute, Faisalabad at fortnightly starting from November to March.

Data were analyzed statistically using Fisher analysis of variance technique and LSD test was employed to compare treatment means at 0.05 level of probability.

Data revealed that check clone HSF 240 exhibited highest cane yield compared to other clones while lowest was recorded for S2013 M-45. Whereas, maximum sugar contents was recorded for S2014 SL-1359 as against the lowest for S2012 M-1379. Out of eight clones, five (05) were rejected due to their susceptibility to red rot disease, poor crop stand & cane yield and low sugar contents, whereas three (03) were retained for further evaluation.

**Table-1.17: Results of Final Varietal Trial**

| Clone | Germ. (%) | Tillers / plant | Millable canes (000/ha) | Cane yield (t/ ha) | Sugar contents (CCS%) Nov. to Feb. | Remarks |
|---|---|---|---|---|---|---|
| S2012 M-1379 | 49.8 ab | 2.0 a | 134 ab | 123 ab | 11.82 | rejected due low sugar contents |
| S2013 M-45 | 51.6 a | 1.89 a | 89.7 d | 101 b | 12.0 | rejected due less number of canes, cane yield & sugar contents |
| S2013 US-917 | 51.6 a | 1.41 abc | 104 bcd | 130 ab | 12.6 | retained |
| S 2014 SL-1359 | 46.4 abc | 1.73 ab | 102 cd | 123 ab | 12.79 | retained |
| S2014 SL-2200 | 38.3 d | 0.95 c | 133 ab | 125 ab | 12.64 | retained |
| S2014 SL-2290 | 49.9 ab | 1.18 bc | 125 abc | 122 ab | 12.33 | rejected due to red rot susceptibility |
| S2014 SL-2350 | 44.8 bc | 0.99 c | 121 bc | 129 ab | 11.94 | rejected due to low sugar contents |
| S2014 SL-2477 | 33.9 d | 1.20 bc | 126 abc | 108 b | 12.49 | rejected due to red rot susceptibility |
| CPF 249 | 50.2 ab | 1.19 bc | 127 abc | 130 ab | 12.77 | check |
| HSF 240 | 44.2 c | 1.83 a | 153 a | 139 a | 12.22 | check |
| **LSD at 5%** | **5.4943** | **0.5901** | **30.386** | **29.377** | **-** | |

**8- National Uniform Varietal Yield Trial (1st Year) 2018-20**

The experiment was carried out to evaluate adaptability for growth, yield and qualitative performance of fourteen (14) sugarcane clones against check varieties; CPF 246 and CPF 249 ar SRI, Faisalabad (Table-1.18). The experiment was laid out in randomized complete block design with three replications. The trial was planted at 120 cm apart trenches in plots measuring 5m x 8.4m on 25 September 2018. All recommended agronomic practices were kept uniform for all experimental units. Observations on germination, tillering, cane count, cane girth, cane length, cane tonnage and sugar contents were recorded and analyzed by using statistical software STATISTIX 8.1. Data indicates that highest cane yield was noted for S96 SP-302 as against lowest was recorded for CPSG 2415. The highest cane yield for

S96 SP-32 was mainly attributed to better performance in climatic conditions of Faisalabad that resulted in good growth and yield-contributing characteristics like cane girth, cane length and cane weight. Whereas, maximum sugar contents was noticed for S2009 SA-111 as against lowest for Lam PTJ-76/803.

**1.18- National Uniform Varietal Yield Trial (1st Year) 2018-20**

| CLONE | Germ. (%) | Tillers per plant | Cane girth (mm) | Cane length (cm) | Millable cane | TCH | Sugar contents (CCS%) | Sugar yield (CCSt/ha) |
|---|---|---|---|---|---|---|---|---|
| VMC 87-599 | 49.7 bc | 1.00 b | 225 efg | 23.6 bcd | 84.5 d | 96.7 cd | 13.1 | 13.4 cd |
| S2009 SA-111 | 52.1 abc | 1.19 ab | 234 defg | 24.2 bc | 91.8 cd | 103 cd | 13.6 | 14.9 bcd |
| S96 SP-302 | 59.9 abc | 0.98 b | 258 bcd | 28.7 a | 103 bcd | 150 a | 12.0 | 19.3 ab |
| CPSG-2415 | 69.3 a | 1.31 ab | 221 fg | 21.1 def | 103 bcd | 89.4 d | 13.2 | 12.6 d |
| CPSG-2718 | 53.8 abc | 1.06 ab | 233 defg | 25.9 ab | 55.8 bcd | 118 bcd | 13.2 | 16.5 abcd |
| SLSG-1283 | 53.9 abc | 1.23 ab | 276 ab | 19.8 ef | 98.7 bcd | 120 abcd | 13.3 | 17.1 abcd |
| CPFG-14 | 63.8 ab | 1.30 ab | 289 a | 22.6 cde | 133 a | 140 ab | 13.3 | 19.7 a |
| CPFG-15 | 50.7 bc | 1.34 ab | 268 abc | 21.5 cdef | 104 bcd | 114 bcd | 13.4 | 16.2 abcd |
| CPFG-16 | 55.3 abc | 1.20 ab | 237 defg | 21.0 def | 118 ab | 122 abc | 13.3 | 17.2 abc |
| MH 91-CP-582 | 44.3 c | 1.49 a | 218 g | 22.1 cdef | 86.9 d | 97.2 cd | 13.4 | 13.8 cd |
| Lam PTJ-76/803 | 62.7 ab | 1.36 ab | 245 cdef | 19.3 f | 116 abc | 107 cd | 11.3 | 12.8 cd |
| CPTJ-349 | 59.2 abc | 1.14 ab | 239 defg | 22.6 cde | 84.5 d | 100 cd | 13.0 | 13.8 cd |
| CPTJ-1549 | 47.8 bc | 1.27 ab | 253 bcd | 22.7 cd | 97.9 bcd | 119 abcd | 13.1 | 16.7 abcd |
| Th-1510 | 42.8 c | 1.00 b | 238 defg | 22.6 cde | 94.6 bcd | 111 bcd | 12.1 | 14.2 cd |
| CPF 246 (check) | 59.7 abc | 1.35 ab | 238 defg | 22.1 cdef | 99.8 bcd | 104 cd | 13.5 | 14.9 bcd |
| CPF 249 (check) | 52.1 abc | 1.48 a | 248 cde | 21.2 def | 101 bcd | 96.2 cd | 13.4 | 13.7 cd |
| **LSD Value** | **18.399** | **0.4353** | **25.789** | **2.8571** | **26.064** | **31.29** | **-** | **4.4857** |

**9- National Uniform Varietal Yield Trial (2nd Year) 2017-19**

The experiment was carried out to evaluate growth, yield and quality performance of eight (08) sugarcane clones against two check varieties; CPF 249 and HSF 240 at SRI, Faisalabad (Table-1.19). The trial was laid out in randomized complete block design with three replications. The crop was planted at 120 cm apart trenches in plots measuring 6m x 4.8m on 18 September 2018. All experimental units were received recommended and uniform

**Table-1.20 Data Summary of Zonal Trials(2018-2019)**

agronomic practices. Data on germination, tillering, cane count, cane girth, cane length, cane tonnage and sugar contents were recorded and analyzed by using statistical software STATISTIX 8.1. The clone 2008 AUS-133 surpassed all other clones for cane yield as against lowest was exhibited by Th-1312. Highest cane yield for S2008 AUS-133 was due to better growth, taller & thick stalks and cane weight. Whereas, maximum sugar contents was associated with S2003 US-633 as compared to all other clones and minimum was recorded for Th-1312.

**Table-1.19: National Uniform Varietal Yield Trial (2nd Year) 2017-19**

| CLONE | Germ. (%) | Tillers per plant | Cane girth (mm) | Cane length (cm) | Millable cane | TCH | Sugar contents CCS(%) | Sugar yield (CCS t/ha) |
|---|---|---|---|---|---|---|---|---|
| **S2002 US-133** | 67.1 a | 1.15 de | 261 c | 24.3 ab | 98.4 cd | 116 bc | 13.5 | 16.8 b |
| **S2003 US-127** | 53.6 ab | 1.18 cde | 299 ab | 22.3 bc | 89.2 d | 98.6 cd | 13.7 | 14.4 bc |
| **S2003 US-633** | 53.5 ab | 1.73 a | 254 cd | 20.9 c | 115 bc | 103 cd | 14.0 | 15.4 bc |
| **S2005 US-54** | 59.4 ab | 1.32 cd | 268 bc | 21.7 bc | 104 cd | 101 cd | 13.0 | 13.9 c |
| **S2008 M-42** | 52.4 abc | 1.53 abc | 225 de | 22.7 bc | 131 ab | 110 bc | 13.2 | 15.5 bc |
| **S2008 M-133** | 57.8 ab | 0.87 e | 318 a | 25.9 a | 88.7 d | 138 a | 13.5 | 19.6 a |
| **Th-1312** | 33.6 c | 1.33 bcd | 243 cde | 26.1 a | 66.3 e | 88.4 d | 11.8 | 11.1 d |
| **Th-1412** | 54.9 ab | 1.13 de | 215 e | 22.6 bc | 97.2 cd | 100 cd | 13.3 | 14.2 bc |
| **CPF 249 (check)** | 43.9 bc | 1.69 ab | 266 c | 22.7 bc | 104 cd | 97.6 cd | 13.4 | 13.9 c |
| **HSF 240 (check)** | 66.7 a | 1.34 bcd | 270 bc | 22.3 bc | 138 a | 125 ab | 12.5 | 16.6 bc |
| **LSD Value** | **18.809** | **0.3686** | **32.206** | **2.8746** | **20.417** | **20.697** | **-** | **2.7352** |

## 10. ZONAL VARIETAL TRIALS

Zonal trials were conducted at 9 locations of Punjab, 04 at Southern Punjab, 3 at Central Punjab and 2 at Northern Punjab. The performance of thirteen varieties were to be tested. The variety CPF-251 gave the best performance in Southern Punjab and gave yield of 124 t/ha with sugar recovery of 13.49% (Table-1.20). S2005-US-54 gave the maximum yield of 118 t/ha in Central Punjab. CPF-249 gave maximum yield of 119 t/ha with 12.78% sugar recovery.

| | | Southern Punjab (4-locations ) | | Central Punjab (3-locations) | | Northern Punjab (2-locations) | |
|---|---|---|---|---|---|---|---|
| **S.No** | **Name of Varieties** | **Cane Yield (t/ha)** | **Sugar Recovery %** | **Cane yield (t/ha)** | **Sugar recovery %** | **Cane Yield (t/ha)** | **Sugar recovery %** |
| 1 | S2008-AUS-133 | 96.00 | 12.99 | - | - | 101.00 | 10.94 |
| 2 | S2008-M-42 | 72.50 | 10.80 | 84.66 | 11.02 | 84.00 | 10.28 |
| 3 | S2009-SA-111 | 80.50 | 12.08 | 93.33 | 11.57 | 88.67 | 12.05 |
| 4 | **S2005-US-54** | 110.00 | 11.91 | **118.00** | 9.61 | 83.50 | 11.65 |
| 5 | VMC-87-599 | 75.50 | 10.50 | 114.33 | 10.97 | 102.83 | 12.24 |
| 6 | CPF-246 | 91.00 | 11.03 | 87.00 | 11.36 | 91.67 | 10.34 |
| 7 | CPF-247 | 98.33 | 12.30 | 96 | 12.14 | 96.50 | 12.78 |
| 8 | CPF-248 | 87.50 | 11.95 | 103.33 | 12.25 | 85.63 | 12.29 |
| 9 | **CPF-249** | 98.33 | 12.48 | 106.66 | **12.50** | **119.00** | **12.78** |
| 10 | CPF-250 | 100.50 | 11.66 | - | - | 85.00 | 12.61 |
| 11 | **CPF-251** | **124.00** | **13.49** | - | - | 103.00 | 13.08 |
| 12 | CPF-252 | 96.00 | 11.01 | - | - | - | - |
| 13 | **CPF-253** | **119.25** | **12.45** | **122.89** | **12.73** | **116.66** | **13.26** |

## 11. INTRODUCTION AND MAINTENANCE OF GENE POOL

Introduction, a breeding technique which is used to increase and to expand the already available germ-plasm. During 2018-19, 422 varieties included in the experiment were sown as fresh crop. A list of the countries from which gene pool belongs is presented in the table-1.21 given below:

**Table-1.21: List of Countries**

| Country | Nos. | Country | Nos. |
|---|---|---|---|
| Australia | 9 | Mauritius | 01 |
| Bangladesh | 3 | Mexico | 09 |
| Brazil | 13 | Pakistan | 128 |
| China | 02 | Taiwan | 02 |
| India | 11 | U.S.A. | 113 |
| Indonesia | 01 | Gen pool from | |
| West Indies (Barbados) | 23 | Murree | 107 |
| | | Total: | **422** |

## 13. TAXONOMIC CLASSIFICATION OF CANE VARIETIES/CLONES

To identify new sugarcane varieties/lines, nine (09) entries were studied taxonomically. Ten (10) matured plants were selected randomly from each variety. Number of mill able canes regarding each plot was recorded. One healthy cane from each selected plant was taken out to study other characteristics. Qualitative characters were recorded by visual observations and quantitative characters were recorded by measuring the characters; whereas brix %age was recorded by hand refrecto-meter and then average was calculated.

New sugarcane varieties / lines were studied taxonomically during 2018-19. Detailed taxonomy of the above varieties is shown in the Table-1.22.

**TABLE-1.22 TAXONOMIC CLASSIFICATION OF SUGARCANE VARIETIES**

| CHARACTER | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M-42** | **PSR-07-45** | **SL-426** | **M-45** | **M-1379** | **US-917** | **SL-1359** | **SL-2200** | **SL-2290** | **SL-2350** | **SL-2477** |
| **1. PLANT** | | | | | | | | | | | |
| Height at maturity (cm) | 460 | 443.25 | 461 | 444 | 408 | 436 | 433 | 404 | 388 | 429 | 393 |
| Growth Habit | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect |
| Tillering | 4 | 4 | 4 | 5 | 5 | 5 | 7 | 6 | 6 | 10 | 9 |
| Stooling | 4 | 4 | 4 | 5 | 5 | 5 | 7 | 6 | 6 | 10 | 9 |
| Tops | Medium | Medium | Light | Light | Medium | Medium | Medium | Light | Medium | Medium | Medium |
| Trash | Loose | Loose | Clinging | Loose | Clinging | Clinging | Loose | Loose | Loose | Loose | Loose |
| **2. LEAF** | | | | | | | | | | | |
| No. of Leaves/Plant | 25.75 | 29.00 | 26.50 | 33.25 | 32.00 | 24.25 | 29.75 | 28.25 | 23.25 | 29.00 | 30.00 |
| Length (cm) | 182.50 | 161.25 | 141.25 | 177.75 | 164.50 | 146.50 | 146.75 | 145.50 | 153.50 | 144.00 | 133.00 |
| Width (cm) | 4.77 | 4.27 | 3.45 | 4.37 | 3.52 | 4.07 | 4.15 | 3.87 | 4.57 | 4.4 | 4.5 |
| Colour | Green | Green | Green | Green | Green | Green | Green | Green | Green | Green | Green |
| Attitude | Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect | Semi Erect |
| Surface | Plain | Plain | Plain | Plain | Plain | Plain | Plain | Plain | Plain | Plain | Plain |
| Margins | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated | Serrated |
| Ligule | Deltoid | Deltoid | Crescent | Crescent | Crescent | Crescent | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid |
| Auricle | Absent | Absent | Absent | Present | Absent | Present | Absent | Absent | Present | Long Lonceabl | Long Lonceabl |
| **3. SHEATH** | | | | | | | | | | | |
| Length | 31.75 | 26.5 | 30.25 | 33.75 | 29.13 | 30 | 31 | 32 | 33 | 34.00 | 35.00 |
| Spines | Present | Absent | Absent | Absent | Absent | Absent | Absent | Present | Present | Present | Absent |
| Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping | Clasping |
| Trashing | Loose | Loose | Clinging | Loose | Loose | Clinging | Loose | Loose | Loose | Loose | Loose |
| Colour | Light Green | Green | Green | Light Green | Green | Green | Purple | Purple | Purple | Green | Green |

| Pubescence | Present | Absent | Absent | Present | Absent | Absent | Absent | Present | Present | Present | Absent |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Anthocyanin | Absent | Present | Absent | Present | Absent | Present | Present | Present | Present | Present | Absent |
| Wax | Absent | Absent | Present | Absent | Present | Absent | Absent | Present | Present | Present | Present |
| Ligule Size | Small | Large | Large | Large | Large | Small | Small | Small | Small | Small | Small |
| Auricle Size | Small | Large | Large | Long | Large | Small | | | Long | Long | Long |
| Auricle Shape | Small | Large | Large | Lanceolate | Large | Small | | | Long Lan | | |
| Dewlap Colour | Light Green | Light Green | Light Green | Light Green | Green | Green | Green | Green | Green | Light Green | Green |
| Dewlap Shape | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid | Deltoid |
| Dewlap Wax | Present | Absent | Absent | Absent | Present | Present | Absent | Absent | Absent | Present | Absent |
| **4. CANE** | | | | | | | | | | | |
| Cane | 2.40 | 2.43 | 2.92 | 2.21 | 2.25 | 2.55 | 2.32 | 2.31 | 2.02 | 2.32 | 2.38 |
| Thickness (cm) | 2.70 | 2.45 | 1.82 | 2.60 | 2.25 | 2.33 | 2.23 | 2.29 | 2.46 | 2.91 | 2.58 |
| **CHARACTER** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| | **M-42** | **PSR-07-45** | **SL-426** | **M-45** | **M-1379** | **US-917** | **SL-1359** | **SL-2200** | **SL-2290** | **SL-2350** | **SL-2477** |
| Colour (Exposed) | Greenish Yellow | Greenish Yellow | Greenish | Greenish | Greenish | Yellowish Green | Yellowish | Greenish | Greenish Yellow | Purple | Green |
| Colour (Unexposed) | Yellowish | Greenish | Yellowish | Greenish Yellow | Greenish | Greenish Yellow | Greenish Yellow | Greenish | Yellowish | Purplish Green | Greenish Yellow |
| Cane Hardness | Soft | Soft | Hard | Hard | Hard | Soft | Medium | Soft | Soft | Hard | Soft |
| Internode Length (cm) | 16.15 | 15.50 | 11.57 | 11.66 | 11.80 | | | | | 12.00 | 12.00 |
| Internode Diameter (cm) | 2.70 | 2.45 | 1.82 | 2.20 | 2.42 | | | | | 2.91 | 2.58 |
| Shape | Cylindrical | Cylindrical | Cylindrical | Bobbin | Cylindrical | Cylindrical | Bobbin | Tumescent | Bobbin | Bobbin | Cylindrical |
| Position | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag | Zigzag |
| Wax | Present | Present | Absent | Absent | Present | Present | Present | Present | Present | Present | Present |
| Splits | Present | Absent | Absent | Present | Absent | Absent | Absent | Absent | Absent | Absent | Present |
| Streaks | Absent | Absent | Absent | Present | Present | Absent | Absent | Absent | Absent | Absent | Absent |
| Pith | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| Flesh Colour | Whitish | Whitish | Whitish | Greenish | Greenish | Whitish | Greenish | Whitish | Whitish | Whitish | Whitish |

| **5. INTERNODE** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Length (cm) | 16.15 | 15.50 | 11.57 | 11.66 | 11.80 | 18.40 | 15.60 | 12.90 | 12.60 | 12.00 | 12.00 |
| Diameter (cm) | 2.70 | 2.45 | 1.82 | 2.20 | 2.42 | 2.37 | 1.91 | 2.26 | 2.26 | 2.91 | 2.58 |
| Shape | Cylindrical | Cylindrical | Cylindrical | Bobbin | Cylindrical | Cylindrical | Bobbin | Tumescent | Bobbin | Bobbin | Cylindrical |
| Splits | Present | Absent | Absent | Present | Absent | Present | Absent | Absent | Absent | Absent | Present |
| Depth of Splits | Shallow | Absent | Absent | Shallow | Absent | Absent | Absent | Absent | Absent | Absent | Shallow |
| Ivory Marking | Present | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| **6. Bud** | | | | | | | | | | | |
| Bud Grove | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| Bud Shape | Round | Round | Round | Ovate | Pointed | Round | Round | Ovate | Round | Pointed | Round |
| Position | | | | | | | | | | Above Growthring | At Scar |
| Weather Marking | Absent | Absent | Absent | Absent | Present | Absent | Absent | Absent | Absent | | |
| Groove Depth | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| Colour | Yellow | Yellow | Yellow | Yellow | Yellow | Yellow | Yellow | Yellow | Yellow | Green | Green |
| Base | At Scar | At Scar | At Scar | At Scar | At Scar | At Scar | Above Scar | Above Scar | At Scar | At Scar | At Scar |
| Growth Ring Shape | Even | Swollen | Swollen | Swollen | Swollen | Swollen | Swollen | Swollen | Swollen | Even | Swollen |
| Root Band Rows | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Root Band Width (mm) | 6.00 | 9.00 | 7.00 | 6.00 | 8.75 | 6.50 | 6.50 | 10.00 | 9.75 | 11.00 | 11.00 |
| Colour (Exposed) | Yellow | Yellow | Yellow | Greenish | Greenish | Green | Yellow | Yellow | Yellow | Purple | Green |
| Colour (Unexposed) | Yellowish Green | Yellowish Green | Yellowish | Greenish | Yellow | Yellow | Yellowish Green | Yellow | Yellow | | |
| Flowering | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent | Absent |
| Lodging | Low | Absent | Low | Absent | Absent | Present | Absent | Absent | Absent | Absent | Absent |

# 2. SUGARCANE AGRONOMY

## 1. COMPARATIVE PERFORMANCE OF PROMISING CLONES/ VARIETIES

The experiment comprising of thirteen sugarcane clones / varieties was laid out in randomized complete block design during spring, 2019 at research area of Sugarcane research institute, Faisalabad. The plot size of experiment was 4m × 8.4 m and replicated thrice. The data in Table-2.1 depicts that all clones have statistically significant affects regarding germination, tiller / plant, no of canes, cane yield, sugar yield and commercial cane sugar. Highest germination of 51.67% was obtained in S2008-AUS-133 which was closely followed by CPF-253, CPF-250 and SP-93.

Maximum number of cane 107 thousand per ha was observed in SA-111. While the lowest number of canes were found in CPF-251. As regarding cane and sugar yield, CPF-252 produced highest cane yield (102.67 t. $ha^{-1}$) and HSF-240 produced highest sugar yield (13.26 t. $ha^{-1}$) followed by CPF-252 (13.05 t.$ha^{-1}$). whereas, CPF-251 gave maximum commercial cane sugar of 14.35 % followed by CPF-250 with CCS of 13.85%.

**Table-2.1: COMPARATIVE PERFORMANCE OF PROMISING CLONES/ VARIETIES**

| S. No. | Variety | Germination % | Tiller / plant | No. of canes/ha (Thous.) | Cane yield t/ ha | Sugar yield t/ha | CCS % |
|---|---|---|---|---|---|---|---|
| V1 | S2003-US-778 | 40.67 c | 1.90 bc | 96.33 c | 86 e | 11.14 ef | 12.96 g |
| V2 | CPF-253 | 50.33 ab | 2.10 a | 65 h | 95.33 c | 11.46 d | 12.02 j |
| V3 | CPF-250 | 51 a | 1.88 bcd | 63.67 h | 90 d | 12.46 b | 13.85 b |
| V4 | CPF-251 | 49 b | 1.78 cd | 53.67 i | 73 g | 10.47 g | 14.35 a |
| V5 | CPF-252 | 49 b | 2.10 a | 85 de | 102.67 a | 13.05 a | 12.71 h |
| V6 | SA -111 | 41 d | 2.10 a | 107.33 a | 79 f | 10.89 f | 13.79 c |
| V7 | S2008 AUS-130 | 47 c | 1.88 bcd | 87 d | 86 e | 11.84 c | 13.77 c |
| V8 | S2008-AUS-133 | 51.67 a | 1.47 e | 71 g | 80.33 f | 9.38 i | 11.69 l |
| V9 | CPF-249 | 46.67 c | 1.47 e | 84.67 e | 79.67 f | 9.92 h | 12.46 i |
| V10 | SP 93 | 50.33 ab | 1.75 cd | 95.33 c | 84 e | 11.31 de | 13.46 e |
| V11 | VMC-87/599 | 45.67 c | 2.00 a | 82 f | 94.33 c | 11.08 ef | 11.74 k |
| V12 | PSR 07-45 | 45.67 c | 1.72 d | 95 c | 79.67 f | 10.42 g | 13.08 f |
| V13 | HSF-240 | 51 a | 1.83 cd | 99 b | 98 b | 13.26 a | 13.53 d |
| | **LSD 5%** | **1.966** | **0.168** | **2.23** | **2.12** | **0.277** | **0.037** |

## 2. PERFORMANCE OF PROMISING SUGARCANE VARIETIES AT DIFFERENT PLANT POPULATIONS

A research experiment comprising of three seed rates and five sugarcane clones / varieties was laid out in randomized complete block design with split plot arrangement during spring, 2019 at research area of Sugarcane Research Institute, Faisalabad to find out the best seed rate for promising sugarcane clones. The plot size of experiment was maintained as 4 m × 8.4 m and treatment were replicated thrice. The treatments included three seed rates viz. 35000, 50000, 65000 TBS per ha and five sugarcane clones viz. CPF-250, CPF-251, CPF-253, S2008-AUS-133, HSF-240. The data in Table-2.2 depicted that highest germination (54%) was found in S2008-AUS-133 at seed rate of 65000 TBS per ha followed by 53.67% in CPF-253, 51.67% in HSF-240 & S2006-AUS-133 respectively. The sugarcane clones CPF-253, when sown at 50000 TBS produced highest number of canes (107.33 thousand $ha^{-1}$). The data depicts the differential behavior of the clones with respect to total no. of millable canes at all seeding rates and lowest no. of canes were noted at 35,000 TBS $ha^{-1}$ in all clones. CPF-250, CPF-253, HSF-240 produced higher number of canes at 50,000 TBS $ha^{-1}$ than other seed rates while going toward higher seed rates (65,000 TBS $ha^{-1}$) also showed lower No. of millable cane. While S2008-AUS-133 and CPF-251 produced 95 and 88.33 thousand per ha at 65000 TBS plant populations.

Sugarcane clone CPF-253 produced highest cane and sugar yield ((105.67 t. $ha^{-1}$, 12.81 t. $ha^{-1}$) respectively at 50000 TBS $ha^{-1}$ while CPF-250 produced sugar yield of 12.09 t. $ha^{-1}$ at 50000 and 65000 TBS respectively. The sugarcane clones did not respond well at low seed rate (35000 TBS) regarding cane and sugar yield. Commercial cane sugar was statistically non-significant. However highest commercial cane sugar was found in CPF-251 with 12.73%.

**Table-2.2 PERFORMANCE OF PROMISING SUGARCANE VARIETIES AT DIFFERENT PLANT POPULATIONS**

| Variety | Seed Rate | Germination % | Tiller / plant | No. of canes/ha | Cane yield t/ ha | Sugar yield t/ha | CCS % |
|---|---|---|---|---|---|---|---|
| CPF 253 | **35000** | 38.33 ef | 1.90 bc | 70 g | 72.67 f | 9.20 fg | 12.65 |
| CPF 250 | **35000** | 38.33 ef | 1.65 fg | 65 h | 67.67 g | 8.41 g | 12.44 |
| CPF 251 | **35000** | 38 f | 1.57 gh | 63.67 h | 59 h | 7.48 h | 12.73 |
| S2008-AUS-133 | **35000** | 34.67 g | 1.40 j | 53.67 i | 57.33 h | 7.11 h | 12.40 |
| HSF-240 | **35000** | 41 e | 1.49 hij | 78.67 f | 79.67 e | 9.92 ef | 12.45 |
| CPF 253 | 50000 | 53.67 ab | 2.10 a | 107.33 a | 105.67 a | **12.81 a** | 12.13 |
| CPF 250 | 50000 | 50.33 b | 1.88 cd | 97.33 bc | 96.67 bc | **12.09 ab** | 12.52 |
| CPF 251 | 50000 | 49 bc | 1.78 de | 88.67 d | 81.33 e | 10.13cd | 12.45 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| S2008-AUS-133 | 50000 | 51.67 ab | 1.47 ij | 84.67 e | 90 d | 11.07 cd | 12.30 |
| HSF-240 | 50000 | 51.67 ab | 1.75 ef | 95.33 bc | 94 c | 10.92 cd | 11.62 |
| CPF 253 | **65000** | 45.67 d | 2.0 ab | 97.67 b | 96 bc | 11.75 bc | 12.26 |
| CPF 250 | **65000** | 46 d | 1.72 ef | 95 c | 97.67 bc | 12.09 ab | 12.39 |
| CPF 251 | **65000** | 49.67 bc | 1.60 gh | 84.33 e | 78.33 e | 9.79 fg | 12.50 |
| S2008-AUS-133 | **65000** | 54 a | 1.55 ghi | 88.33 d | 96 bc | 11.21 bc | 11.67 |
| HSF-240 | **65000** | 47 cd | 1.54 ghi | 86 de | 87 d | 10.36 de | 11.90 |
| | LSD 5% | 2.81 | 0.104 | 2.59 | 3.52 | 0.93 | N.S. |

## 3. STUDY OF BUD CHIPS PLANTING IN SUGARCANE

The experiment comprising of thirteen sugarcane clones / varieties was laid out in randomized complete block design during spring, 2019 at research area of Sugarcane research institute, Faisalabad. The plot size of experiment was 4m × 8.4 m and replicated thrice. The treatments included three seed types and four planting times. Sugarcane bud chips were made by using bud-chipper machine and sown in seedling trays on 20$^{th}$ February, 2019 and after emergence, were shifted to the field on 15$^{th}$ march, 1$^{st}$ April, 15$^{th}$ April and 1$^{st}$ May respectively. At the same time, triple and single budded setts were also sown directly in field.

The data in table-2.3 depicts that the treatment has showed significant effects on germination, tiller / plant, no of canes, cane yield, sugar yield and commercial cane sugar. Maximum germination (58%) was observed in raised bud chips seedling transplanted on 15$^{th}$ March followed by 1$^{st}$ April. Triple budded setts planted on 15$^{th}$ March and 1$^{st}$ April showed 41.5% and 26% germination. Highest tiller per plant (3.69 and 3.65) were obtained in raised bud chips seedling transplanted on 1$^{st}$ April and 15$^{th}$ March respectively, whereas lowest number of tillers per plant (1.48) was observed in Planting of bud chips in field on 1$^{st}$ May. Highest number of canes (83.75 thousand), cane yield (82 t. ha$^{-1}$) and sugar yield (9.11 t. ha$^{-1}$) was obtained in triple budded setts planted on 15$^{th}$ March. Commercial cane sugar was also found significant and maximum of 11.11% was obtained in triple budded setts planted on 15$^{th}$ March.

**Table-2.3 STUDY BUD CHIPS PLANTING IN SUGARCANE**

| Sowing time | Seed type | Germination % | Tiller / plant | No. of canes/ha (Thousand) | Cane yield t/ ha | Sugar yield t/ha | CCS % |
|---|---|---|---|---|---|---|---|
| 15-Mar | Raised bud chips seedling | 58 a | 3.65 a | 61 d | 68 bc | 7.49 b | 11.03 a |
| | Planting of bud chips in field | 35.75 de | 2.95 b | 59.5 de | 66 c | 7.31 bc | 11.08 a |
| | Triple budded Setts | 41.5 c | 1.86 e | 83.75 a | 82 a | 9.11 a | 11.11 a |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1-Apr | Raised bud chips seedling | 56.75 a | 3.69 a | 59.75 d | 65.5 cd | 7.15 c | 10.92 ab |
| | Planting of bud chips in field | 32.5 ef | 2.61 cd | 56 e | 62.25 e | 6.78 d | 10.89 abc |
| | Triple budded Setts | 26 g | 1.59 ef | 80.25 b | 80.75 a | 8.83 a | 10.92 ab |
| 15-Apr | Raised bud chips seedling | 46.5 b | 2.85 bc | 52.25 f | 55.75 fg | 5.96 e | 10.68 cd |
| | Planting of bud chips in field | 32 f | 2.51 d | 57.25 e | 58.5 f | 6.25 e | 10.67 d |
| | Triple budded Setts | 39 cd | 1.58 f | 67.5 c | 70 b | 7.49 b | 10.70 bcd |
| 1-May | Raised bud chips seedling | 36.5 de | 1.49 f | 50.5 g | 54.75 g | 5.30 f | 9.68 e |
| | Planting of bud chips in field | 31.75 f | 1.48 f | 50.25 g | 51 h | 4.95 g | 9.70 e |
| | Triple budded Setts | 32.25 ef | 1.53 f | 65.75 c | 63 de | 6.14 e | 9.74 e |
| | LSD: 0.05 | 3.44 | 0.278 | 2.08 | 2.814 | 0.303 | 0.219 |

## 4. PERFORMANCE OF SUGARCANE CLONES AT VARIOUS PLANTING TIMES

The experiment comprised of seven sugarcane planting dates viz. 15$^{th}$ August, 15$^{th}$ September, 15$^{th}$ October, 2018, 15$^{th}$ February, 15$^{th}$ March & 15$^{th}$ April during 2019, was laid out in randomized complete block design during 2018-2019 at research area of Sugarcane Research Institute, Faisalabad. The plot size of experiment was 5 m × 8.4 m and replicated thrice. Sugarcane variety HSF-240 was used as test variety. The data in table-2.4 depicted that all sowing dates have statistically significant effects on germination, tiller / plant, no of canes, cane & sugar yield and commercial cane sugar. Maximum germination (50.63%) was obtained in 15$^{th}$ September, sowing followed by 15$^{th}$ August (48.93%) and 15 October (48.52%). Lowest germination (34.07%) was found in 15$^{th}$ April sowing date. Among spring planting dates, mid-February planting gave maximum germination (48.33%) followed by mid-March (45.85%). Yield contributing factors were improved by the length of crop growth period.

The highest number of canes (88 thousand), cane yield (92.33 t. ha$^{-1}$), sugar yield (11.73 t. ha$^{-1}$) were attained in 15 September planting of sugarcane crop followed by 15$^{th}$ October. Among spring planting dates, February planted crop gave maximum number of canes (79 thousand), cane yield (77 t ha$^{-1}$), sugar yield (7.34 t. ha$^{-1}$) followed by 15$^{th}$ March. Maximum CCS (12.72%) was attained in 15$^{th}$ August planted crop followed by 15$^{th}$ September &15 October.

**Table-2.4 PERFORMANCE OF SUGARCANE CLONES AT VARIOUS PLANTING TIMES**

| Planting Time | Germination % | Tiller / plant | No. of canes/ha | Cane yield t/ ha | Sugar yield t/ha | CCS % |
|---|---|---|---|---|---|---|
| 15-Aug 2018 | 48.93 a | 2.32 a | 77.33 c | 80.33 c | 10.21 ab | 12.72 a |
| 15-Sep 2018 | 50.63 a | 2.27 ab | 88 a | 92.33 a | 11.73 a | 12.71 a |
| 15-Oct 2018 | 48.52 ab | 1.57 c | 83 b | 85 b | 10.44 ab | 12.29 a |
| **15-Jan 2019** | 38.15 c | 2.21 ab | 76.67 c | 73.33 e | 8.64 c | 11.79 a |
| 15-Feb 2019 | 48.33 ab | 2.40 a | 79 c | 77 d | 9.04 bc | 11.75 a |
| 15-Mar 2019 | 45.85 b | 2.02 b | 72.33 d | 66.67 f | 7.34 c | 11.01 a |
| 15-Apr 2019 | 34.07 d | 1.30 c | 50.67 e | 50.33 g | 5.34 d | 10.61 b |
| LSD 5% | 3.0 | 0.30 | 3.51 | 2.86 | 1.82 | 2.72 |

## 5. EFFECT OF DIFFERENT IRRIGATION REGIMES / LEVELS AND PLANTING METHODS ON YIELD AND QUALITY OF SUGARCANE.

The experiment was carried out in RCBD (split plot arrangement). The main factor was irrigation levels (main plats) while second factor was sowing methods (Sub-Plots). The net plot size was 10m X 9.6m having 3 replications. The sugarcane variety HSF-240 was used. All other agronomic practices were kept normal. It is obvious from the table-2.5 that the sugarcane (HSF-240) gave the maximum yield of 118.75 t/ha at irrigation level of 1.0 Co- efficient than irrigation level of 0.8 co efficient (113.54 t/ha). The Rumber planting (S3) gave the maximum cane yield of 124.3t/ha which was closely followed by the other sowing methods. The maximum cane yield of 128.47 t/ha was obtained with Rumber planting at irrigation level of 1.0 Coefficient than other methods of sowing.

**Table-2.5 EFFECT OF DIFFERENT IRRIGATION REGIMES / LEVELS AND PLANTING METHODS ON YIELD AND QUALITY OF SUGARCANE.**

| Treatment | Germination (%) | Tillers/ plant | Cane account (000/ha) | Cane yield (t/ha) | Sugar recovery (%) | Sugar yield (t/ha) |
|---|---|---|---|---|---|---|
| **A**-Irrigation levels | | | | | | |
| I1=1.0 CO-efficient | 48.75 | 1.33 | 131.08 | 118.75 A | 12.17 | 14.45 |
| I2=0.8 CO-efficient | 49.50 | 1.36 | 131.25 | 113.54 B | 12.40 | 14.08 |
| LSD=0.05 | NS | NS | NS | 0.3189 | NS | NS |
| B=planting methods | | | | | | |
| $S_1$ = Trench Planting | 48.50 A | 1.27 BC | 124.50 | 116.32 A | 12.60 A | 14.64 A |
| $S_2$ = Up-Hill Planting | 42.50 C | 1.10 C | 127.33 | 106.25 B | 12.03 B | 12.79 B |
| $S_3$ = Ramber Planting | 55.00 B | 1.54 A | 130.33 | 124.30 A | 11.98 B | 14.87 A |
| $S_4$ = Pit Planting | 50.50 B | 1.46 AB | 142.50 | 117.70 A | 12.53 A | 14.76 A |
| LSD= 0.05 | 2.3979 | 0.0927 | NS | 4.4639 | 0.2169 | 0.6036 |
| **A**-Irrigation levels x B=Planting methods | | | | | | |
| $I_1xS_1$ | 48 CD | 1.25 AB | 129.67 | 118.06 AB | 12.48 | 14.74 |
| $I_1xS_2$ | 43 DE | 1.00 B | 119.33 | 107.64 BC | 11.97 | 12.87 |
| $I_1xS_3$ | 54 AB | 1.58 A | 143.00 | 128.47 A | 11.67 | 15.00 |
| $I_1xS_4$ | 50 BC | 1.50 A | 132.33 | 120.83 AB | 12.57 | 15.20 |
| $I_2xS_1$ | 49 BC | 1.30 AB | 119.33 | 114.58 BC | 12.73 | 14.56 |
| $I_2xS_2$ | 42 E | 1.22 AB | 135.33 | 104.86 C | 12.10 | 12.72 |
| $I_2xS_3$ | 56 A | 1.50 A | 142.00 | 120.13 AB | 12.29 | 14.76 |
| $I_2xS_4$ | 51 ABC | 1.43 AB | 128.33 | 114.58 BC | 12.50 | 14.32 |
| LSD=0.05 | 2.3979 | 0.1311 | NS | 6.3129 | NS | NS |

## 6. PERFORMANCE OF SUGARCANE CLONES/ VARIETIES AT VARIOUS IRRIGATION LEVELS / REGIMES

The experiment was laid out in factorial RCBD (Split plot arrangement) having two factors; A- Irrigation levels of 1.0, 0.8 & 0.6 coefficient (Main plots) & B- varieties V1- CPF-253 and V2- CPF-252 (Sub plots). All other agronomic practices were kept normal. It is obvious from the Table-2.6 that Irrigation level of 1.0 coefficient / gave the maximum cane yield of 126.33 t/ha. The variety CPF-253 gave the maximum cane yield of 127.78 t/ha than other variety CPF-252 giving cane yield of 121.44 t/ha significantly. CPF-253 (VI) gave the maximum cane yield of 131.33 t/ha with I irrigation level of 1.0 coefficient. The minimum yield of 115.33 t/ha statistically was given by CPF -252 (V2) at irrigation level of 0.6 Coefficient.

**Table-2.7: Economic assessment of various canola planting techniques in sugarcane.**

**Table-2.6 PERFORMANCE OF SUGARCANE CLONES/ VARIETIES AT VARIOUS IRRIGATION LEVELS / REGIMES**

| Treatment | Germination (%) | Tillers/ plant | Cane account (000/ha) | Cane yield (t/ha) | Sugar recovery (%) | Sugar yield (t/ha) |
|---|---|---|---|---|---|---|
| **A**-Irrigation levels | | | | | | |
| $I_1$=1.0 CO-efficient | 48.17 | 1.58 | 95.33 A | 126.33 | 12.64 | 15.38 |
| $I_2$=0.8 CO-efficient | 49.50 | 1.76 | 87.50 B | 125.33 | 12.52 | 14.83 |
| $I_3$=0.6 CO-efficient | 47.00 | 1.69 | 93.33 AB | 122.17 | 12.51 | 14.12 |
| LSD=0.05 | NS | NS | 2.4133 | NS | NS | NS |
| B=varieties | | | | | | |
| $V_1$ =CPF-253 | 49.00 | 1.69 | 98.22 A | 127.78 A | 12.81 A | 16.09 A |
| $V_2$ = CPF-252 | 47.00 | 1.66 | 85.89 B | 121.44 B | 12.30 B | 13.46 B |
| LSD= 0.05 | NS | NS | 3.8522 | 2.5580 | 0.1971 | 0.4766 |
| **A**-Irrigation levels x B=Varieties | | | | | | |
| $I_1xV_1$ | 53.67 AB | 1.77 AB | 103.33 | 131.33 A | 13.29 A | 17.39 A |
| $I_1x$ $V_2$ | 43.67 C | 1.43 BC | 88.67 | 123.00 AB | 11.82 B | 14.53 BC |
| $I_2x$ $V_1$ | 49.67 B | 1.89 A | 102.67 | 129.00 A | 13.37A | 16.34 AB |
| $I_2x$ $V_2$ | 42.67 C | 1.40 BC | 87.33 | 121.33 AB | 12.03 B | 13.37 CD |
| $I_3xV_1$ | 55.33 A | 2.10 A | 86.33 | 127.67 AB | 13.23 A | 15.12 BC |
| $I_3xV_2$ | 44.33 C | 1.50 BC | 84 | 115.33 B | 11.66 B | 11.89 D |
| LSD=0.05 | 1.5153 | 0.1313 | NS | 4.4305 | 0.3415 | 0.8255 |

**7- <u>CANOLA INTER CROPING IN SUGARCANE</u>**

The Sugarcane was sown at 2.5 ft. and 4.0 ft. apart rows in in Autumn season (September). The canola was inter cropped in sugarcane as per treatment. The experiment was laid out in RCBD with 3 repeats having plot size of 10mx 8.4m. All other agronomic practices were kept normal. It is obvious from the data Table-2.7 that the sugarcane 4 ft. apart sown with 2 lines of canola on each ridge gave the maximum net income of Rs. 345210 with BCR of 1.93.

| Treatments | Sugar-cane yield (t/ha ) | Canola yield (t / ha) | Sugarc-ane Income Rs. | Canola Income Rs. | Total income Rs. | Cost of production of sugarcane Rs. | Cost of protection of canola Rs. | Total cost Rs. | Net income Rs. | BCR |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 sugarcane apart 2.5ft rows +broad cast of canola | 49.5 | 2.35 | 222750 | 131600 | 354350 | 175000 | 4000 | 179000 | 175350 | 0.98 |
| T2 sugarcane apart 2.5ft rows +1 line of canola | 60.9 | 1.36 | 274050 | 76160 | 350210 | 175000 | 4000 | 179000 | 171210 | 0.95 |
| T3 canola alone | - | 1.92 | - | 107520 | 107520 | - | 24680 | 24680 | 82840 | 3.35 |
| T4 sugarcane apart 4ft rows +broad cast of canola | 83.0 | 1.98 | 373500 | 110880 | 484380 | 175000 | 4000 | 179000 | 305380 | 1.71 |
| T5 sugarcane apart 4ft rows +1 line of canola | 79.4 | 1.06 | 357300 | 59360 | 416660 | 175000 | 4000 | 179000 | 237660 | 1.33 |
| T6 sugarcane apart 4ft rows +2 line of canola | 103.3 | 1.06 | 464850 | 59360 | 524210 | 175000 | 4000 | 179000 | 345210 | 1.93 |
| T7 sugarcane alone | 95.8 | - | 431100 | - | 431100 | 175000 | - | 175000 | 256100 | 1.46 |

Sugarcane @ Rs.180/40Kg
Canola @ Rs. 56/Kg

## 8- EFFECT OF FARM YARD MANURE ON FERTILIZER USE EFFICIENCY

A field trial was conducted to evaluate impact of farmyard manure and fertilizer on soil fertility and sugarcane yield. The experiment was laid out in RCBD with split plot arrangements. The treatments were comprised of Farm Yard Manure application (Main plot) i.e. T1= Control (No application FYM), T2= FYM applied one month prior to sowing) and T3= FYM applied at sowing and **Fertilizer doses (sub plot)** i.e. F1= 168:112:112 kg NPK (Rec), F2= 200:150:150 kg NPK and F3= 138:72:72 NPK kg/ha. The results (Table-2.8) revealed that fertilizer dose of F2= 200:150:150 gave statistically the highest **germination (58 %),** tillers per plant (2.11), cane yield (120 t/ha) and sugar recovery (13.37 %) when farmyard manure applied one month prior to sowing ($T_2$). On the other hand, the lowest cane yield (76 t/ha) was recorded in F2= 200:150:150 NPK kg/ha when farmyard manure applied at the time of sowing ($T_3$).

**Table-2.8 EFFECT OF FARM YARD MANURE ON FERTILIZER USE EFFICIENCY**

| Farm Yard Manure | Fertilizer doses kg/ha NPK | Germination (%) | Tillers/Plant | Cane Yield (t/ha) | S. Rec. (%) |
|---|---|---|---|---|---|
| Control (No application FYM) | 168-112-112 | 47 BC | 1.52 D | 100 C | 13.14 A |
| | 200:150:150 | 53 B | 1.75 BC | 88 D | 12.26 ABC |
| | 138:72:72 | 52 B | 1.90 AB | 84 D | 13.04 A |
| FYM applied one month prior to sowing) | 168-112-112 | 51 B | 1.41 D | 118 A | 13.15 A |
| | 200:150:150 | 58 A | 2.11 A | 120 A | 13.37 A |
| | 138:72:72 | 49 BC | 1.05 E | 102 BC | 11.74 BC |
| FYM applied at sowing | 168-112-112 | 45 C | 1.58 CD | 106 B | 12.46 AB |
| | 200:150:150 | 49 BC | 1.45 D | 76 E | 11.17 C |
| | 138:72:72 | 52 B | 1.73 BC | 87 D | 11.15 C |
| LSD 5% | | 5.75 | 0.26 | 5.41 | 1.2750 |

## 9- SCREENING OF DROUGHT TOLERANT SUGARCANE VARIETIES/CLONES

The current study was conducted to screen out drought tolerant varieties/clones. Eight sugarcane varieties/clones were exposed with three different drought conditions i.e. 50-60% FC (Field Capacity), 70-80% FC, 90-100% FC. The experiment was layout under CRD (Factorial). Sugarcane buds were sown in soil filled pots and drought conditions were created in pots. The results (Fig-2.1) revealed that sugarcane variety HSF-240 and CPF-248 gave the maximum plant height (cm) and dry weight (g) at 50-60% FC respectively. Whereas, the maximum plant height (cm) and dry weight (g) were recorded for variety HSF-240. Overall results showed that sugarcane variety HSF-240 might have drought tolerance character.


## 10- EFFECT OF VARIOUS SOURCES OF NPK FERTILIZERS ON SOIL FERTILITY AND SUGARCANE CROP

The current study was planned to evaluate impact of various NPK fertilizers on sugarcane yield. The experiment was laid out in RCBD under split split plot followed by three replications. The results of the experiment revealed that statistically significant differences were observed in case of various nitrogenous fertilizer application. Whereas Phosphorous and potassium sources showed non-significant difference. Urea application enhances germination percentage and cane yield (t/ha) as compared to other sources. The interaction was also found non-significant.

Table-2.9 **EFFECT OF VARIOUS SOURCES OF NPK FERTILIZERS ON SOIL FERTILITY AND SUGARCANE CROP**

| Fertilizer Sources | Germination (%) | Tillers/Plant | Cane Yield (t/ha) | CCS (%) |
|---|---|---|---|---|
| SOP | 65.38 | 2.12 | 118.12 | 12.81 |
| MOP | 65.21 | 2.13 | 117.98 | 12.80 |
| LSD 5% | NS | NS | NS | NS |
| Urea | 67.12 A | 2.14 C | 122.1 A | 12.48 |
| CAN | 65.55 B | 2.18 B | 118.2 B | 12.51 |
| AS | 65.36 B | 2.23 A | 116.4 B | 12.45 |
| LSD 5% | 1.01 | 0.02 | 3.9 | NS |
| DAP | 67.48 | 2.15 | 121.30 | 12.62 |
| SSP | 65.91 | 2.13 | 122.01 | 12.57 |
| TSP | 66.81 | 2.11 | 121.26 | 12.61 |
| NP | 66.71 | 2.13 | 120.5 | 12.49 |
| LSD 5% | NS | NS | NS | NS |
| Interaction | NS | NS | NS | NS |

## 11- EFFECT OF INCREASED AND LATE APPLICATION OF FERTILIZERS ON SUGARCANE AND SOIL PROPERTIES

The experiment was planned to assess the effects of late addition of NPK fertilizer on nutrients uptake and sugarcane yield. The experiment was laid out in RCBD under split plot arrangement. The time of application was kept in main plots and doses of fertilizer kept in sub-plots. The results (Table-2.10) of experiment revealed that there were statistically significant differences among all treatments. Late application of fertilizer doses cause reduction in germination (%), tillers/plant, cane yield (t/ha) and sugar recovery (%). The increased dose of fertilizer applied at recommended time gave maximum net return in terms of yield. Timely application of Phosphorous is better than applied in late months (October/November).

**Table-2.10 PREVIOUS YEARS RESULTS:**

**A: NITROGEN**

| Time of Application | N Rates and PK (kg/ha) | Germination (%) | Tillers/Plant | Cane Yield (t/ha) | CCS (%) |
|---|---|---|---|---|---|
| Timely Application (Recommended) | 168-112-112 | 75.88 a | 1.43 bc | 116.05 de | 11.99 c |
| | 200-112-112 | 75.13 a | 1.68 b | 137.73 b | 11.45 d |
| | 250-112-112 | 76.55 a | 2.19 a | 148.57 a | 13.82 a |
| Late August-Early September | 168-112-112 | 61.88 c | 2.10 a | 129.00 c | 12.70 b |
| | 200-112-112 | 64.78 b | 1.75 b | 120.80 d | 12.75 b |
| | 250-112-112 | 56.11 de | 1.37 d | 119.10 d | 12.72 b |
| Late October- | 168-112-112 | 51.55 f | 1.43 bc | 114.87 e | 10.86 e |

| | | | | | |
|---|---|---|---|---|---|
| Early November | 200-112-112 | 57.22 d | 1.35 de | 108.23 f | 11.48 d |
| | 250-112-112 | 54.05 e | 1.32 de | 101.77 g | 11.67 d |
| LSD 5% | | **1.952** | **0.195** | **5.750** | **0.516** |

**B: PHOSPHOROUS**

| Time of Application | N Rates and PK (kg/ha) | Germination (%) | Tillers/Plant | Cane Yield (t/ha) | S. Rec. (%) |
|---|---|---|---|---|---|
| Timely Application (Recommended) | 168-112-112 | 66.30 | 2.34 | 114.06 abc | 12.06 |
| | 168-150-112 | 61.28 | 2.23 | 111.80 a | 12.94 |
| | 168-200-112 | 62.47 | 2.11 | 101.30 bcd | 12.55 |
| Late August-Early September | 168-112-112 | 62.63 | 2.02 | 103.77 ab | 12.40 |
| | 168-150-112 | 67.74 | 2.29 | 93.89 cd | 12.14 |
| | 168-200-112 | 63.95 | 2.82 | 92.64 d | 13.27 |
| Late October-Early November | 168-112-112 | 67.65 | 2.03 | 95.74 bcd | 13.06 |
| | 168-150-112 | 60.99 | 2.55 | 80.92 e | 12.78 |
| | 168-200-112 | 63.13 | 2.67 | 79.31 e | 12.08 |
| LSD 5% | | N.S. | N.S. | 9.714 | N.S. |

# 3. SUGARCANE PATHOLOGY

In sugarcane pathological studies, screening against major diseases was done for selecting disease resistant/tolerant clones/lines. The major diseases are Red Rot (*Colletotrichum falcatum*), Whip smut (*Ustilago scitaminea*), Red stripe *(Xanthomonas rubrilineans*), Pokkah Boeng *(Fusarium moniliformae*) and Sugarcane rust (*Puccinia melanocephala*). The work done during the year is reported as under:

## 1. SCREENING OF SUGARCANE LINES AGAINST RED ROT (*Colletotrichum falcatum*) IN FRESH CROP

Fifteen promising sugarcane lines were subjected to artificial inoculations. Sugarcane lines were injected with disease inoculum using plug technique. Varietal reaction was assessed on the basis of Srinivasan and Bhats, rating scale (0-9). Among 15 lines, 06 were found resistant, 06 moderately resistants', and 03 susceptible. (Table 3.1).

## 2. SCREENING OF SUGARCANE LINES AGAINST WHIP SMUT (*Ustilago scitaminea*) IN FRESH CROP

Seed setts of 15 lines were dipped for five minutes in spore suspension of *Ustilago scitaminea* before planting. Varietal reaction was recorded on the basis of infected cane percentage. Eight (08) were found resistant, 04 moderately resistants, 01 moderately susceptible and 02 susceptible to whip smut. (Table 3.1).

## 3. SCREENING OF SUGARCANE LINES AGAINST POKKAH BOENG *(Fusarium moniliformae*).

The growing point of 15 sugarcane lines were injected with spore suspension of causal fungus *"Fusarium moniliformae*" during the month of August. Assessment of the disease was done on the basis of chlorosis of young growing tops and top rot c canes. All the lines/entries were found free from the disease. (Table 3.1).

## 4. SCREENING OF SUGARCANE LINES AGAINST RED STRIPE *(Xanthomonas rubrilineans*).

Fifteen sugarcane lines were screen against red stripe disease by injecting causal bacterium near the growing point of standing canes. Assessment of the disease was made on the basis of reddish streaks and top rotting. This year, the check line S2011 BD 1283 showed 75 % infection. But the test lines/ entries remained free from the disease under discussion. (Table 3.1).

## 5. SCREENING OF SUGARCANE LINES AGAINST RUST (*Puccinia melanocephala*).

Fifteen sugarcane lines were screen against sugarcane rust. A highly susceptible variety BF-162 was planted as spreader and check variety between the test lines. Rust intensity was recorded by counting rust pustules on the you4g leaves. All the lines were found resistant to the disease. (Table 3.1).

## 7. BEHAVIOUR OF SUGARCANE LINES AGAINST RED ROT IN NURSERY-II & NURSERY-III

NURSERY-II

In Nursery-II fifty-five lines (80) were artificially inoculated with red rot pathogen. Fifty-two (52) were resistant twelve (12) lines were found moderately resistant, six (06) moderately susceptible and ten (10) were susceptible against the disease. (Table 3.2).

NURSERY-III

Out of sixty-three (63) lines inoculated with red rot pathogen. Twenty-three (23) lines were found resistant, eleven (11) moderately resistant, four (4) were mod. susceptible and twenty-five (25) entries were susceptible to the disease. (Table 3.3).

## 8. BEHAVIOUR OF SUGARCANE LINES AGAINST RED ROT IN VARIETAL TRIALS OF SUGARCANE

### a. Semi-final varietal trials

In semi-final, twenty (20) lines were artificially inoculated and evaluated against Red Rot. Ten (10) were found resistant, four (04) were moderately resistant, three (03) mod. Susceptible and two (03) were susceptible to the disease respectively. (Table 3.4).

### b. Final varietal trials

(Early and medium late final varietal trials).

Eight (08) advanced lines were evaluated in the final varietals trials against Red Rot. Out of eight (08) lines, two (02) were found resistant, four (04) moderately resistant and two (02) moderately susceptible. (Table 3.5).

### c. Coordinated varietal trials (NUVYT):

**(i) NUVYT (2019-21) 1st year:** In this set of the trial sixteen (16) sugarcane lines were screen against Red Rot pathogen. Out of these, one (01) was found resistant, three (03) moderately resistant, one (01) moderately susceptible and eleven (11) were susceptible to the disease. (Table 3.6).

**(ii) NUVYT (2018-20) 2nd year:** In 2nd set of the trial, ten (10) sugarcane clones were subjected for screening to red rot disease. Three (03) the lines showed resistant reaction while five (05) and two (02) possessed moderate to susceptible reaction respectively (Table 3.7).

**d. Sugarcane Research Station, Khanpur;**

In preliminary, semi-final, final varietal trials and NUVYT about fifty-four clones/ promising lines of sugarcane were artificially inoculated with red rot pathogen to find out resistance to the disease under climatic condition of South Punjab. Out of fifty-four (53) advanced lines/entries. Thirty-three (32) were found resistant, nine (09) moderately resistant, five (05) moderately susceptible and seven (07) susceptible to the disease. (Table 3.9).

**e. Sugarcane Research Station Sargodha;**

Eleven (11) advanced sugarcane lines / clones were tested against red rot disease under artificial inoculation condition only two (02) were found resistant while remaining four (04) and five (05) showed moderately to susceptible reaction to red rot respectively. (Table 4.00)

**9. Evaluation of varietal resistant against diseases (Direct introduction from France) at SRI, Faisalabad.**

Eleven (11) sugarcane varieties as direct introduction from France were tested against diseases. Four varieties found resistant to red rot one (01) moderate resistant, three (03) each remained moderately susceptible to susceptible against the disease. In case of whip smut disease all the varieties were found resistant expect one. Other diseases did not appear in the field. (Table .4.1).

**Criteria for the assessment of varietal reaction against diseases in sugarcane.**

**a. (Whip Smut, Pokkah Boeng, Red Stripe and Rust)**

| Reaction to disease | | Disease infection |
|---|---|---|
| Resistant (R) | = | 0 – 5 % |
| Moderately resistant (MR) | = | 5.1 – 15 % |
| Moderately susceptible (MS) | = | 15.1 – 30 % |
| Susceptible (S) | = | above 30% |

Reference: (G.P. Rao *et al*., 1996)

**b. Red Rot**

| Reaction to disease | | Disease score |
|---|---|---|
| Resistant (R) | = | 0.00 – 2.00 |
| Moderately resistant (MR) | = | 2.1 – 4.00 |
| Moderately susceptible (MS) | = | 4.1 – 6.00 |
| Susceptible (S) | = | 6.1 – 8.00 |
| Highly susceptible (HS) | = | Above 8.00 |

Reference: (Srinivasan & Bhati 1961)

**Table 3.1** :- **SCREENING OF SUGARCANE LINES AGAINST RED ROT (*Colletotrichum falcatum*) IN FRESH CROP**

| Sr.# | Name of advanced lines | Reaction | | | | |
|---|---|---|---|---|---|---|
| | | Red rot | Whip smut | Pokha. Boeng | Red stripe | Rust |
| 1 | S2003-US-778 | S | S | R | R | R |
| 2 | S2006-US-54 | MR | R | R | R | R |
| 3 | S2003-US-633 | MR | R | R | R | R |
| 4 | S2008-AUS-133 | R | MR | R | R | R |
| 5 | CO-238 | R | R | | | |
| 6 | S96-SP-302 | R | MR | R | R | R |
| 7 | S2006-SP-93 | S | MR | R | R | R |
| 8 | S2006-US-658 | R | R | R | R | R |
| 9 | VMC-87/599 | MR | R | R | R | R |
| 10 | S2009-SA-111 | MR | MS | R | R | R |
| 11 | S2009-SA-08 | MR | R | R | R | R |
| 12 | S2012-FD-18 | R | S | R | R | R |
| 13 | S2008-M-42 | R | MR | R | R | R |
| 14 | S2002-US-133 | R | R | R | R | R |
| 15 | S2003-US-127 | MR | R | R | R | R |

**Brief summary of advance clones of sugarcane**

| Reaction to diseases | Number of Clone | | | | | |
|---|---|---|---|---|---|---|
| | Red Rot | Whip Smut | Pokkah Boeng | Red Stripe | Rust | Sugarcane mosaic |
| Resistant (R) | 6 | 08 | 15 | 15 | 15 | 15 |
| Moderately Resistant (MR) | 6 | 04 | 0 | 0 | 0 | 0 |
| Moderately Susceptible (MS) | 0 | 01 | 0 | 0 | 0 | 0 |
| Susceptible (S) | 3 | 2 | 0 | 0 | 0 | 0 |
| Total: | 15 | 15 | 15 | 15 | 15 | 0 |

Table 3.2 :- **Screening of Sugarcane Clones in Nursery-II during 2018-19**

| Sr# | Clones | Reaction (Red Rot) | Sr.#. | Clones | Reaction (Red Rot) |
|---|---|---|---|---|---|
| 1 | SLF17-91 | R | 42 | SLF17-158 | R |
| 2 | SLF17-87 | R | 43 | SLF17-161 | R |
| 3 | SLF17-80 | R | 44 | SLF17-200 | R |
| 4 | SLF17-74 | MR | 45 | SLF17-202 | R |
| 5 | SLF17-71 | R | 46 | SLF17-209 | R |
| 6 | SLF17-70 | R | 47 | SLF17-268 | R |
| 7 | SLF17-68 | R | 48 | SLF17-267 | R |
| 8 | SLF17-64 | R | 49 | SLF17-259 | R |
| 9 | SLF17-63 | MR | 50 | SLF17-254 | R |
| 10 | SLF17-61 | R | 51 | SLF17-249 | R |
| 11 | SLF17-11 | R | 52 | SLF17-248 | R |
| 12 | SLF17-34 | R | 53 | SLF17-244 | R |
| 13 | SLF17-38 | R | 54 | SLF17-232 | R |
| 14 | SLF17-39 | R | 55 | SLF17-226 | S |
| 15 | SLF17-40 | R | 56 | SLF17-221 | MS |
| 16 | SLF17-42 | R | 57 | SLF17-311 | S |
| 17 | SLF17-46 | S | 58 | SLF17-310 | MR |
| 18 | SLF17-50 | MR | 59 | SLF17-309 | S |
| 19 | SLF17-58 | R | 60 | SLF17-299 | MS |
| 20 | SLF17-59 | MR | 61 | SLF17-289 | S |
| 21 | SLF17-146 | R | 62 | SLF17-296 | MR |
| 22 | SLF17-144 | R | 63 | SLF17-295 | MS |
| 23 | SLF17-141 | MS | 64 | SLF17-294 | MR |
| 24 | SLF17-139 | R | 55 | SLF17-293 | R |
| 25 | SLF17-138 | R | 66 | SLF17-292 | R |
| 26 | SLF17-137 | R | 67 | SLF17-275 | MR |
| 27 | SLF17-133 | S | 68 | SLF17-280 | R |
| 28 | SLF17-132 | R | 69 | SLF17-281 | MR |
| 29 | SLF17-95 | S | 70 | SLF17-283 | R |

| | | | | | |
|---|---|---|---|---|---|
| 30 | SLF17-97 | R | 71 | SLF17-284 | R |
| 31 | SLF17-113 | R | 72 | SLF17-286 | R |
| 32 | SLF17-121 | S | 73 | SLF17-287 | S |
| 33 | SLF17-123 | R | 74 | SLF17-289 | MR |
| 34 | SLF17-126 | R | 77 | SLF17-290 | MR |
| 35 | SLF17-127 | R | 78 | SLF17-291 | S |
| 36 | SLF17-128 | R | 79 | SLF17-293 | R |
| 37 | SLF17-129 | R | 80 | SLF17-131 | S |
| 38 | SLF17-130 | R | | | |
| 39 | SLF17-152 | R | | | |
| 40 | SLF17-157 | R | | | |

**Summary OF N-II:**

| Red Rot diseases | No. of clones |
|---|---|
| Resistant (R) | 54 |
| Moderately resistant (MR) | 11 |
| Moderately susceptible (MS) | 04 |
| Susceptible (S) | 11 |
| Total | **80** |

**Table 3.3:- Screening of Sugarcane Clones in Nursery-III during 2018-19**

| Sr.# | NAME OF LINE/ ENTRY | REACTION TO RED ROT DISEASE | Sr.# | NAME OF LINE/ ENTRY | REACTION TO RED ROT DISEASE |
|---|---|---|---|---|---|
| 1 | PSR00-23 | MS | 32 | S-2016SL-109 | MR |
| 2 | PSR-98-140 | R | 33 | S-2016SL-104 | MR |
| 3 | HSF-240 | R | 34 | S-2016SL-131 | S |
| 4 | PSR-01-232 | MS | 35 | S-2016SL-143 | R |
| 5 | PSR-99-85 | **S** | 36 | S-2016SL-171 | S |
| 6 | PSR-98-27 | MR | 37 | S-2016SL-182 | S |
| 7 | PSR-01-28 | R | 38 | S-2016SL-218 | S |
| 8 | PSR-99-89 | S | 39 | S-2016SL-233 | S |
| 9 | CP00-1101 | **R** | 40 | S-2016SL-296 | R |
| 10 | CP-09-1952 | S | 41 | S-2016SL-290 | S |
| 11 | PLL02-6448 | MR | 42 | S-2016SL-284 | R |
| 12 | HSF-240 | MR | 43 | S-2016SL-276 | S |
| 13 | CP01-1372 | MR | 44 | S-2016SL-240 | S |
| 14 | CP-03-1912 | S | 45 | S-2016SL-234 | S |
| 15 | CPLL-05-1102 | R | 46 | CPF-249 | S |
| 16 | CPLL-02-0926 | R | 47 | S-2016SL-300 | R |
| 17 | CPF-249 | S | 48 | CP06-2400 | R |
| 18 | CP-04-1385 | S | 49 | CPF-249 | S |
| 19 | CP-09-1822 | R | 50 | CO-0238 | R |
| 20 | CPLL-05-1201 | MS | 51 | CP-7-2137 | S |
| 21 | CO-05-1526 | **R** | 52 | HSF-240 | MR |

| | | | | | |
|---|---|---|---|---|---|
| 22 | S-2016SL-02 | R | 53 | S-2016-SL-306S | MR |
| 23 | S-2016SL-41 | R | 54 | PSR-98-11 | S |
| 24 | S-2016SL-80 | S | 55 | PSR-98-38 | MR |
| 25 | S-2016SL-81 | S | 56 | PSR-01-46 | MS |
| 26 | S-2016SL-83 | MR | 57 | PSR-98-38 | R |
| 27 | S-2016SL-91 | R | 58 | PSR-01-46 | R |
| 28 | S-2016SL-128 | S | 59 | PSR-00-11 | S |
| 29 | S-2016SL-127 | MR | 60 | PSR-99-182 | R |
| 30 | S-2016SL-124 | S | 61 | CPF-249 | S |
| 31 | S-2016SL-114 | R | 62 | CP-04-1385 | R |
| | | | 63 | CP-04-1935 | R |

**Summary OF N-III:**

| **Red Rot diseases** | **No. of clones** |
|---|---|
| Resistant (R) | 23 |
| Moderately resistant (MR) | 11 |
| Moderately susceptible (MS) | 04 |
| Susceptible (S) | 25 |
| **Total** | **63** |

**Table.3.4:- Screening of sugarcane clones in semi-final varietal Trials.**

| Sr.# | Clones | Reaction(Red rot) |
|---|---|---|
| 1 | S2015-SL-636 | S |
| 2 | S2015-SL-574 | MS |
| 3 | S2015-547 | MS |
| 4 | S2015-SL-540 | R |
| 5 | S2015-SL-444 | MR |
| 6 | S2015-SL-416 | R |
| 7 | S2015-SL-404 | MR |
| 8 | S2015-SL-302 | R |
| 9 | S2015-SL-290 | MR |
| 10 | S2015-SL-289 | R |
| 11 | S2015-SL-244 | R |
| 12 | S2015-SL-158 | MS |
| 13 | S2015-SL-108 | R |
| 14 | S2015-SL-101 | R |
| 15 | S2015-SL-89 | R |
| 16 | S2015-SL-10 | R |
| 17 | S2014-SL-2006 | S |
| 18 | S2014-SL-1700 | MR |
| 19 | S2015-SL-1322 | R |
| 20 | PSR07-145 | R |

**SUMMARY OF SEMI-FINAL**

| Reaction to Red rot | No of clones |
|---|---|
| Resistant | 10 |
| Moderately resistant | 04 |
| Moderately susceptible | 03 |
| Susceptible | 03 |
| **Total** | **20** |

**Tab.3.5:- Screening of sugarcane clones of Final Varietal Trials.**

| Sr.# | Clones | Reaction(Red rot) |
|---|---|---|
| 1 | S2014-SL-247 | MS |
| 2 | S2014-SL-2350 | MR |
| 3 | S2014-SL-2290 | MS |
| 4 | S2014-SL-2200 | MR |
| 5 | S2014-SL-1359 | R |
| 6 | S2013-US-917 | MR |
| 7 | S2013-M-45 | MR |
| 8 | S2012-M1379 | R |

**SUMMARY OF FINAL VARIATAL TRIAL**

| Reaction to Red rot | No of clones |
|---|---|
| Resistant | 2 |
| Moderately resistant | 4 |
| Moderately susceptible | 2 |
| Susceptible | 0 |
| **Total** | **8** |

**Table 3.6:- Screening of Sugarcane Clones in NUVYT 2019-20 (1st year)**

| **S.#.** | **Clone** | **Reaction to red rot disease** |
|---|---|---|
| 1 | VMC-87/599 | S |
| 2 | S2009 SA-111 | MR |
| 3 | S96 SP-302 | S |
| 4 | CPSG-2415 | MS |
| 5 | CPSG-2718 | S |
| 6 | SLSG-1283 | MR |
| 7 | CPFG-14 | S |
| 8 | CPFG-15 | MR |
| 9 | CPSG-16 | R |
| 10 | MH-91 | S |
| 11 | LampTJ-76/803 | S |
| 12 | CPTJ-349 | S |
| 13 | CPTJ-1549 | S |
| 14 | SLTh-1510 | S |
| 15 | CPF 246 | S |
| 16 | CPF 249 | S |

## Summary OF NUSYT-2019-20 (1st year)

| Red Rot diseases | No. of clones |
|---|---|
| Resistant (R) | 01 |
| Moderately resistant (MR) | 03 |
| Moderately susceptible (MS) | 01 |
| Susceptible (S) | 11 |
| **Total** | **16** |

**Table :- 3.7. Reaction of Sugarcane Clones to Red Rot in NUYT 2019-20 (2nd year) Planted at SRI, Faisalabad**

| S.# | Clone | Reaction to red rot disease |
|---|---|---|
| 1 | S2002 US-133 | R |
| 2 | S2003 US-127 | MR |
| 3 | S2003 US-633 | MR |
| 4 | S2005 US-54 | MR |
| 5 | S2008 M-42 | MR |
| 6 | S2008 Aus-133 | R |
| 7 | Th-1312 | MR |
| 8 | Th-1412 | S |
| 9 | CPF 249 | S |
| 10 | HSF 240 | R |

## Summary OF NUSYT-2019-20 (2nd year)

| Red Rot diseases | No. of clones |
|---|---|
| Resistant (R) | 03 |
| Moderately resistant (MR) | 05 |
| Moderately susceptible (MS) | 0 |
| Susceptible (S) | 02 |
| **Total** | **10** |

**Table :-3.8 DIRECTION INTRODUCTION FROM FRANCE (SEED INCREASE)**

| Sr.# | Name of advanced lines | Reaction | | | | |
|---|---|---|---|---|---|---|
| | | Red rot | Whip smut | Pokha. boeng | Red stripe | Rust |
| 1 | B-111 | S | R | R | R | R |
| 2 | FR-89-746 | MS | R | R | R | R |
| 3 | FR-90-88 | S | R | R | R | R |
| 4 | FR-92-394 | S | R | R | R | R |
| 5 | FR-94-129 | R | R | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | FR-95-579 | R | R | R | R | R |
| 7 | FR-96-01 | R | R | R | R | R |
| 8 | FR-09-382 | MS | MR | R | R | R |
| 9 | FR-09-190 | MS | R | R | R | R |
| 10 | CRS-76 | MR | MS | R | R | R |
| 11 | Karan | R | R | R | R | R |

**SUMMARY OF CANES (Direct introduction from FRANCE)**

| Reaction to Red rot | No of clones |
|---|---|
| Resistant | 04 |
| Moderately resistant | 01 |
| Moderately susceptible | 03 |
| Susceptible | 03 |
| Total | 11 |

**Table:- 3.9 Screening of sugarcane clones at SRS, Khanpur**

| Sr.# | Clones | Reaction (Red rot) | Sr.#. | Clones | Reaction (Red rot) |
|---|---|---|---|---|---|
| 1 | S2008-FD-19 | R | 27 | S2011-SL-62 | MS |
| 2 | S2008-M-42 | R | 28 | S2011-SL-392 | R |
| 3 | S2006-US-658 | R | 29 | S2011-SL-809 | MR |
| 4 | S2008-AUS-133 | R | 30 | PSR-97-41 | R |
| 5 | S2008-AUS-134 | S | 31 | SL-97-45 | R |
| 6 | S2008-AUS-138 | MR | 32 | SL-96-175 | R |
| 7 | S2009-SA-54 | R | 33 | M-2238/89 | R |
| 8 | SPF-234 | S | 34 | MS-03-CP-368 | R |
| 9 | **S2009-SA-08** | MR | 35 | MS-03-CP-389 | R |
| 10 | S2009-SA-79 | R | 36 | CP-TJ-27 | MR |
| 11 | S2009-SA-111 | R | 37 | LAM-TJ-76/803 | S |
| 12 | VMC-87/599 | MS | 38 | CP-TJ-349 | S |
| 13 | SL-96/128 | R | 39 | CP-TJ-70/1549 | MS |
| 14 | SL-96/175 | R | 40 | S2007-SP-576 | R |
| 15 | CPF-249 | S | 41 | S-96-US-302 | MR |
| 16 | SPF-234 | S | 42 | S2005-US-54 | R |
| 17 | **S2012-FD-25** | R | 43 | **S2002-US-133** | R |
| 18 | VMC88/354 | R | 44 | HSF-240 | R |
| 19 | S2011-SL-62 | MS | 45 | S2008-M-42 | R |
| 20 | S2011-SL-392 | R | 46 | S2003-US-633 | MR |
| 21 | PSR97/45 | R | 47 | S2003-US-127 | MR |
| 22 | M-2238-89 | R | 48 | S2008-AUS-133 | R |
| 23 | S2008-FD-22 | R | 49 | TH-1312 | MR |
| 24 | S2008-FD-25 | R | 50 | TH-1412 | S |
| 25 | VMC-88/354 | R | 51 | SPF-213 | R |
| 26 | VMC-87/599 | MS | 52 | CPF-77400 | MR |
| | | | 53 | S2009-SA-57 | R |

**SUMMARY SUGARCANE CLONES AT SRS, KHANPUR**

| Reaction to Red rot | No of clones |
|---|---|
| Resistant | 32 |
| Moderately resistant | 09 |
| Moderately susceptible | 05 |
| Susceptible | 07 |
| Total | 53 |

**Table:- 3.10 Screening of sugarcane clones at SRS, Sargodha**

| Sr.# | Name of advanced lines | Red rot |
|---|---|---|
| 1 | S2003-US-778 | S |
| 2 | S2003-US-127 | MS |
| 3 | S2002-US-133 | R |
| 4 | S2003-US-633 | S |
| 5 | S2005-US-54 | MS |
| 6 | CPF-249 | S |
| 7 | HSF-240 | R |
| 8 | CPF-248 | MS |
| 9 | VMC-97/599 | MS |
| 10 | S2009-SA-111 | S |
| 11 | S96-SP-302 | S |

**SUMMARY SUGARCANE CLONES AT SRS, SARGODHA**

| **Reaction to Red rot** | **No of clones** |
|---|---|
| **Resistant** | **02** |
| **Moderately resistant** | **0** |
| **Moderately susceptible** | **04** |
| **Susceptible** | **05** |
| **Total** | **11** |

# 4. SUGARCANE ENTOMOLOGY

During the year 2019-20, new varieties / advanced lines planted at Sugarcane Research Institute, Faisalabad in different varietal trials were screened for resistance against sugarcane borers viz., top borer, stem borer, root borer, and Gurdaspur borer. The tiller infestation was recorded at tillering stage of the crop by counting the total healthy and infested tillers from central two rows of each plot. "Dead hearts" % age was calculated by using the following formula.

$$\text{Dead heart \%} = \frac{\text{Number of dead hearts}}{\text{Total No. of tillers}} \times 100$$

At harvest time samples of 10 canes of each variety / clone were randomly collected from 3 replications. The canes were splitted/ dissected longitudinally and closely observed for each borer damage. The internode damage was recorded by counting the total number of internodes along with attacked internodes by each borer separately. The internode damage was calculated by using the following formula.

$$\text{Internode Damage \%} = \frac{\text{Number of attacked internodes}}{\text{Total No. of internodes}} \times 100$$

## 1. SCREENING OF ADVANCED LINES OF SEMI FINAL VARIETAL TRIAL AGAINST SUGARCANE BORERS (SET-1).

Twelve (12) clones/varieties included in Semi Final varietal trials (Set-I) were planted at Research Area of Sugarcane Research Institute, Faisalabad under normal input requirements following Randomized Complete Block Design (RCBD) having a plot size of 4mx4.80m with three replications during the month of March 2019. Dead heart % age was recorded from two central rows of each plot twice during May and June with one month interval. At harvest time, internode damage % age was recorded and data recorded in Table-4.1.

**Table-4.1: Semi Final Varietal Trial (Set-I)**

| Sr. No | Clone | Tiller Infestation % | Internode Damage % | | | | | Resistance Status |
|---|---|---|---|---|---|---|---|---|
| | | | Top Borer | Stem Borer | Root Borer | Gurdaspur Borer | Cumulative Internode Damage | |
| 1 | PSR-07-145 | 0.365 | 0.00 | 8.229 | 0.330 | 0.00 | 8.559 | T* |
| 2 | S-2014-Sl-1322 | 1.903 | 0.00 | 6.348 | 0.000 | 0.00 | 6.348 | T |
| 3 | S-2014-SL-1700 | 2.815 | 0.00 | 12.438 | 0.463 | 0.00 | 12.901 | MT** |
| 4 | S-2014-SL-2006 | 1.048 | 0.00 | 12.293 | 1.235 | 0.00 | 13.528 | MT** |
| 5 | S-2015-SL-10 | 1.012 | 0.00 | 5.006 | 0.182 | 0.00 | 5.188 | T |
| 6 | S-2015-SL-89 | 0.963 | 0.00 | 10.521 | 1.858 | 0.00 | 12.379 | MT** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | S-2015-SL-101 | 0.528 | 0.00 | 2.468 | 0.000 | 0.00 | 2.468 | T |
| 8 | S-2015-SL-108 | 0.575 | 0.00 | 12.316 | 0.487 | 0.00 | 12.803 | MT** |
| 9 | S-2015-SL-158 | 1.240 | 0.00 | 15.422 | 0.816 | 0.00 | 16.238 | MT** |
| 10 | S-2015-SL-244 | 1.091 | 0.00 | 6.547 | 0.360 | 0.00 | 6.907 | T |
| 11 | HSF-240(Check) | 1.040 | 0.00 | 3.856 | 0.352 | 0.00 | 4.208 | T |
| 12 | CPF-249(Check) | 0.963 | 0.00 | 6.226 | 0.000 | 0.00 | 6.226 | T |
| T*-Tolerant MT**- Moderately Tolerant | | | | | | | | |

The results (Table-4.1) revealed that out of twelve (12) clones / varieties, minimum tiller infestation was recorded on PSR-07-145(0.365%) followed by S-2015-SL-101 (0.528%), S-2015-SL-108 (0.575%), S-2015-SL-89 (0.963%) and CPF-249 (Check) (0.963%), while it was maximum on S-2014-SL-1700 (2.815%) followed by S-2014-Sl-1322 (1.903%) and S-2015-SL-158 (1.240%).

With respect to internode damage, no internode damage by top borer was recorded on any advanced line. Minimum damage by stem borer was recorded on S-2014-SL-1359 (2.468%) followed by S-2014-SL-1322 (3.856%) and CPF-249 (Check) (5.006%) whereas, it was maximum on S-2014-SL-1700 (15.422%) followed by S-2014-SL-2006 (12.438%), HSF-240 (Check) (12.316%), S-2013-M-46 (12.293%) and S-2015-SL-89 (10.521%). No internode damage by root borer was observed on S-2014-Sl-1322, S-2015-SL-101 and CPF-249 (Check), minimum on S-2015-SL-10 (0.182), PSR-07-145 (0.33%) HSF-240 (Check) (0.352%) and S-2015-SL-244 (0.360%) while it was maximum on S-2015-SL-89 (1.858%) and S-2014-SL-2006 (1.235%). The attack of Gurdaspur Borer was found nil during the crop season.

Minimum cumulative internode damage was recorded on S-2015-SL-101 (2.468%) followed by HSF-240 (Check) (4.208%) and S-2015-SL-10 (5.188%) while it was maximum on S-2015-SL-158 (16.238%) followed by S-2014-SL-2006 (13.528%), S-2014-SL-1700 (12.901 %), S-2015-SL-108 (12.803%) and S-2015-SL-89 (12.379%).

Out of twelve (12) clones/ varieties seven (07) were found tolerant and five (05) moderately tolerant with respect to cumulative internode damage.

## 2. SCREENING OF ADVANCED LINES OF SEMI FINAL VARIETAL TRIAL AGAINST SUGARCANE BORERS (SET-II)

Twelve (12) clones / varieties included in Semi Final varietals trials (Set-II) were planted at Research Area of Sugarcane Research Institute, Faisalabad under normal input requirements, following Randomized Complete Block Design having a plot size of 4mx4.80m with three replications during the month of March 2019. Dead heart % age was recorded from two central rows of each plot twice during May and June with one-month

interval. At harvest time, internode damage % age was recorded and data recorded in Table-4.2.

**Table-4.2 Semi Final Varietal Trial (Set II)**

| Sr. No | Clone | Tiller Infestation % | Internode Damage % | | | | | Resistance Status |
|---|---|---|---|---|---|---|---|---|
| | | | Top Borer | Stem Borer | Root Borer | Gurdaspur Borer | Cumulative Internode Damage | |
| 1 | S-2015-SL-289 | 0.000 | 0.00 | 5.060 | 0.000 | 0.00 | 5.060 | T* |
| 2 | S2015-SL-290 | 1.637 | 0.00 | 1.598 | 0.292 | 0.00 | 1.890 | T |
| 3 | S-2015-SL-302 | 4.497 | 0.00 | 7.647 | 0.000 | 0.00 | 7.647 | T |
| 4 | S-2015-SL-404 | 0.178 | 0.00 | 8.016 | 0.532 | 0.00 | 8.548 | T |
| 5 | S-2015-SL-416 | 2.094 | 0.00 | 4.381 | 0.000 | 0.00 | 4.381 | T |
| 6 | S-2015-SL-444 | 0.642 | 0.00 | 8.995 | 0.353 | 0.00 | 9.348 | T |
| 7 | S-2015-SL-540 | 3.597 | 0.00 | 2.571 | 0.340 | 0.00 | 2.911 | T |
| 8 | S-2015-SL-547 | 1.608 | 0.00 | 6.285 | 0.824 | 0.00 | 7.109 | T |
| 9 | S-2015-SL-574 | 0.823 | 0.00 | 9.635 | 0.728 | 0.00 | 10.363 | MT** |
| 10 | S-2015-SL-636 | 0.492 | 0.00 | 15.316 | 0.706 | 0.00 | 16.022 | MT** |
| 11 | HSF-240 Check) | 1.718 | 0.00 | 2.807 | 0.150 | 0.00 | 2.957 | T |
| 12 | CPF-249 Check) | 1.494 | 0.00 | 8.617 | 0.626 | 0.00 | 9.243 | T |

T*-Tolerant MT**- Moderately Tolerant

The results (Table-4.2) revealed that out of twelve (12) clones / varieties, no tiller infestation was recorded on S-2015-SL-289. Minimum tiller infestation was recorded on S-2015-SL-404 (0.178%) followed by S-2015-SL-636 (0.492%), S-2015-SL-444 (0.642%) and S-2015-SL-574 (0.823%), while it was maximum on S-2015-SL-302 (4.497%) followed by S-2015-SL-540 (3.597%) and S-2015-SL-416 (2.094%).

With respect to internode damage, no internode damage by top borer was recorded on any advanced line. Minimum damage by stem borer was recorded on S2015-SL-290 (1.598%) followed by S-2015-SL-540 (2.571%) and HSF-240 Check) (2.807%) whereas, it was maximum on S-2015-SL-636 (15.316%) followed by S-2015-SL-574 (9.635%), S-2015-SL-444 (8.995%), CPF-249 Check) (8.617%) and S-2015-SL-404 (8.016%). No internode damage by root borer was observed on S-2015-SL-289, S-2015-SL-302 and S-2015-SL-416. Minimum internode damage by root borer was observed on HSF-240 Check) (0.150), S2015-SL-290 (0.292%), S-2015-SL-540 (0.340%) and S-2015-SL-444 (0.353%) while it was maximum on S-2015-SL-547 (0.824%), S-2015-SL-574 (0.728%) and S-2015-SL-636 (0.706). The attack of Gurdaspur Borer was found nil during the crop season.

Minimum cumulative internode damage was recorded on S2015-SL-290 (1.890%) followed by S-2015-SL-540 (2.911%) and HSF-240 Check) (2.957%) while it was maximum on S-2015-SL-636 (16.022%) followed by S-2015-SL-574 (10.363%), S-2015-

SL-444 (9.348 %), CPF-249 Check) (9.243%) and S-2015-SL-404 (8.548%).

Out of twelve (12) clones/ varieties ten (10) were found tolerant and two (02) moderately tolerant with respect to cumulative internode damage.

## 3. SCREENING OF DIFFERENT ADVANCED LINES / VARIETIES OF FINAL VARIETAL TRIAL FOR RESISTANCE AGAINST SUGARCANE BORERS

Ten (10) clones/varieties included in Final Varietal Trial were planted at research area of Sugarcane Research Institute, Faisalabad under normal input requirements following Randomized Complete Block Design having a plot size of 3mx3.60m with three replications during the month of March 2019. Dead heart % age was recorded from central two rows of each plot by counting the total number of tillers along with infested tillers twice during May and June with one-month interval. At harvest time a sample of 10 canes randomly selected was collected from each plot. The canes were splitted/ dissected longitudinally and closely observed for recording internode damage by each borer separately. Results of cumulative internode damage was calculated and presented in Table-4.3.

**Table-4.3: Final Varietal Trial**

| Sr. No | Clone | Tiller Infestation % | Internode Damage % | | | | | Resistance Status |
|---|---|---|---|---|---|---|---|---|
| | | | Top Borer | Stem Borer | Root Borer | Gurdaspur Borer | Cumulative Internode Damage | |
| 1 | S2012-M-1379 | 2.880 | 0.000 | 8.197 | 0.153 | 0.000 | 8.350 | T* |
| 2 | S-2013-M-45 | 4.661 | 0.000 | 9.767 | 0.583 | 0.000 | 10.350 | MT** |
| 3 | S-2013-US-917 | 3.936 | 0.000 | 4.250 | 0.167 | 0.000 | 4.417 | T |
| 4 | S-2014-SL-1359 | 2.526 | 0.000 | 6.407 | 0.150 | 0.000 | 6.557 | T |
| 5 | S-2014-SL-2200 | 4.543 | 0.000 | 6.470 | 0.343 | 0.000 | 6.813 | T |
| 6 | S-2014-SL-2290 | 4.285 | 0.000 | 3.447 | 0.150 | 0.000 | 3.597 | T |
| 7 | S-2014-SL-2350 | 0.383 | 0.000 | 2.543 | 0.000 | 0.000 | 2.543 | T |
| 8 | S2014-SL-2477 | 2.644 | 0.000 | 2.137 | 0.000 | 0.000 | 2.137 | T |
| 9 | CPF-249(Check) | 1.393 | 0.000 | 5.573 | 0.157 | 0.000 | 5.730 | T |
| 10 | HSF-240(Check) | 4.079 | 0.000 | 3.443 | 0.313 | 0.000 | 3.756 | T |

T*-Tolerant MT**- Moderately Tolerant

The results (Table-4.3) revealed that out of ten (10) clones / varieties minimum tiller infestation was recorded on S-2014-SL-2350 (0.383%) followed by CPF-249(Check) (1.393%), S-2014-SL-1359 (2.526%), S2014-SL-2477 (2.644%) and S2012-M-1379 (2.880%) while it was maximum on S-2013-M-45 (4.661%) followed by S-2014-SL-2200 (4.543%), S-2014-SL-2290 (4.285%) and HSF-240 (Check) (4.079%).

With respect to internode damage, no internode damage by top borer was recorded on any advanced line. Minimum damage by stem borer was recorded on S2014-SL-2477 (2.137%), S-2014-SL-2350 (2.543%), HSF-240(Check) (3.443%), S-2014-SL-2290 (3.447%) and S-2013-US-917 (4.250%) whereas, it was the maximum on S-2013-M-45 (9.767%) followed by S2012-M-1379 (8.197%), S-2014-SL-2200 (6.470%), S-2014-SL-1359 (6.407%) and CPF-249(Check) (5.573%). No internode damage by root borer was observed on S-2014-SL-2350 and S2014-SL-2477. The minimum internode damage by root borer was observed on S-2014-SL-1359 (0.150%), S-2014-SL-2290 (0.150 %), S2012-M-1379 (0.153 %) and CPF-249(Check) (0.157 %) while it was the maximum on S-2013-M-45 (0.583 %), S-2014-SL-2200 (0.343 %) and HSF-240(Check) (0.313). The attack of Gurdaspur Borer was found nil during the crop season.

The minimum cumulative internode damage was recorded on S2014-SL-2477 (2.137 %) followed by S-2014-SL-2350 (2.543 %), S-2014-SL-2290 (3.597%), HSF-240(Check) (3.756) and S-2013-US-917 (4.417%) while it was the maximum on S-2013-M-45 (10.350%) followed by S2012-M-1379 (8.350%), S-2014-SL-2200 (6.813 %), S-2014-SL-1359 (6.557 %) and S-2014-SL-2200 (6.813 %).

Out of ten (10) clones/ varieties nine (09) were found tolerant and one (01) moderately tolerant with respect to cumulative internode damage.

## 4. SCREENING OF ADVANCED LINES OF NATIONAL UNIFORM VARIETAL YIELD TRIAL (NUVYT) FOR RESISTANCE AGAINST SUGARCANE BORERS (1st Year).

The results of National Uniform Varietal Yield Trials (Table-4.4) revealed that out of sixteen (16) clones varieties minimum tiller infestation was recorded on S2009 SA-111 (0.856%) followed by CPTJ-1549 (1.189%), CPFG-14 (1.253%) and CPSG-2718 (1.738%) while it was maximum on Lam PTJ-76/803 (5.139%) followed by CPF249 (Check) (4.939%) and CPF-246 (3.546%). No internode damage by top borer was observed on any of the clones screened except S2009 SA-111 (0.877%).

Minimum internode damage by stem borer was recorded on SLSG-1283 (1.996%) followed by CPFG-14 (2.534%) while it was maximum on S96 SP-302 (13.693%) followed by CPTJ-349 (12.074%), CPSG-2718 (11.535%), SL-Th-1510 (10.235%) and CPSG-2415 (10.089).

No internode damage by root borer was observed on SLSG-1283, CPFG-14, and CPFG-16. Minimum internode damage by root borer was recorded on CPF249(Check)

(0.159%), S96 SP-302 (0.399%), followed by CPTJ-349 (0.469%), Lam PTJ-76/803 (0.529%), SL-Th-1510 (0.570%) and CPTJ-1549 (0.581%) while it was maximum on VMC 87/599 (1.550%) and CPSG-2718 (1.426%). The attack of Gurdaspur Borer was found nil during the crop season.

With respect to cumulative internode damage minimum damage was recorded on SLSG-1283 (1.996%) followed by CPFG-14 (2.534%) and maximum on S96 SP-302 (14.092%) followed by CPSG-2718 (12.961%), CPTJ-349 (12.543%), CPSG-2415 (11.181%) and SL-Th-1510 (10.805%).

Out of sixteen (16) clones screened against borers eleven (11) were found tolerant and (05) moderately tolerant with respect to internode damage.

**Table-4.4: National Uniform Varietal Yield Trial (NUVYT) (1st Year)**

| Sr. No | Clone | Tiller Infestation % | Internode Damage % | | | | | Resistance Status |
|---|---|---|---|---|---|---|---|---|
| | | | Top Borer | Stem Borer | Root Borer | Gurdaspur Borer | Cumulative Internode Damage | |
| 1 | VMC 87/599 | 2.194 | 0.000 | 6.302 | 1.550 | 0.000 | 7.852 | T* |
| 2 | S2009 SA-111 | 0.856 | 0.877 | 7.240 | 0.452 | 0.000 | 8.569 | T |
| 3 | S96 SP-302 | 2.573 | 0.000 | 13.693 | 0.399 | 0.000 | 14.092 | MT** |
| 4 | CPSG-2415 | 2.110 | 0.000 | 10.089 | 1.092 | 0.000 | 11.181 | MT** |
| 5 | CPSG-2718 | 1.738 | 0.000 | 11.535 | 1.426 | 0.000 | 12.961 | MT** |
| 6 | SLSG-1283 | 2.410 | 0.000 | 1.996 | 0.000 | 0.000 | 1.996 | T |
| 7 | CPFG-14 | 1.253 | 0.000 | 2.534 | 0.000 | 0.000 | 2.534 | T |
| 8 | CPFG-15 | 1.848 | 0.000 | 6.181 | 0.986 | 0.000 | 7.167 | T |
| 9 | CPFG-16 | 2.245 | 0.000 | 5.238 | 0.000 | 0.000 | 5.238 | T |
| 10 | MH 91-CP-582 | 2.077 | 0.000 | 6.145 | 0.647 | 0.000 | 6.792 | T |
| 11 | Lam PTJ-76/803 | 5.139 | 0.000 | 8.207 | 0.529 | 0.000 | 8.736 | T |
| 12 | CPTJ-349 | 2.545 | 0.000 | 12.074 | 0.469 | 0.000 | 12.543 | MT** |
| 13 | CPTJ-1549 | 1.189 | 0.000 | 6.081 | 0.581 | 0.000 | 6.662 | T |
| 14 | SL-Th-1510 | 2.359 | 0.000 | 10.235 | 0.570 | 0.000 | 10.805 | MT** |
| 15 | CPF-246 | 3.546 | 0.000 | 5.771 | 0.000 | 0.000 | 5.771 | T |
| 16 | CPF249(Check) | 4.939 | 0.000 | 8.312 | 0.159 | 0.000 | 8.471 | T |

T*-Tolerant MT**- Moderately Tolerant

**5. SCREENING OF ADVANCED LINES OF NATIONAL UNIFORM VARIETAL YIELD TRIAL (NUVYT) FOR RESISTANCE AGAINST SUGARCANE BORERS (2nd Year).**

The results of National Uniform Varietal Yield Trials (Table-4.5) revealed that minimum tiller infestation was recorded on S2002-US133 (0.754%) followed by S2005-US-54 (0.871%), Th-1412 (0.925%), CPF-249 (0.936%) and HSF-240 (0.969%) while it was

maximum on S2003-US-127 (2.067%) followed by S2003-US-633 (1.901%), S2008-M-42 (1.816%) and Th-1312 (1.702%).

With respect to internode damage, no internode damage by top borer was recorded on any advanced line. Minimum internode damage by stem borer was recorded on S2008-M-42 (3.590%) followed by S2005-US-54 (4.837%) while it was maximum on Th-1412 (10.962%) followed by S2002-US133 (9.151%), S2003-US-127 (8.858%) and CPF-249 (7.501%).

No internode damage by root borer was observed on HSF-240 and Th-1312. Minimum internode damage by root borer was recorded on CPF-249 (0.330%) followed by Th-1412 (0.345%), S2005-US-54 (0.758%), S2008-AUS-133 (0.825%) and S2008-M-42 (0.914%) while it was maximum on S2002-US133 (1.661%) followed by S2003-US-633 (1.365%) and S2003-US-127 (1.299%). The attack of Gurdaspur Borer was found nil during the crop season.

With respect to cumulative internode damage, minimum internode damage was recorded on S2008-M-42 (4.504%) whereas it was maximum on Th-1412 (11.307%) followed by S2002-US133 (10.812%), S2002-US133 (10.157%) and CPF-249 (7.831%). Out of ten (10) clones seven (07) were found tolerant and three (03) moderately tolerant against sugarcane borers.

**Table-4.5: National Uniform Varietal Yield Trial (NUVYT) (2nd Year)**

| Sr. No | Clone | Tiller Infestation % | Internode Damage % | | | | | Resistance Status |
|---|---|---|---|---|---|---|---|---|
| | | | Top Borer | Stem Borer | Root Borer | Gurdaspur Borer | Cumulative Internode Damage | |
| 1 | HSF-240 | 0.969 | 0.000 | 6.109 | 0.000 | 0.000 | 6.109 | T* |
| 2 | CPF-249 | 0.936 | 0.000 | 7.501 | 0.330 | 0.000 | 7.831 | T |
| 3 | Th-1412 | 0.925 | 0.000 | 10.962 | 0.345 | 0.000 | 11.307 | MT** |
| 4 | Th-1312 | 1.702 | 0.000 | 6.466 | 0.000 | 0.000 | 6.466 | T |
| 5 | S2008-AUS-133 | 1.291 | 0.000 | 6.458 | 0.825 | 0.000 | 7.283 | T |
| 6 | S2008-M-42 | 1.816 | 0.000 | 3.590 | 0.914 | 0.000 | 4.504 | T |
| 7 | S2005-US-54 | 0.871 | 0.000 | 4.837 | 0.758 | 0.000 | 5.595 | T |
| 8 | S2003-US-633 | 1.901 | 0.000 | 6.167 | 1.365 | 0.000 | 7.532 | T |
| 9 | S2003-US-127 | 2.067 | 0.000 | 8.858 | 1.299 | 0.000 | 10.157 | MT** |
| 10 | S2002-US133 | 0.754 | 0.000 | 9.151 | 1.661 | 0.000 | 10.812 | MT** |

T*-Tolerant MT**- Moderately Tolerant

## 6. MICROBIAL BIOCONTROL OF SUGARCANE INSECT PEST COMPLEX.

The experiment was conducted on the spring sown sugarcane crop (CPF-247) during

2019 to evaluate the efficacy of five (05) different microbial bio-control agents and a synthetic insecticide alongside a control treatment where nothing was applied. All the treatments, viz.,

Bacteria (*Bacillus thuringiensis*) based (G) formulation @ 8 kg / acre;

Bacteria (*Bacillus thuringiensis)* based (WP) formulation @ 1 kg / acre ;

Fungus (*Metarhizium anisoplai*) based (WP) formulation @ 1 kg / acre ;

Baculovirus based (WP) formulation @ 1 kg / acre ;

Mixture (Bacteria G+Bacteria WP+Fungal WP+Baculovirus WP) @ 3 kg / acre and Chlorantraniliprol+Thiamethoxam @4Kg/acre were applied on setts at the time of sowing, completion of germination, earthing up stage and 130 to 140 days after planting (DAP).

Control plots were maintained under natural conditions. Experiment was laid out following Randomized Complete Block Design having a plot size of 4m x3.60m with three replications. Dead heart % age was recorded from central two rows of each plot by counting the total number of tillers along with infested tillers twice during May and June with one-month interval. At harvest time a sample of 10 canes randomly selected was collected from each plot. The canes were splitted/ dissected longitudinally and closely observed for recording internode damage by each borer separately and cumulative internode damage was calculated. The Pyrilla and Black bug population was recorded on per leaf and per leaf sheath basis respectively and presented in Table-4.6.

**Table-4.6: MICROBIAL BIOCONTROL OF INSECT PEST COMPLEX IN SUGARCANE**

| | | **BORERS** | | | | | | **SUCKING INSECTS** | |
|---|---|---|---|---|---|---|---|---|---|
| **Sr. No** | **Treatments** | **Tiller Infestation %** | **Internode Damage %** | | | | | **Pyrilla (Per leaf)** | **Black bug (Per leaf sheath)** |
| | | | **Top Borer** | **Stem Borer** | **Root Borer** | **Gurdaspur Borer** | **Cumulative Internode Damage** | | |
| 1 | T1: Bacteria (*Bacillus thuringiensis*) based (G) formulation | 7.715 | 0.775 | 0.945 | 1.825 | 0.000 | 3.545 | 17.583 | 1.834 |
| 2 | T2 :Bacteria (*Bacillus thuringiensis)* based (WP) formulation | 9.373 | 0.721 | 1.964 | 0.887 | 0.000 | 3.572 | 16.223 | 1.778 |
| 3 | T3 :Fungus (*Metarhizium anisoplai*) | 8.686 | 0.789 | 5.073 | 1.836 | 0.000 | 7.698 | 16.278 | 2.167 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | based (WP) formulation | | | | | | | | |
| 4 | T4: Baculovirus based (WP) formulation | 11.104 | 0.000 | 3.398 | 0.588 | 0.000 | 3.986 | 12.223 | 1.75 |
| 5 | T5 :2+3+4 (Mixture) | 8.708 | 0.000 | 3.646 | 0.574 | 0.000 | 4.220 | 13.639 | 1.972 |
| 6 | T6: Chlorantraniliprol+Thiamethoxam | 6.944 | 0.896 | 0.896 | 0.000 | 0.000 | 1.792 | 6.917 | 1.458 |
| 7 | T7 :Control (under natural condition) | 12.816 | 0.000 | 1.919 | 1.880 | 0.000 | 3.799 | 15.167 | 1.833 |

Based on the results (Table-4.6) it is concluded that at tillering stage among the microbial formulations, T1 gave best control with respect to tiller infestation i.e., 39.802% above control treatment (T7) as compared with T6 where it was 45.818% above control. Regarding internode damage, the tested microbial formulations did not show any efficacy.

For sucking insects T4 gave control efficacy of 19.411% for Pyrilla as compared to 54.394% by T6 above control treatment (T7) and for Black bug it was 4.528% and 20.458% respectively.

# 5. SUGARCANE TECHNOLOGY

## 1. QUALITY EVALUATION OF SUGARCANE CLONES

Two different sets of sugarcane clones i.e. ten clones as final varietal trial, twelve as semi-final varietal trial Set-I and Set-II were studied for evaluation of best juice quality in order to assess CCS (%) and the stage of maturity. Qualitative analysis of different cane varieties for their juice is an important mandate of varietal development program. The parameters of juice quality analysis are Brix (%), Pol (%), Purity (%) and CCS (%) of juice. Three sets of different cane clones / varieties were studied in this experiment, i.e., Final varietal trial, Semi-Final Varietal Trial Set-I and Semi-Final Varietal Trial Set-II. The analysis of various clones was conducted for juice quality parameters starting from October-2019 on bi-monthly basis.

**Semi-Final Varietal Trial:**

In Semi-final varietal trial Set- I, mean the maximum CCS% was observed in SL-158 (12.18) followed by SL-89 (12.1) and PSR-07-45 (12.06) as compared to HSF-240 (12.37) & CPF-249 (12.85) as standard [Table 1(i)].

**[Table-5.1(i)]. Qualitative Analysis (CCS %) of Semi Final Varietal Trial Set –I**

| Sr. No. | Variety/Clone Name | October | November | December | January | February | Avg. (Nov. to Jan.) CCS% |
|---|---|---|---|---|---|---|---|
| 1 | PSR-07-45 | 9.00 | 9.77 | 13.0 | 13.4 | 13.51 | 12.06 |
| 2 | S2014SL-1322 | 6.78 | 8.67 | 11.76 | 13.07 | 13.12 | 11.17 |
| 3 | SL-1700 | 8.99 | 9.66 | 10.99 | 12.75 | 12.85 | 11.13 |
| 4 | SL-2006 | 9.10 | 10.84 | 11.33 | 12.73 | 12.92 | 11.63 |
| 5 | SL-10 | 7.96 | 10.88 | 11.54 | 13.1 | 13.15 | 11.84 |
| 6 | SL-89 | 8.18 | 11.16 | 12.16 | 12.98 | 13.11 | 12.1 |
| 7 | SL-101 | 6.17 | 7.91 | 11.92 | 13.44 | 13.48 | 11.09 |
| 8 | S2015SL-108 | 6.92 | 9.02 | 12.92 | 13.44 | 13.52 | 11.79 |
| 9 | SL-158 | 6.47 | 10.62 | 12.43 | 13.49 | 13.53 | 12.18 |
| 10 | SL-244 | 7.53 | 9.81 | 11.56 | 12.97 | 13.18 | 11.45 |
| 11 | CPF-249 | 10.49 | 11.88 | 13.23 | 13.43 | 13.48 | 12.85 |
| 12 | HSF-240 | 9.44 | 11.45 | 12.65 | 13.02 | 13.12 | 12.37 |

In set-II, maximum CCS% was noted in S2015-SL-289 (12.78) followed by SL-547 (12.20) as compared to HSF-240 (12.21) & CPF-249 (12.54) as standard [Table-5.1(ii)]. In this Semi-final varietal trial, twenty-four (24) different sugarcane clones/varieties, including CPF-249 and HSF-240 as standard, were studied. The quality parameters data [Table-5.1(I&ii)]. showed that CCS% gradually improved with the maturity of crop. It was lower during the month of October and slightly improved up to the month of February.

**[Table-5.1(ii)]. Qualitative Analysis (CCS %) of Semi Final Varietal Trial Set –II**

| Sr. No. | Variety/Clone Name | October | November | December | January | February | Avg. (Nov. to Jan.) CCS% |
|---|---|---|---|---|---|---|---|
| 1 | S2015-SL-289 | 11.14 | 12.45 | 12.81 | 13.07 | 13.12 | 12.78 |
| 2 | SL-290 | 6.07 | 9.05 | 12.47 | 12.94 | 13.05 | 11.49 |
| 3 | SL-302 | 8.32 | 9.92 | 10.52 | 13.10 | 13.15 | 11.18 |
| 4 | SL-404 | 9.02 | 10.74 | 12.38 | 13.32 | 13.40 | 12.15 |
| 5 | SL-416 | 8.07 | 10.69 | 12.34 | 12.97 | 13.10 | 12.0 |
| 6 | SL-444 | 10.01 | 11.6 | 11.8 | 12.11 | 12.80 | 11.84 |
| 7 | SL-540 | 7.25 | 9.73 | 12.31 | 12.50 | 12.85 | 11.51 |
| 8 | SL-547 | 7.62 | 10.89 | 12.59 | 13.12 | 13.25 | 12.20 |
| 9 | SL-574 | 9.06 | 9.39 | 11.9 | 13.82 | 13.80 | 11.70 |
| 10 | SL-636 | 8.40 | 9.65 | 12.15 | 12.25 | 12.40 | 11.35 |
| 11 | HSF-240 | 9.60 | 11.31 | 12.37 | 12.94 | 13.10 | 12.21 |
| 12 | CPF-249 | 10.36 | 11.72 | 12.65 | 13.24 | 13.35 | 12.54 |

**Final Varietal Trial:**

In final varietal trial, the mean maximum CCS% was recorded by S2014SL-1359 (12.79) followed by S2013US-917 (12.60) as compared to HSF-240 (12.22) & CPF-249 (12.77) as standard [Table-5.1(iii)].

In this final varietal trial, ten (10) different sugarcane clones/varieties, including CPF-249 and HSF-240 as standard, were studied. The quality parameters showed that CCS% gradually improved with the maturity of crop. The sugar recovery generally was lower during the month of October and November but gradually enhanced up to the month of January and February.

Table [Table-5.1(iii)]. Qualitative Analysis (CCS %) of Final Varietal Trial.

**[Table-5.1(iii)] Qualitative Analysis (CCS %) of Final Varietal Trial.**

| Sr. No. | Variety/Clone | 18-Oct | 1-Nov | 17-Nov | 2-Dec | 18-Dec | 2-Jan | 17-Jan | 3-Feb | Avg. (Nov. to 03 Feb.) CCS% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S2012M-1379 | 8.89 | 10.61 | 10.78 | 11.02 | 12.35 | 12.45 | 12.72 | 12.8 | 11.82 |
| 2 | S2013M-45 | 9.63 | 10.68 | 11.44 | 11.63 | 12.34 | 12.56 | 12.66 | 12.68 | 12.0 |
| 3 | S2013US-917 | 10.92 | 10.96 | 11.43 | 12.53 | 12.98 | 13.1 | 13.25 | 13.96 | 12.6 |
| 4 | S2014SL-1359 | 11.72 | 11.84 | 11.91 | 12.41 | 12.77 | 13.34 | 13.40 | 13.88 | 12.79 |
| 5 | S2014SL-2200 | 10.43 | 10.75 | 11.98 | 12.81 | 12.92 | 13.14 | 13.2 | 13.66 | 12.64 |
| 6 | S2014SL2290 | 9.27 | 10.31 | 11.19 | 11.48 | 12.74 | 13.46 | 13.47 | 13.69 | 12.33 |
| 7 | S2014SL2350 | 9.37 | 10.14 | 11.41 | 11.98 | 12.31 | 12.49 | 12.62 | 12.61 | 11.94 |
| 8 | S014SL2477 | 11.03 | 11.34 | 11.42 | 11.83 | 12.81 | 12.9 | 13.3 | 13.81 | 12.49 |
| 9 | CPF249 | 10.68 | 11.37 | 12.25 | 12.91 | 13.01 | 13.05 | 13.25 | 13.53 | 12.77 |
| 10 | HSF240 | 9.53 | 10.75 | 11.13 | 11.44 | 12.56 | 12.91 | 13.15 | 13.6 | 12.22 |

## 2. SCREENING OF PROMISING SUGARCANE CLONES FOR GUR PRODUCTION AND QUALITY

To find out new promising cane clones for gur production and their quality evaluation. The cane samples of seven different promising sugarcane varieties / clones were tested for gur production and its quality [Table-5.2(i)]. The gur samples of each line/clone were analyzed for color before and after storage of 90 days [Table-5.2(i & ii)]. On the other hand, storage effect for 90 days at ambient conditions showed darkening of color (Table-5.2) and moisture reduction in the gur of all cane clones. The analysis results depicted that sugarcane clones S2003-US-633 and S2003-US-127 produced significantly higher gur % juice. As a result, it was concluded that with respect to good nutritional aspect, lighter color and good keeping quality, sugarcane clones S2003-US-633 and S2003-US-127 were found better as compared to clones S2009-SA-111 & S2003-US-778.

**[Table-5.2(i)]. Comparison of Gur % juice in different sugarcane varieties**

| Varieties | Gur (%) Juice |
|---|---|
| S2002-US-133 | 17.18 CD |
| S 2009-SA-111 | 16.80 D |
| S2003-US-127 | 18.52 B |
| S2003-US-633 | 19.64 A |
| S2003-US-778 | 17.13 CD |
| HSF-240 (CHK) | 17.72 C |
| LSD | 0.66 |

**[Table-5.2(ii)] Comparison of Gur color in different sugarcane varieties**

| Varieties | Appearance | |
|---|---|---|
| | B.S | A.S |
| S2002-US-133 | Light Brown | Brown |
| S 2009-SA-111 | Creamy Golden Brown | Dark Brown |
| S2003-US-127 | Light Brown | Brown |
| S2003-US-633 | Golden Brown | Light Brown |
| S2003-US-778 | Creamy Light Brown | Dark Brown |
| HSF-240 (CHK) | Shiny Brown | Dark Brown |

* B.S = Before Storage ** A.S = After Storage

## 3. SURVEY AND COLLECTION OF SUGARCANE SAMPLES FROM FARMER FIELD FOR QUALITY ANALYSIS

A survey study was conducted to evaluate the qualitative performance of sugarcane varieties cultivated in different areas of Faisalabad district. The sugarcane samples of five varieties (HSF-240, CPF-246, CPF-248, CPF-249 and CP 77-400) were collected from November to January (2019-20). The cane juice was extracted from collected samples and analyzed for sugar recovery (%) [Table-5.3(i)].

**[Table-5.3(i)]. Average Sugar Recovery (%) for the month of November, 2019**

| Sr. No | Variety | Sugar Recovery (%) | | | |
|---|---|---|---|---|---|
| | | Sumandri | Tandlianwala | Jaranwala | ChakJhumra |
| 1 | HSF-240 | 11.15 | 11.35 | 10.97 | 10.57 |
| 2 | CPF-246 | 12.44 | 11.75 | 11.55 | 11.30 |
| 3 | CPF-248 | 11.41 | 11.66 | 11.85 | 10.87 |

| | | | | | |
|---|---|---|---|---|---|
| 4 | CPF-249 | 10.92 | 11.13 | 11.71 | 11.33 |
| 5 | CP77-400 | 12.10 | 12.13 | 11.41 | 11.69 |

The results described that sugar recovery % increases in December and January as compared to month of November [Table-5.3(ii & iii)]. The sugar recovery (%) of different varieties and from different location was in the range of 10.92 to 12.44%, 11.33 to 12.90 % and 11.71 to 12.81 % in the month of November, December (2019) and January (2020) respectively.

**[Table-5.3(ii)] Average Sugar Recovery (%) for the month of December, 2019**

| Sr. No | Variety | Sugar Recovery (%) | | | |
|---|---|---|---|---|---|
| | | Sumandri | Tandlianwala | Jaranwala | ChakJhumra |
| 1 | HSF-240 | 11.71 | 12.11 | 11.91 | 11.57 |
| 2 | CPF-246 | 12.90 | 12.45 | 12.38 | 12.70 |
| 3 | CPF-248 | 11.95 | 12.11 | 11.85 | 11.74 |
| 4 | CPF-249 | 11.82 | 11.97 | 12.55 | 11.33 |
| 5 | CP77-400 | 12.33 | 12.45 | 11.93 | 12.40 |

**[Table-5.3(iii)]. Average Sugar Recovery (%) for the month of January, 2020**

| Sr. No | Variety | Sugar Recovery (%) | | | |
|---|---|---|---|---|---|
| | | Sumandri | Tandlianwala | Jaranwala | ChakJhumra |
| 1 | HSF-240 | 12.28 | 11.90 | 11.71 | 12.20 |
| 2 | CPF-246 | 12.67 | 12.55 | 12.35 | 12.81 |
| 3 | CPF-248 | 11.95 | 12.11 | 12.31 | 12.55 |
| 4 | CPF-249 | 12.11 | 12.55 | 12.27 | 11.95 |
| 5 | CP77-400 | 12.71 | 12.55 | 12.81 | 12.27 |

## 4. EVALUATION OF MINERAL NUTRIENT CONTENTS IN JUICE SAMPLES OF DIFFERENT SUGARCANE VARIETIES

The purpose of this study is to evaluate the mineral nutrients in juice of different sugarcane varieties/clones. The results depicted that the maximum sugar recovery 12.15 and 12.69 % was observed in CPF-247 and CPF-246 in the month of December and January respectively [Table-5.4(i)]. Similarly, the EC value of sugarcane juice was also higher in CPF- 246. Maximum K (136 Mm) and Zn (8.15 mg/L) in sugarcane juice were observed in CPF-246 as compared to HSF-240. The sugar recovery positively correlates with K, Zn and Fe contents of sugarcane juice [Table-5.4(ii)] but sugar recovery decreases as Na and Cl contents in cane juice increases.

**[Table-5.4(i)] Average Sugar Recovery (%) in different sugarcane varieties**

| Sr. No. | Variety | S. Rec. (%) December | S. Rec. (%) January |
|---|---|---|---|
| 1 | HSF-240 | 11.55 | 12.25 |
| 2 | CPF-246 | 12.11 | 12.69 |
| 3 | CPF-247 | 12.15 | 12.49 |
| 4 | CPF-248 | 12.13 | 12.41 |
| 5 | CPF-249 | 12.10 | 12.45 |

**[Table 4(ii)] Relationship of Juice EC with mineral nutrients in different sugarcane varieties**

| Sr. No. | EC ($mSm^{-1}$) | K (mM) | Na (mM) | Cl (mM) | Zn (mg/L) | Cu (mg/L) | Fe (mg/L) |
|---|---|---|---|---|---|---|---|
| 1 | 509 | 89 | 5.11 | 48 | 4.51 | 2.07 | 75 |
| 2 | 581 | 136 | 3.60 | 31 | 8.15 | 2.70 | 89 |
| 3 | 545 | 111 | 3.58 | 33 | 5.67 | 2.68 | 73 |
| 4 | 542 | 114 | 3.87 | 34 | 4.58 | 2.14 | 71 |
| 5 | 534 | 95 | 4.75 | 45 | 5.11 | 2.36 | 65 |

## 5. BALANCE USE OF MACRO AND MICRONUTRIENTS TO INCREASE SUGAR YIELD PER UNIT AREA UNDER CHANGING SCENARIO OF CLIMATE CHANGE

The purpose of this study was to evaluate the effect of macro and micronutrients on cane yield and juice quality. The results depicted [Table-5.5(i)] that in treatment $T_3$ and $T_8$, maximum and significantly higher cane yield (112.33 and 117.67 t/ha) was recorded, where zinc fertilizer was incorporated as compared to $T_2$ (94.33 t/ha).

**[Table-5.5(i)] Effect of macro and micronutrients on sugarcane yield**

| Treatments | Yield (t $ha^{-1}$) | Sugar Yield (t $ha^{-1}$) |
|---|---|---|
| T1 Control | 43.33 E | 5.17 E |
| T2 NPK | 94.33 CD | 11.58 CD |
| T3 NPK + Zn | 112.33 AB | 13.94 AB |
| T4 NPK + Cu | 97.67 C | 11.98 C |
| T5 NPK + Fe | 95.33 CD | 11.66 CD |
| T6 NPK + B | 90.33 D | 11.12 D |
| T7 NPK + Half dose (Zn+Cu+Fe+B) | 108.33 B | 13.27 B |
| T8 NPK + Full dose (Zn+Cu+Fe+B) | 117.67 A | 14.45 A |
| LSD | 6.58 | 0.82 |

While the treatments $T_7$ and $T_3$ were statistically at par but significantly higher as compared to control (43.33 t/ha). The sugar yield was also found higher in zinc fertilizer treated treatments as compared to control.

# 6. SUGARCANE RESEARCH STATION, KHANPUR

## 1. PRELIMINARY VARIETAL TRIAL OF SUGARCANE

This genotypic experiment consisted of eight sugarcane strains including SPF-234 as standard. The investigation was laid out in RCBD with three replications and a net plot size of 3.6 x 10 m. The statistical analysis of the data (Table-6.1) reveals that sugarcane strain S2011-SL-392 gave the highest cane yield of 99.00 t/ha. Sugarcane genotype PSR-97-41 surpassed the list in field brix (21.66%).

**Table 6.1 Performance of sugarcane varieties under Preliminary varietal trial (2019-20)**

| Sr. No. | Variety | Germination % | Tillers Plant$^{-1}$ | Cane stand (000/ha) | Cane Yield (t/ha) | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | S2008-FD-25 | 42.47b | 1.99c | 96.39 | 70.91b | 19.00d |
| 2 | VMC-88-354 | 65.74a | 3.27a | 105.09 | 80.60ab | 19.66cd |
| 3 | S-2011-SL-62 | 67.72a | 1.99c | 109.29 | 81.43ab | 21.00ab |
| 4 | S2011-SL-392 | 67.53a | 2.49bc | 103.12 | 99.00a | 20.33bc |
| 5 | PSR-97-41 | 64.75a | 1.96C | 112.96 | 79.72ab | 21.66a |
| 6 | PSR-97-45 | 61.80a | 2.46bc | 114.75 | 85.74ab | 20.66abc |
| 7 | M-2238-89 | 61.17a | 2.12bc | 102.96 | 82.37ab | 21.00ab |
| 8 | SPF-234 | 61.30a | 2.69ab | 94.60 | 81.85ab | 20.33bc |
| LSD 0.05 | | 6.75 | 0.64 | NS | 22.56 | 1.21 |

Values with different letter(s) differ significantly (P=0.05)

## 2. SEMI-FINAL VARIETAL TRIAL

Two sets of Semi-Final Varietal trial comprising of 8 clones including two standard varieties i.e. SPF-234 and CPF-249 were layout in RCDB with 3 replications with the net plot size of 3.6 m x10 m. The data pertaining to germination, tillering, cane count, cane yield, and field brix were recorded (Table-6.2). The periodic brix data were recorded on monthly basis from November 15, 2019 to February 15, 2020. The sugarcane clone VMC-87-599 surpassed the set of clones with a final cane yield of 105.04 t/ha. Sugarcane genotype S2009-SA-8 surpassed the list in field brix (23.00%). On the basis of data recorded 4 clones were selected and promoted to final varietal trials stage for further study.

**Table- 6.2**. **Performance of sugarcane varieties under Semi Final varietal trial (2019-20)**

| S. No | Variety | Germin-ation % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | S2009-SA-8 | 52.51c | 2.76ab | 103.18 | 85.18bc | 23.00a |
| 2 | S2009-SA-79 | 56.60bc | 2.18abc | 98.92 | 84.46c | 19.00de |
| 3 | S2009-SA-111 | 55.55c | 2.37abc | 105.71 | 86.85bc | 21.33b |
| 4 | VMC-87-599 | 63.83a | 2.13bc | 103.12 | 105.04a | 19.67cd |
| 5 | SL-96-128 | 65.86a | 1.85c | 104.69 | 102,57ab | 18.67e |
| 6 | SL-96-175 | 54.57c | 2.63ab | 105.65 | 100.79abc | 19.00de |
| 7 | CPF-249 | 62.53ab | 2.88a | 102.96 | 93.21abc | 21.00b |
| 8 | SPF-234 | 53.95c | 2.73ab | 101.95 | 91.97abc | 20.00c |
| LSD 0.05 | | 6.90 | 0.73 | NS | 17.67 | 0.98 |

Values with different letter(s) differ significantly (P=0.05)

### 3. FINAL VARIETAL TRIAL

This trial was conducted to evaluate the biometric and quantitative performance of eight (08) clones against one standard variety viz. SPF-234. The experiment was laid out in RCBD three repeats with net plot size of 3.6 m x 10 m. Out of eight clones, one (S2008-AUS-133) was promoted as it exhibited better cane yield and sugar recovery as compared to standard varieties (Table-6.3). Whereas two were rejected due poor growth and cane yield and five were retained for further studies.

**Table-6.3**. **Performance of sugarcane varieties under Final varietal trial (2019-20)**

| S. No | Variety | Germin-ation % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | S2008-FD-19 | 59.57ab | 2.20ab | 103.18ab | 93.06bc | 21.33abc |
| 2 | S2008-M-42 | 63.10a | 2.60ab | 106.30ab | 97.43abc | 23.00a |
| 3 | S2006-US-658 | 59.38ab | 1.91b | 99.07ab | 95.18bc | 22.33ab |
| 4 | S2008-AUS-133 | 62.13a | 2.15ab | 103.12ab | 110.68a | 20.67bc |
| 5 | S2008-AUS-134 | 55.49bc | 2.08ab | 109.01a | 101.57ab | 21.67abc |
| 6 | S2008-AUS-138 | 59.44ab | 1.77b | 100.96ab | 101.61ab | 22.33ab |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | S2009-SA-57 | 49.63c | 2.90a | 86.97b | 86.85c | 21.00bc |
| 8 | SPF-234 | 40.62d | 2.52ab | 98.89ab | 91.97bc | 20.00c |
| LSD 0.05 | | 6.21 | 0.92 | 20.70 | 13.98 | 1.68 |

Values with different letter(s) differ significantly (P=0.05)

## 4. ZONAL VARIETAL TRIAL

This trial consisted of eight sugarcane strains planted for their quantitative as well as qualitative evaluation under extended growth period by planting them in the month of September. The genotypic trial was laid out in RCBD with a net plot size of 3.6 x 10 m and three replications. The promising sugarcane clone CPF-246 surpassed the list in cane yield (Table-6.4) by producing 102.19 t/ha stripped canes and also surpassed the list in field brix (22.67%).

**Table-6.4**. **Performance of sugarcane varieties under Zonal varietal trial (2019-20)**

| S. No | Variety | Germin-ation % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | CPF-246 | 68.21a | 3.2ab | 103.89ab | 102.19a | 22.67a |
| 2 | SO2US-133 | 64.75ab | 2.51bcd | 93.52abcd | 79.08bc | 22.67a |
| 3 | CPF-247 | 61.60bcd | 2.3cd | 88.05bcd | 74.62c | 21.00bc |
| 4 | VMC-87-599 | 64.82ab | 2.36cd | 93.98abcd | 90.83ab | 19.67c |
| 5 | CPF-248 | 63.77abc | 2.25 cd | 101.94abc | 91.57ab | 21.33ab |
| 6 | SO9SA-111 | 57.16d | 1.80d | 83.80d | 75.28c | 22.33ab |
| 7 | CPF-249 | 58.76cd | 3.42a | 107.13a | 98.04a | 22.00ab |
| 8 | SO8M-42 | 59.93bcd | 2.97abc | 86.66cd | 82.33bc | 22.00ab |
| LSD 0.05 | | 5.36 | 0.83 | 16.57 | 12.75 | 1.60 |

Values with different letter(s) differ significantly (P=0.05)

## 5. National Uniform Varietal Yield Trial (2017-19)

A trial comprising of ten (10) sugarcane varieties was conducted to check their performance for qualitative and quantitative traits in national varietal trial against standard varieties SPF-234 and HSF- 240. The experiment was planted according to RCBD with three replications. The genotype S02-US-133 yielded highest cane tonnage of 130.19 t ha$^{-1}$ as against the lowest (71.82 t ha$^{-1}$) for S08-M-42. Maximum field brix (22.67%) was recorded for S02-US-133 whereas lowest (19.67%) was observed for TH-1312 (Table-6.5).

**Table-6.5. National Uniform Varietal Yield Trial of Sugarcane [2017-19(1)]**

| S. No | Variety | Germination % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | S08-M-42 | 62.11a | 2.96abc | 105.36ab | 71.82c | 22.67a |
| 2 | S05-US-54 | 49.26c | 3.04ab | 98.72b | 63.33c | 19.33c |
| 3 | S03-US-127 | 58.33ab | 2.19cd | 127.36ab | 114.73ab | 22.33ab |
| 4 | S02-US-133 | 53.15bc | 2.66bc | 131.30ab | 130.19a | 22.67a |
| 5 | S08-US-633 | 60.12ab | 3.01ab | 133.74a | 125.68a | 22.33ab |
| 6 | S08-AUS-133 | 62.53a | 1.66d | 99.05b | 116.18a | 22.33ab |
| 7 | TH-1312 | 61.60a | 2.49bc | 121.96ab | 113.49ab | 19.67c |
| 8 | TH-1412 | 28.76d | 3.18ab | 110.99ab | 82.22bc | 21.67ab |
| 9 | HSF-240 | 56.48abc | 3.47a | 123.45ab | 127.89a | 21.00abc |
| 10 | SPF-234 | 55.80abc | 2.83abc | 117.13ab | 130.28a | 20.67bc |
| LSD 0.05 | | 7.64 | 0.79 | 15.94 | 15.86 | 1.69 |

Values with different letter(s) differ significantly (P=0.05)

## 6. NATIONAL UNIFORM VARIETAL YIELD TRIAL (2018-20)

A trial comprising of fifteen (15) sugarcane varieties was conducted to check their performance for qualitative and quantitative traits in national varietal trial against standard varieties SPF-234 and CPF-249. The experiment was planted according to RCBD with three replications. The genotype SLSG-1283 yielded highest cane tonnage of 145.96 t ha$^{-1}$ as against the lowest (85.91 t ha$^{-1}$) for CPTJ-1549. Maximum field brix (22.33%) was recorded for CPTJ-349 whereas lowest (17.00%) was observed for SLTH-1510 (Table-6.6).

**Table-6.6. National Uniform Varietal Yield Trial of Sugarcane [2018-20(11)]**

| Sr. #. | Variety | Germination % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | SLTH-1510 | 61.11a | 1.45cde | 123.80ab | 98.34defg | 17.00e |
| 2 | CPFG-14 | 43.42cd | 2.36a | 107.50bc | 133.51ab | 19.00cde |
| 3 | CPFG-16 | 42.43d | 2.37a | 121.11ab | 91.61efg | 18.33cde |
| 4 | VMC-87-599 | 59.75a | 1.33de | 135.76a | 131.13ab | 18.67cde |
| 5 | S-2009-SA-111 | 46.64cd | 1.14e | 113.70abc | 88.20efg | 18.00de |
| 6 | S-96-SP-302 | 57.72a | 1.01e | 133.72a | 131.02ab | 17.33e |
| 7 | LAMPTJ-76-803 | 59.81a | 1.95abcd | 130.09ab | 120.59bc | 19.00cde |
| 8 | CPTJ-349 | 55.00ab | 1.71abcd | 107.22bc | 114.47bcd | 22.33a |
| 9 | CPTJ-1549 | 59.93a | 1.32de | 108.98bc | 85.91fg | 19.00cde |
| 10 | SPF-234 | 48.33bcd | 2.25ab | 122.78ab | 122.46bc | 19.67bcd |
| 11 | CPF-249 | 49.38bc | 2.12abc | 118.98abc | 108.99cde | 20.33abc |
| 12 | SLSG-1283 | 30.27e | 1.41cde | 125.84ab | 145.96a | 22.33a |
| 13 | CPSG-2718 | 20.86f | 1.63bcde | 117.96abc | 119.56bcd | 21.67ab |
| 14 | CPSG-2415 | 35.61e | 1.59bcde | 133.33a | 102.65cdef | 20.00bcd |
| 15 | MH-91-CP-582 | 31.85 e | 1.46cde | 97.78c | 80.14g | 21.33ab |
| | LSD 0.05 | 6.70 | 0.71 | 23.07 | 21.81 | 2.18 |

Values with different letter(s) differ significantly (P=0.05)

## 7. WATER USE EFFICIENCY TRIAL

Sugarcane is a water loving crop. The present study was conducted to explore the water use efficiency of five irrigation levels for sugarcane crop. The experiment was planted in RCBD with three replications and a net plot size of 7.2 x 10 m. Five levels of irrigation were maintained in this study All strips irrigation (14Nos.) enhanced the yield (104.00 t/ha) of SPF-234 (Table-6.7).

**Table-6.7. Water use efficiency trial (2019-20)**

| S. No | Variety | Germin-ation % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| 1 | Alternate strip irrigation(16 No) | 63.29 | 2.08 | 94.52 | 74.46b | 20.67 |
| 2 | All strips irrigations(12 No) | 64.78 | 2.38 | 104.03 | 97.02ab | 20.33 |
| 3 | All strips irrigations(14 No) | 70.88 | 3.01 | 111.67 | 104.00a | 20.00 |
| 4 | All strips irrigations(16 No) | 62.77 | 2.87 | 102.57 | 84.82ab | 19.67 |
| 5 | All strips irrigations(18 No) | 66.20 | 3.10 | 93.75 | 87.01ab | 20.00 |
| LSD 0.05 | | NS | 0.64 | NS | 24.69 | NS |

Values with different letter(s) differ significantly (P=0.05)

## 8. SOWING METHOD TRIAL OF SUGARCANE

This trial has been conducted to quantify the impact of different sowing methods on growth and yield of sugarcane crop. The trial was laid out in RCBD with a net plot size of 6 x 7.5 m and three replications. Five treatments Pit planting (2 x 2 ft), Trench planting (RxR=4ft), Ladder planting (RxR=4ft), Trench planting (RxR=4ft) followed by planking at wattar and early hill planting (RxR=2.5ft) were included in the trial. Maximum cane yield of 108.85 t/ha was given by pit planting method followed by trench planting with planking 102.73 t/ha (Table-6.8).

**Table-6.8. Sowing Method Trial of Sugarcane (2019-20)**

| S. No | Treatment | Germin-ation % | Tillers Plant$^{-1}$ | Cane stand 000/ha | Cane Yield t/ha | Field Brix (%) |
|---|---|---|---|---|---|---|
| $P_1$ | Pit planting | 60.18a | 2.07b | 128.61 | 108.85a | 19.33 |
| $P_2$ | Ladder Planting | 56.25a | 1.93b | 114.21 | 87.94c | 19.67 |
| $P_3$ | Early Hill Planting | 35.23b | 3.18a | 131.34 | 94.76bc | 20.00 |
| $P_4$ | Rumber planting | 39.72b | 2.94a | 131.25 | 102.73a | 20.67 |
| $P_5$ | Trench Planting | 55.73a | 2.01b | 121.16 | 100.96ab | 20.33 |
| LSD 0.05 | | 6.80 | 0.86 | N.S | 7.91 | NS |

Values with different letter(s) differ significantly (P=0.05).