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Abstract

Plant Breeding & Genetics Section develops new cotton varieties or lines with desirable fibre traits equipped with inbuilt resistance/tolerance against insect-pest and diseases by utilizing purposeful breeding (crossing) of closely or distantly related genotypes. Plants are cross-bred to introduce traits/genes from one variety or line into a new genetic background. The promising hybrids, Bt. and non-Bt.. strains (in coded form) of all the cotton breeders of the country were evaluated under National Coordinated Variety Testing (NCVT) Program of Pakistan Central Cotton Committee. The prominent commercial varieties (Bt. and non-Bt.) were also tested for their performance under the local agro-climatic conditions of Multan zone in standard varietal trials. The breeding materials in different filial generations were screened out for selection into next generation. Major emphasis was laid on the selection of material having resistance/tolerance against biotic (Cotton Leaf Curl Virus (CLCuV), Pink boll worm etc) and abiotic factors (tolerance against heat-drought and Glyphosate etc) with excellent fibre characteristics. The genetic stock of World Cotton collections comprising of 6243 cultivars of four species of Gossypium from 41 countries of the World are being preserved for short (25 years), medium (50 years) and long (100 years) duration as well as for utilization in breeding program by cotton breeders in the country and abroad. Promising lines i.e. Bt.CIM-990 and Bt.CIM-909 developed by utilizing USDA and local cotton germplasm material were tested for second and first years respectively in NCVT. Trainings were also imparted to small farmers, progressive growers from core and non-core zones of the cotton belts along with technical staffs of different seed companies. Students from different universities were also trained thorough internship training program. Summary of above mentioned activities are given below.

Keywords: NCVT; Selection and Early Generation Testing in Cotton Genotypes

PLANT BREEDING & GENETICS SECTION

Plant Breeding & Genetics Section develops new cotton varieties or lines with desirable fibre traits equipped with inbuilt resistance/tolerance against insect-pest and diseases by utilizing purposeful
breeding (crossing) of closely or distantly related genotypes. Plants are cross-bred to introduce traits/genes from one variety or line into a new genetic background.

The promising hybrids, Bt. and non-Bt. strains (in coded form) of all the cotton breeders of the country were evaluated under National Coordinated Variety Testing (NCVT) Program of Pakistan Central Cotton Committee. The prominent commercial varieties (Bt. and non-Bt.) were also tested for their performance under the local agro-climatic conditions of Multan zone in standard varietal trials. The breeding materials in different filial generations were screened out for selection into next generation. Major emphasis was laid on the selection of material having resistance/tolerance against biotic (Cotton Leaf Curl Virus (CLCuV), Pink boll worm etc) and abiotic factors (tolerance against heat-drought and Glyphosate etc) with excellent fibre characteristics. The genetic stock of World Cotton collections comprising of 6243 cultivars of four species of Gossypium from 41 countries of the World are being preserved for short (25 years), medium (50 years) and long (100 years) duration as well as for utilization in breeding program by cotton breeders in the country and abroad. Promising lines i.e. Bt.CIM-990 and Bt.CIM-909 developed by utilizing USDA and local cotton germplasm material were tested for second and first years respectively in NCVT. Trainings were also imparted to small farmers, progressive growers from core and non-core zones of the cotton belts along with technical staffs of different seed companies. Students from different universities were also trained thorough internship training program. Summary of above mentioned activities are given below.

Testing of new strains
2.1.1 Varietal Trial-1

Objective: Testing and evaluation of promising medium long staple Bt. strains for the development of commercial varieties

Nine medium long staple promising Bt. strains viz., Bt.CIM-793 - Bt.CIM-801, were evaluated against one commercial variety Bt.CIM-663 at CCRI, Multan. Data of seed cotton yield and other parameters are given in Tables 2.1.

The strain Bt.CIM-798 produced the highest seed cotton yield of 2475 kg ha⁻¹ followed by Bt.CIM-795 having yield 2341 kg ha⁻¹ while the standard variety Bt.CIM-663 yielded 1956 kg ha⁻¹. (Table 2.1).

The new strain Bt.CIM-800 produced the highest lint percentage of 42.4 followed by Bt.CIM-801 having lint percentage values of 41.2 compared with the standard Bt.CIM-663 i.e. 39.0 (Table 2.1). The new strain Bt.CIM-795 produced the longest staple of 28.7 mm, followed by Bt.CIM-793 with 28.6 mm while the standard Bt.CIM-663 produced 27.2 mm of staple length (Table 2.1).

All the new strains possess desirable micronaire value ranging from 4.0 to 4.9 in comparison to Bt.CIM-663 with 4.9. The fiber strength of all the new strains and standard are in the desirable range, i.e., 26.2 to 28.7 g/tex (Table 2.1).

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Seed Cotton Yield (kg ha⁻¹)</th>
<th>Lint (% age)</th>
<th>Staple length (mm)</th>
<th>Micronaire value</th>
<th>Fibre strength (g/tex)</th>
<th>Av. boll wt. (g)</th>
<th>Plant Pop. (ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bt. CIM-793</td>
<td>1845</td>
<td>38.5</td>
<td>28.6</td>
<td>4.8</td>
<td>27.8</td>
<td>3.2</td>
<td>28604</td>
</tr>
<tr>
<td>2.</td>
<td>Bt. CIM-794</td>
<td>1749</td>
<td>39.3</td>
<td>28.3</td>
<td>4.5</td>
<td>27.8</td>
<td>3.2</td>
<td>32639</td>
</tr>
</tbody>
</table>
3. *Bt. CIM-795* 2341 38.0 28.7 4.0 27.5 2.8 28693
4. *Bt. CIM-796* 2025 40.4 27.8 4.9 26.8 2.9 32011
5. *Bt. CIM-797* 2114 39.9 27.5 4.1 28.7 2.5 30397
6. *Bt. CIM-798* 2475 37.7 27.5 4.5 26.2 2.7 28693
7. *Bt. CIM-799* 2213 40.2 27.6 4.8 27.0 2.9 34611
8. *Bt. CIM-800* 1980 42.4 26.8 4.9 26.2 2.6 26183
9. *Bt. CIM-801* 2049 41.2 28.1 4.8 28.5 2.9 35060
10. *Bt. CIM-663* 1956 39.0 27.2 4.9 25.9 3.0 35060

Sowing date 01.04.2022, CD (5%) for seed cotton: Strains =356.65; CV % =10.75

### 2.1.2 Varietal Trial-2

**Objective:** Testing and evaluation of promising strains with high ginning out turn for the Development of commercial varieties

Nine new strains with medium-long staple viz., *Bt.CIM-782, Bt.CIM-783, Bt.CIM-784, Bt.CIM-787, Bt.CIM-802, Bt.CIM-803, Bt.CIM-804, Bt.CIM-805, Bt.CIM-806* and *Bt.CIM-663* were tested at CCRI, Multan and Punjab Seed Corporation Farm, Khanewal against a commercial variety *Bt.CIM-602.*

Data presented in **Table 2.4** showed that averaged across locations the new strain *Bt.CIM-782* produced the highest seed cotton yield of 2367 kg ha\(^{-1}\), followed by *Bt.CIM-806* with 2128 kg ha\(^{-1}\) while the standard varieties *Bt.CIM-602* produced 777 kg ha\(^{-1}\).

The strain *Bt.CIM-804* had the highest lint percentage of 44.3, followed by 43.4% of *Bt.CIM-782* in comparison to the commercial varieties *Bt.CIM-602* produced 43.3 lint percentages. The strain *Bt.CIM-802* produced the longest staple of 29.8 mm followed by *Bt.CIM-787* having 29.5 mm (**Table 2.5**) while standard *Bt.CIM-602* produced 27.8 mm staple length.

All the strains possess desirable micronaire value ranging from 4.0 to 4.8. The fibre strength of the strains ranged from 26.0 to 28.5 g/tex (**Table 2.6**).

**Table 2.2** Performance of advanced strains in Varietal Trial-2

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Seed Cotton Yield (kg ha(^{-1}))</th>
<th>Lint (% age)</th>
<th>Staple length (mm)</th>
<th>Micronaire value</th>
<th>Fibre strength (g/tex)</th>
<th>Av. boll wt. (g)</th>
<th>Plant Pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Bt. CIM-782</em></td>
<td>2367</td>
<td>43.4</td>
<td>28.3</td>
<td>4.8</td>
<td>26.6</td>
<td>2.9</td>
<td>33356</td>
</tr>
<tr>
<td>2</td>
<td><em>Bt. CIM-783</em></td>
<td>1728</td>
<td>42.8</td>
<td>28.1</td>
<td>4.5</td>
<td>27.1</td>
<td>3.4</td>
<td>19996</td>
</tr>
<tr>
<td>3</td>
<td><em>Bt. CIM-784</em></td>
<td>1527</td>
<td>39.1</td>
<td>28.5</td>
<td>4.0</td>
<td>26.9</td>
<td>2.9</td>
<td>26900</td>
</tr>
<tr>
<td>4</td>
<td><em>Bt. CIM-787</em></td>
<td>1703</td>
<td>42.3</td>
<td>29.5</td>
<td>4.5</td>
<td>28.5</td>
<td>4.3</td>
<td>25107</td>
</tr>
<tr>
<td>5</td>
<td><em>Bt. CIM-802</em></td>
<td>1795</td>
<td>42.1</td>
<td>29.8</td>
<td>4.7</td>
<td>26.8</td>
<td>3.3</td>
<td>30756</td>
</tr>
<tr>
<td>6</td>
<td><em>Bt. CIM-803</em></td>
<td>1616</td>
<td>42.7</td>
<td>29.4</td>
<td>4.4</td>
<td>28.4</td>
<td>3.1</td>
<td>28873</td>
</tr>
<tr>
<td>7</td>
<td><em>Bt. CIM-804</em></td>
<td>1289</td>
<td>44.3</td>
<td>29.1</td>
<td>4.2</td>
<td>28.3</td>
<td>3.3</td>
<td>23493</td>
</tr>
<tr>
<td>8</td>
<td><em>Bt. CIM-805</em></td>
<td>1649</td>
<td>43.0</td>
<td>28.9</td>
<td>4.4</td>
<td>27.5</td>
<td>3.5</td>
<td>23941</td>
</tr>
<tr>
<td>9</td>
<td><em>Bt. CIM-806</em></td>
<td>2128</td>
<td>42.3</td>
<td>29.3</td>
<td>4.3</td>
<td>28.5</td>
<td>3.1</td>
<td>29859</td>
</tr>
<tr>
<td>10</td>
<td><em>Bt. CIM-663</em></td>
<td>777</td>
<td>43.3</td>
<td>27.8</td>
<td>4.7</td>
<td>26.0</td>
<td>3.0</td>
<td>23672</td>
</tr>
</tbody>
</table>

Sowing date 19.05.2020 C.V =6.68
CD (5%) for seed cotton: Locations (L) = 87.713; Varieties (V) = 170.60; \( L \times V = 181.05 \)

### 2.1.3 Varietal Trial-3

**Objective:** Testing and evaluation of promising medium long staple \( Bt. \) strains for the development of commercial varieties

Nine medium staple promising \( Bt. \) strains \( Bt. \).CIM-807, \( Bt. \).CIM-808, \( Bt. \).CIM-809, \( Bt. \).CIM-810, \( Bt. \).CIM-811, \( Bt. \).CIM-812, \( Bt. \).CIM-813 were evaluated against commercial variety \( Bt. \).CIM-663 at CCRI, Multan. Data on seed cotton yield and other parameters are given in **Tables 2.7**.

The strain \( Bt. \).CIM-810 produced the highest seed cotton yield of \( 2182 \) kg ha\(^{-1}\) followed by \( Bt. \).CIM-807 having yield of \( 1912 \) kg ha\(^{-1}\) while the standards \( Bt. \).CIM-663 produced yield of \( 923 \) kg ha\(^{-1}\) (**Table 2.7**).

**Table 2.7** Performance of advanced strains in Varietal Trial-3

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Plant Pop. (ha-1)</th>
<th>SCY (Kg/ha)</th>
<th>Av. Boll Weight (g)</th>
<th>GOT%</th>
<th>Staple Length (mm)</th>
<th>Uniformity Index %</th>
<th>Mic</th>
<th>Fiber Strength (g/tex) 1/8&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-807</td>
<td>27795</td>
<td>1912</td>
<td>3.0</td>
<td>41.9</td>
<td>28.1</td>
<td>83.3</td>
<td>4.7</td>
<td>29.0</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-808</td>
<td>24119</td>
<td>1418</td>
<td>2.8</td>
<td>43.4</td>
<td>24.4</td>
<td>81.5</td>
<td>6.1</td>
<td>21.7</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-809</td>
<td>25105</td>
<td>1238</td>
<td>2.7</td>
<td>42.7</td>
<td>25.8</td>
<td>82.2</td>
<td>5.5</td>
<td>23.0</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-810</td>
<td>37120</td>
<td>2182</td>
<td>3.2</td>
<td>43.2</td>
<td>28.3</td>
<td>84.2</td>
<td>5.1</td>
<td>27.1</td>
</tr>
<tr>
<td>5.</td>
<td>CIM-811</td>
<td>30485</td>
<td>1685</td>
<td>2.5</td>
<td>40.5</td>
<td>25.7</td>
<td>82.9</td>
<td>5.0</td>
<td>25.4</td>
</tr>
<tr>
<td>6.</td>
<td>CIM-812</td>
<td>17663</td>
<td>1146</td>
<td>2.4</td>
<td>36.0</td>
<td>27.9</td>
<td>83.8</td>
<td>4.2</td>
<td>28.0</td>
</tr>
<tr>
<td>7.</td>
<td>CIM-813</td>
<td>15242</td>
<td>1147</td>
<td>2.6</td>
<td>42.0</td>
<td>27.0</td>
<td>83.6</td>
<td>5.0</td>
<td>26.7</td>
</tr>
<tr>
<td>8.</td>
<td>CIM-663</td>
<td>30126</td>
<td>923</td>
<td>2.6</td>
<td>36.9</td>
<td>25.0</td>
<td>81.9</td>
<td>4.9</td>
<td>24.3</td>
</tr>
</tbody>
</table>

**Sowing date 15.04.2022,**

The new strains \( Bt. \).CIM-808 produced the highest GOT% of 43.4, followed by \( Bt. \).CIM-810 having lint percentage value of 43.2 (**Table 2.7**). \( Bt. \).CIM-810 produced the longest staple of 28.3 mm, followed by \( Bt. \).CIM-807 with 28.1 mm while the standards \( Bt. \).CIM-663 produced 25.0 mm staple length (**Table 2.7**).

All the new strains possess desirable micronaire values ranging from 4.2 to 5.1 except \( Bt. \).CIM-808 and \( Bt. \).CIM-809. The fibre strength of all the new strains and standard is in the range of 21.7 to 29.0 g/tex (**Table 2.7**).

### 2.1.4 Varietal Trial-4

**Objective:** Testing and evaluation of promising medium long staple \( Bt. \) strains for the development of commercial varieties

Eight medium staple promising \( Bt. \) strains \( Bt. \).CIM-785, \( Bt. \).CIM-759, \( Bt. \).CIM-778, \( Bt. \).CIM-762, \( Bt. \).CIM-792, \( Bt. \).CIM-781, and \( Bt. \).CIM-782, were evaluated against commercial variety \( Bt. \).CIM-663 at CCRI, Multan. Data on seed cotton yield and other parameters are given in **Tables 2.7, 2.8 and 2.9**.

Averaged across location, the strain \( Bt. \).CIM-792 produced the highest seed cotton yield of \( 3536 \) kg ha\(^{-1}\) followed by \( Bt. \).CIM-782 having yield of \( 3201 \) kg ha\(^{-1}\) while the standard \( Bt. \).CIM-663 produced \( 2366 \) kg ha\(^{-1}\) yield (**Table 2.7**).
Table 2.8  Performance of advanced strains in Varietal Trial-4 at Central Cotton Research Institute, Multan

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Seed cotton yield (kg ha(^{-1}))</th>
<th>Boll weight (g)</th>
<th>Plant Pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-758</td>
<td>2893</td>
<td>3.2</td>
<td>26181</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-759</td>
<td>2812</td>
<td>3.1</td>
<td>25064</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-778</td>
<td>2560</td>
<td>3.2</td>
<td>27169</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-762</td>
<td>2508</td>
<td>3.0</td>
<td>39543</td>
</tr>
<tr>
<td>5.</td>
<td>CIM-792</td>
<td>3536</td>
<td>3.0</td>
<td>32818</td>
</tr>
<tr>
<td>6.</td>
<td>CIM-781</td>
<td>2509</td>
<td>3.1</td>
<td>33087</td>
</tr>
<tr>
<td>7.</td>
<td>CIM-782</td>
<td>3201</td>
<td>3.2</td>
<td>36584</td>
</tr>
<tr>
<td>8.</td>
<td>CIM-663</td>
<td>2366</td>
<td>3.2</td>
<td>32011</td>
</tr>
</tbody>
</table>

* Sowing date = 16.04.2022  CV = 6.7%

CD (5%) for seed cotton: Locations (L) = 57.57; Varieties (V) = 128.73; L x V = 182.05

The new strains *Bt.* CIM-672 produced the highest lint percentage of 41.4, followed by *Bt.* CIM-782 having lint percentage value of 40.8 (Table 2.8). The new strains *Bt.* CIM-792 produced the longest staple of 29.4 mm, followed by *Bt.* CIM-759 with 29.0 mm while the standard *Bt.* CIM-663 produced 27.8 mm staple length (Table 2.8).

All the new strains possess desirable micronaire values ranging from 4.8 to 5.0 including the standard *Bt.* CIM-663. The fibre strength of all the new strains and standard is in the desirable range. (Table 2.9).

Table 2.9 Lint percentage and staple length of advanced strains in Varietal Trial-4 at Central Cotton Research Institute, Multan

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Lint (%) age</th>
<th>Staple Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-785</td>
<td>40.3</td>
<td>28.8</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-759</td>
<td>40.7</td>
<td>29.0</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-778</td>
<td>40.2</td>
<td>27.0</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-762</td>
<td>41.4</td>
<td>27.6</td>
</tr>
<tr>
<td>5.</td>
<td>CIM-792</td>
<td>39.0</td>
<td>29.4</td>
</tr>
<tr>
<td>6.</td>
<td>CIM-781</td>
<td>40.6</td>
<td>26.9</td>
</tr>
<tr>
<td>7.</td>
<td>CIM-782</td>
<td>40.8</td>
<td>28.2</td>
</tr>
<tr>
<td>8.</td>
<td>CIM-663</td>
<td>39.4</td>
<td>27.8</td>
</tr>
</tbody>
</table>

Table 2.10. Micronaire value and fibre strength of advanced strains in Varietal Trial-4 at Central Cotton Research Institute, Multan,

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Micronaire value</th>
<th>Fibre strength (g/tex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-758</td>
<td>4.9</td>
<td>27.3</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-759</td>
<td>4.8</td>
<td>27.5</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-778</td>
<td>4.7</td>
<td>28.1</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-762</td>
<td>4.8</td>
<td>27.1</td>
</tr>
</tbody>
</table>
2.2.1 Micro Varietal Trial-1
Objective: Testing of newly bulked medium staple *Bt.* strains to develop Commercial varieties
Nine newly bulked strains numbering from MV-1/22 to MV-9/22 were tested against commercial variety *Bt.*CIM-663 at CCRI, Multan for the second year. The strain MV-4/22 surpassed all the strains and standard variety in seed cotton yield by producing 2582 kg ha\(^{-1}\) followed by MV-1/22 with 2264 kg ha\(^{-1}\) compared with 1469 kg ha\(^{-1}\) of *Bt.*CIM-663 (Table 2.10).
The strain MV-7/22 produced the highest GOT% of 44.2 followed by 42.9 percent in MV-2/22 and MV-4/22 while the commercial variety *Bt.*CIM-663 produced the GOT% of 40.1. The strain MV-1/22 and MV-7/22 produced the longest staple of 28.5 mm, followed by 28.0 mm in MV-4/22 compared with the fibre length of 25.2 mm in commercial variety *Bt.*CIM-663. Micronaire values of all the strains are in acceptable limit except MV-2/22 and MV-3/22. The strain MV-7/22 maintained the maximum fibre strength of 29.5 g/tex, followed by 29.3 g/tex in MV-1/22 while standard *Bt.*CIM-663 had 25.5 g/tex.

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>SCY (Kg/ha)</th>
<th>GOT%</th>
<th>Staple Length (mm)</th>
<th>Mike</th>
<th>Fiber Strength (g/tex) 1/8”</th>
<th>Av. Boll weight (g)</th>
<th>Plant Pop. (ha-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MV-1</td>
<td>2264</td>
<td>41.7</td>
<td>28.5</td>
<td>4.3</td>
<td>29.3</td>
<td>2.7</td>
<td>39809</td>
</tr>
<tr>
<td>2.</td>
<td>MV-2</td>
<td>1784</td>
<td>42.9</td>
<td>24.2</td>
<td>5.6</td>
<td>22.0</td>
<td>2.6</td>
<td>37299</td>
</tr>
<tr>
<td>3.</td>
<td>MV-3</td>
<td>1547</td>
<td>42.8</td>
<td>27.4</td>
<td>5.3</td>
<td>24.4</td>
<td>2.7</td>
<td>32816</td>
</tr>
<tr>
<td>4.</td>
<td>MV-4</td>
<td>2582</td>
<td>42.9</td>
<td>28.0</td>
<td>5.0</td>
<td>26.1</td>
<td>2.5</td>
<td>42679</td>
</tr>
<tr>
<td>5.</td>
<td>MV-5</td>
<td>1988</td>
<td>41.5</td>
<td>27.3</td>
<td>5.1</td>
<td>26.0</td>
<td>3.0</td>
<td>35685</td>
</tr>
<tr>
<td>6.</td>
<td>MV-6</td>
<td>2099</td>
<td>40.8</td>
<td>25.6</td>
<td>4.9</td>
<td>25.3</td>
<td>2.3</td>
<td>37837</td>
</tr>
<tr>
<td>7.</td>
<td>MV-7</td>
<td>1497</td>
<td>44.2</td>
<td>28.5</td>
<td>4.7</td>
<td>29.5</td>
<td>2.6</td>
<td>30485</td>
</tr>
<tr>
<td>8.</td>
<td>MV-8</td>
<td>1543</td>
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<td>27.1</td>
<td>3.9</td>
<td>28.0</td>
<td>2.4</td>
<td>28692</td>
</tr>
<tr>
<td>9.</td>
<td>MV-9</td>
<td>1483</td>
<td>35.4</td>
<td>27.1</td>
<td>3.9</td>
<td>28.0</td>
<td>2.7</td>
<td>24029</td>
</tr>
<tr>
<td>10.</td>
<td>CIM-663</td>
<td>1469</td>
<td>40.1</td>
<td>25.2</td>
<td>4.8</td>
<td>25.5</td>
<td>2.9</td>
<td>39809</td>
</tr>
</tbody>
</table>

Sowing date 30.03.2022

2.2.2 Micro Varietal Trial-2
Objective: Testing of newly bulked medium-long staple *Bt.* strains to develop commercial varieties
Nine newly bulked strains numbering from MV-10/22 to MV-18/22 were tested against commercial variety *Bt.*CIM-632 at CCRI, Multan. The new strain MV-16/22 surpassed all the strains and standard variety in seed cotton yield by producing 2315 kg ha\(^{-1}\), followed by MV-15/22 with 2269 kg ha\(^{-1}\) compared with 1281 kg ha\(^{-1}\) of *Bt.*CIM-602 (Table 2.11).
The strain MV-10/22 produced the highest lint percentage of 43.4 followed by 42.6 percent lint in MV-18/22 while the commercial variety Br.CIM-602 produced the lint percentage of 41.3. The strain 17/22 produced the longest staple of 29.2 mm, followed by 29.1 mm in MV-11/22 compared with the fibre length of 26.1 mm in commercial variety Br.CIM-602. All the strains have desirable micronaire and fiber strength values.

Table 2.12. Performance of advanced strains in Micro-Varietal Trial-2 at CCRI, Multan

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Seed Cotton Yield (kg ha(^{-1}))</th>
<th>Lint (% age)</th>
<th>Staple Length (mm)</th>
<th>Micronaire value</th>
<th>Fibre Strength (g/tex)</th>
<th>Av. boll wt. (g)</th>
<th>Plant Pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MV-10</td>
<td>1828</td>
<td>43.4</td>
<td>28.0</td>
<td>4.3</td>
<td>28.0</td>
<td>2.9</td>
<td>30128</td>
</tr>
<tr>
<td>2.</td>
<td>MV-11</td>
<td>1971</td>
<td>41.8</td>
<td>29.1</td>
<td>4.6</td>
<td>29.8</td>
<td>2.6</td>
<td>31921</td>
</tr>
<tr>
<td>3.</td>
<td>MV-12</td>
<td>1575</td>
<td>39.5</td>
<td>27.5</td>
<td>4.9</td>
<td>27.4</td>
<td>3.7</td>
<td>30307</td>
</tr>
<tr>
<td>4.</td>
<td>MV-13</td>
<td>1980</td>
<td>40.8</td>
<td>27.5</td>
<td>4.3</td>
<td>27.9</td>
<td>3.1</td>
<td>29052</td>
</tr>
<tr>
<td>5.</td>
<td>MV-14</td>
<td>2269</td>
<td>39.6</td>
<td>28.8</td>
<td>4.7</td>
<td>28.9</td>
<td>3.3</td>
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</tr>
<tr>
<td>6.</td>
<td>MV-15</td>
<td>1597</td>
<td>42.1</td>
<td>27.3</td>
<td>5.1</td>
<td>27.7</td>
<td>2.7</td>
<td>21879</td>
</tr>
<tr>
<td>7.</td>
<td>MV-16</td>
<td>2315</td>
<td>39.6</td>
<td>28.4</td>
<td>5.0</td>
<td>27.5</td>
<td>3.5</td>
<td>23313</td>
</tr>
<tr>
<td>8.</td>
<td>MV-17</td>
<td>1944</td>
<td>42.2</td>
<td>29.2</td>
<td>4.6</td>
<td>30.3</td>
<td>2.6</td>
<td>28693</td>
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<tr>
<td>9.</td>
<td>MV-18</td>
<td>2099</td>
<td>42.6</td>
<td>28.3</td>
<td>4.7</td>
<td>28.5</td>
<td>2.8</td>
<td>22775</td>
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<tr>
<td>10.</td>
<td>CIM-663</td>
<td>1281</td>
<td>41.3</td>
<td>26.1</td>
<td>5.0</td>
<td>26.8</td>
<td>2.9</td>
<td>25107</td>
</tr>
</tbody>
</table>

Sowing date 19.05.2020, CD (5%) for seed cotton = 275.15, CV. % = 6.90

2.2.3 Micro Varietal Trial-3

Objective: Testing of newly bulked medium-long staple strains to develop commercial varieties

Nine newly bulked strains numbering from MV-19/22 to MV-27/22 were tested against commercial variety Br.CIM-632 at CCRI, Multan. Data presented in Table 2.12 indicated that the new strain MV-25/22 surpassed all the new strains yielding 2344 kg ha\(^{-1}\), followed by strains MV-22/22 produced 2263 kg ha\(^{-1}\) while the standard Br.CIM-632 yielding 975 kg ha\(^{-1}\). The new strain MV-24/22 produced the lint percentage of 44.4 followed by MV-22/20 with 43.4 % in comparison to Br.CIM-632 having 42.6 lint percentages. The strains MV-20/22 has the longest staple of 29.8 mm followed by MV-19/22 and MV-26 with the staple of 29.1 mm compared with the staple length of 26.5 mm in standard variety Br.CIM-632. All the genotypes have desirable micronaire value except MV-23 and MV-27 where as fineness of standard CIM-663 is also undesirable. All the strains were showing fibre strengths ranging from 26.3 to 30.3 g/tex.

Table 2.13. Performance of advanced strains in Micro-Varietal Trial-3 at CCRI, Multan
2.2.4 Micro-Varietal Trial-4

Objective: Testing of medium long staple Bt. strains to develop commercial varieties

Seven newly bulked elite Bt. strains from MV-28/22 to MV-34/22 were tested against commercial variety Bt.CIM-663 at CCRI, Multan. Data on yield and other parameters are presented in Table 2.14.

The strain MV-28/22 out-yielded all the strains and standard variety by producing 2893 kg ha\(^{-1}\) seed cotton, followed by MV-29/22 having seed cotton yields of 2812 kg ha\(^{-1}\) against commercial variety Bt.CIM-663 which produced 2066 kg ha\(^{-1}\) seed cotton. The strain MV-2822 produced the higher lint percentage of 42.9 followed by MV-34/22 with 42.1% compared with that of 41.4% by Bt.CIM-663. The strain MV-33/22 produced the longest staple of 28.6 mm, followed by the 28.4 mm of strain MV-34/22 compared with the 28.4 mm of Bt.CIM-663. All the strains have desirable micronaire values ranging from 4.0 to 4.8. The fibre strength of all the new strains was observed within the range i.e. 26.0 to 28.0.

Table 2.14. Performance of advanced strains in Micro-Varietal Trial-4 at CCRI, Multan

<table>
<thead>
<tr>
<th>Sr.#</th>
<th>Strains</th>
<th>Seed Cotton Yield (kg ha(^{-1}))</th>
<th>Lint (% age)</th>
<th>Staple Length (mm)</th>
<th>Micronaire value</th>
<th>Fibre Strength (g/tex)</th>
<th>Av. boll weight (g)</th>
<th>Plant Pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MV-28/22</td>
<td>2893</td>
<td>42.9</td>
<td>28.1</td>
<td>4.8</td>
<td>26.8</td>
<td>2.9</td>
<td>36584</td>
</tr>
<tr>
<td>2.</td>
<td>MV-29/22</td>
<td>2812</td>
<td>41.7</td>
<td>28.3</td>
<td>4.7</td>
<td>26.3</td>
<td>2.7</td>
<td>23313</td>
</tr>
<tr>
<td>3.</td>
<td>MV-30/22</td>
<td>2560</td>
<td>39.1</td>
<td>27.6</td>
<td>4.8</td>
<td>28.0</td>
<td>2.7</td>
<td>32280</td>
</tr>
<tr>
<td>4.</td>
<td>MV-31/22</td>
<td>2508</td>
<td>40.0</td>
<td>27.1</td>
<td>4.6</td>
<td>27.6</td>
<td>3.3</td>
<td>35867</td>
</tr>
<tr>
<td>5.</td>
<td>MV-32/22</td>
<td>2236</td>
<td>39.2</td>
<td>27.6</td>
<td>4.8</td>
<td>27.9</td>
<td>3.1</td>
<td>37839</td>
</tr>
<tr>
<td>6.</td>
<td>MV-33/22</td>
<td>2250</td>
<td>41.8</td>
<td>28.6</td>
<td>4.0</td>
<td>27.2</td>
<td>2.5</td>
<td>35508</td>
</tr>
<tr>
<td>7.</td>
<td>MV-34/22</td>
<td>2201</td>
<td>42.1</td>
<td>28.4</td>
<td>4.2</td>
<td>27.1</td>
<td>2.8</td>
<td>32459</td>
</tr>
<tr>
<td>8.</td>
<td>Bt.CIM-663</td>
<td>2066</td>
<td>41.4</td>
<td>28.4</td>
<td>4.2</td>
<td>26.0</td>
<td>2.4</td>
<td>30307</td>
</tr>
</tbody>
</table>

Sowing date 01.04.2022, CD (5%) for seed cotton 212.65 CV. % = 9.18

2.2.5 Micro-Varietal Trial-5

Objective: Testing of medium long staple Bt. strains to develop commercial varieties
Eight newly bulked elite strains MV-36/22 to MV-42/22 were tested against commercial variety Bt.CIM-663 at CCRI, Multan. Data on yield and other parameters are presented in Table 2.15. The strain MV-39/22 out-yielded all the strains and standard variety by producing 2479 kg ha\(^{-1}\) seed cotton followed by MV-38/22 having seed cotton yields of 2250 kg ha\(^{-1}\) against commercial variety Bt.CIM-663 which produced 1845 kg ha\(^{-1}\) seed cotton. The strains MV-42/22 produced the higher lint percentage values of 42.1% followed by MV-41/22 with 42.0% compared with that of 40.2% by Bt.CIM-663.

The strain MV-36/22 and MV-41/22 produced the longest staple of 28.9 mm, followed by 28.8 mm in MV-38/22 compared with the fibre length of 27.7 mm in commercial variety Bt.CIM-663. All strains have desirable micronaire values ranging from 4.0 to 4.8. The strain MV-39/22 maintained the maximum fibre strength of 28.5 g/tex followed by MV-35/22 and MV-38/22 with 27.5 g/tex while standard Bt.CIM-663 had 26.7 g/tex fibre strength.

### Table 2.15 Performance of advanced strains in Micro-Varietal Trial-5 at CCRI, Multan

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Strains</th>
<th>Seed Cotton Yield (kg ha(^{-1}))</th>
<th>Lint (% age)</th>
<th>Staple Length (mm)</th>
<th>Micro-naire value</th>
<th>Fibre Strength (g/tex)</th>
<th>Av. boll weight (g)</th>
<th>Plant pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MV-35/22</td>
<td>1780</td>
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<td>28.1</td>
<td>4.0</td>
<td>27.7</td>
<td>2.9</td>
<td>40529</td>
</tr>
<tr>
<td>2.</td>
<td>MV-36/22</td>
<td>2044</td>
<td>40.5</td>
<td>28.9</td>
<td>4.1</td>
<td>26.7</td>
<td>2.6</td>
<td>31563</td>
</tr>
<tr>
<td>3.</td>
<td>MV-37/22</td>
<td>1493</td>
<td>41.9</td>
<td>27.9</td>
<td>4.5</td>
<td>26.2</td>
<td>2.8</td>
<td>38198</td>
</tr>
<tr>
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<td>MV-38/22</td>
<td>2250</td>
<td>40.0</td>
<td>28.8</td>
<td>4.8</td>
<td>27.5</td>
<td>2.6</td>
<td>39812</td>
</tr>
<tr>
<td>5.</td>
<td>MV-39/22</td>
<td>2479</td>
<td>41.8</td>
<td>28.1</td>
<td>4.8</td>
<td>28.5</td>
<td>2.5</td>
<td>40529</td>
</tr>
<tr>
<td>6.</td>
<td>MV-40/22</td>
<td>2094</td>
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<td>28.2</td>
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<td>27.2</td>
<td>2.6</td>
<td>39991</td>
</tr>
<tr>
<td>7.</td>
<td>MV-41/22</td>
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<td>28.9</td>
<td>4.0</td>
<td>26.3</td>
<td>2.5</td>
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</tr>
<tr>
<td>8.</td>
<td>MV-42/22</td>
<td>1875</td>
<td>42.1</td>
<td>28.8</td>
<td>4.6</td>
<td>26.3</td>
<td>2.6</td>
<td>39812</td>
</tr>
<tr>
<td>9.</td>
<td>Bt.CIM-663</td>
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<td>40.2</td>
<td>27.8</td>
<td>4.2</td>
<td>26.7</td>
<td>2.4</td>
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</tr>
</tbody>
</table>

Sowing date = 01.04.2022;  CD (5%) for seed cotton = 383.01; CV. % = 11.23

2.3 Coordinated Variety Testing Program

2.3.1 National Coordinated Varietal Trials (Set-B)

Objective: Testing of promising Bt. strains of different cotton breeders of Pakistan

Twenty three strains from different cotton breeders of the country were received under coded numbers from Director Research PCCC for evaluated at CCRI Multan. The data presented in Table 2.17 showed that the Shara-Klean-10 produced the highest seed cotton yield of 1600 kg ha\(^{-1}\), followed by CEMB-ASS-3 having 1479 kg ha\(^{-1}\) seed cotton yield while Bt.CIM-600 produced lowest yield 662 kg ha\(^{-1}\).

Data also revealed that the strain PC-2227 produced the highest lint percentage of 42.2, followed by PC-2234 with 42.1%. Strain PC-2233 produced the longest staple with 27.9 mm length followed by PC-2224 with 27.8 mm.

All strains have micronaire values ranging from 4.2 to 5.6. Maximum fibre strength was maintained by PC-2235 having 28.4 g/tex, followed by PC-2241 with 27.9 g/tex.
Table 2.17  Performance of different Bt. Strains of public Sector in National Coordinated Varietal Trial (Set-B) at CCRI, Multan

<table>
<thead>
<tr>
<th>Sr.#</th>
<th>Strains</th>
<th>Seed-cotton Yield (kg ha⁻¹)</th>
<th>Lint (%age)</th>
<th>Staple length (mm)</th>
<th>Micronaire value</th>
<th>Fibre strength (g/tex)</th>
<th>Boll Weight</th>
<th>Plant Pop. (ha⁻¹)</th>
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<tbody>
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<td>IUB-4</td>
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<td>20.4</td>
<td>2.5</td>
<td>42362</td>
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<td>42362</td>
</tr>
<tr>
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<td>Silver-Queen-33</td>
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<td>25.3</td>
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<td>2.6</td>
<td>42482</td>
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<tr>
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<tr>
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<td>2.3</td>
<td>38533</td>
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<td>15.</td>
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<td>23.7</td>
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<td>42721</td>
</tr>
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<td>CIM-600 (Bt. Standard)</td>
<td>662</td>
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<td>4.5</td>
<td>23.8</td>
<td>2.1</td>
<td>42242</td>
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<td>25.4</td>
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<td>Diamond-2024</td>
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<td>25.5</td>
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<td>1026</td>
<td>38.9</td>
<td>26.0</td>
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<td>22.6</td>
<td>2.7</td>
<td>42721</td>
</tr>
<tr>
<td>22.</td>
<td>FH-415</td>
<td>832</td>
<td>38.0</td>
<td>26.3</td>
<td>4.7</td>
<td>24.5</td>
<td>2.4</td>
<td>38543</td>
</tr>
<tr>
<td>23.</td>
<td>IR-NIBGE-20</td>
<td>1158</td>
<td>40.9</td>
<td>27.3</td>
<td>5.1</td>
<td>24.7</td>
<td>2.9</td>
<td>41046</td>
</tr>
</tbody>
</table>

Sowing date : 30-04-2022
2.4 Testing of Commercial Varieties

2.4.1 Standard Varietal Trial-1

Objective: To test the performance of commercial varieties of Pakistan under the agro-climatic conditions of Multan

Seven commercial Non Bt. varieties of the country were tested at CCRI, Multan. Data recorded on seed cotton yield and other parameters are presented in Table 2.18. The results indicated that varieties CIM-496 and CIM-482 excelled among all varieties by producing seed cotton yield 1421 kg ha\(^{-1}\) followed by the variety CIM-608 with 1396 kg. ha\(^{-1}\) seed cotton production. Variety CIM-608 had the highest lint percentage of 42.6, followed by variety Cyto-124 having lint percentage of 41.5. The variety CIM-608 maintained the staple length of 28.7 mm, followed by the variety the CIM-124 with 27.9 mm staple length.

Micronaire values of all the varieties were according to the standard. Fibre strength of all the genotypes was in the desirable range.

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Varieties</th>
<th>Year of released</th>
<th>Seed Cotton Yield (kg ha(^{-1}))</th>
<th>Lint (%)</th>
<th>Staple length (mm)</th>
<th>Micronaire value</th>
<th>Fibre Strength(g/tex)</th>
<th>Av. Boll wt. (g)</th>
<th>Plant Pop. (ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-482</td>
<td>2000</td>
<td>1421</td>
<td>39.9</td>
<td>27.0</td>
<td>4.7</td>
<td>27.7</td>
<td>2.4</td>
<td>29590</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-496</td>
<td>2005</td>
<td>1421</td>
<td>39.0</td>
<td>26.3</td>
<td>4.1</td>
<td>27.3</td>
<td>2.5</td>
<td>28155</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-573</td>
<td>2012</td>
<td>1236</td>
<td>40.2</td>
<td>26.3</td>
<td>4.7</td>
<td>25.3</td>
<td>2.6</td>
<td>29590</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-608</td>
<td>2013</td>
<td>1396</td>
<td>42.6</td>
<td>28.7</td>
<td>4.8</td>
<td>29.5</td>
<td>2.6</td>
<td>40171</td>
</tr>
<tr>
<td>5.</td>
<td>Cyto-124</td>
<td>2015</td>
<td>1326</td>
<td>41.5</td>
<td>27.9</td>
<td>4.8</td>
<td>28.3</td>
<td>2.8</td>
<td>34073</td>
</tr>
<tr>
<td>6.</td>
<td>CIM-620</td>
<td>2016</td>
<td>1025</td>
<td>40.2</td>
<td>27.1</td>
<td>4.4</td>
<td>27.7</td>
<td>2.5</td>
<td>27976</td>
</tr>
<tr>
<td>7.</td>
<td>CIM-610</td>
<td>2018</td>
<td>1243</td>
<td>40.0</td>
<td>27.0</td>
<td>4.8</td>
<td>27.8</td>
<td>2.6</td>
<td>30128</td>
</tr>
</tbody>
</table>

Sowing date = 01.04.2022, CD (5%) for seed cotton: 295.35, CV% = 9.90

2.4.2 Standard Varietal Trial-2

Objective: To test the performance of commercial Bt. varieties of Pakistan under the agro-climatic conditions of Multan

Ten Bt. commercial varieties of the country were tested at CCRI, Multan. Data recorded on seed cotton yield and other parameters are presented in Table 2.21. The results indicate that variety Bt.CIM-678 excelled among all varieties by producing seed cotton yield of 2433 kg ha\(^{-1}\), followed by the variety Bt.CIM-600 with 2151 kg ha\(^{-1}\) while Bt.CIM-598 produced lowest (1181 kg ha\(^{-1}\)) seed cotton production. Bt.Cyto-179 had the highest GOT% of 42.9, followed by Bt.CIM-678 showing 42.3%. Longest staple length of 28.9 observed in Bt.Cyto-535. Micronaire and fiber strength of all the varieties were up to the standard.
Table 2.21 Performance of commercial varieties in Standard Varietal Trial-2 at CCRI, Multan

<table>
<thead>
<tr>
<th>Sr.#</th>
<th>Strains</th>
<th>Plant Pop. (ha⁻¹)</th>
<th>SCY (Kg/ha)</th>
<th>Av. Boll weight (g)</th>
<th>GOT%</th>
<th>Staple Length (mm)</th>
<th>Uniformity Index %</th>
<th>Mike</th>
<th>Fiber Strength (g/tex) 1/8&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM-663</td>
<td>38853</td>
<td>1619</td>
<td>2.6</td>
<td>40.3</td>
<td>25.3</td>
<td>82.0</td>
<td>5.3</td>
<td>24.3</td>
</tr>
<tr>
<td>2.</td>
<td>CIM-602</td>
<td>35984</td>
<td>1874</td>
<td>2.3</td>
<td>38.0</td>
<td>27.6</td>
<td>80.7</td>
<td>4.4</td>
<td>28.0</td>
</tr>
<tr>
<td>3.</td>
<td>CIM-600</td>
<td>35267</td>
<td>2151</td>
<td>2.6</td>
<td>35.9</td>
<td>28.0</td>
<td>80.4</td>
<td>4.4</td>
<td>28.6</td>
</tr>
<tr>
<td>4.</td>
<td>CIM-598</td>
<td>39570</td>
<td>1181</td>
<td>2.4</td>
<td>41.6</td>
<td>28.2</td>
<td>81.0</td>
<td>4.5</td>
<td>29.0</td>
</tr>
<tr>
<td>5.</td>
<td>Cyto-179</td>
<td>41244</td>
<td>1717</td>
<td>2.8</td>
<td>42.9</td>
<td>25.3</td>
<td>81.2</td>
<td>4.8</td>
<td>26.1</td>
</tr>
<tr>
<td>6.</td>
<td>Cyto-535</td>
<td>24746</td>
<td>1734</td>
<td>3.4</td>
<td>41.0</td>
<td>28.9</td>
<td>82.7</td>
<td>4.6</td>
<td>29.7</td>
</tr>
<tr>
<td>7.</td>
<td>CRIS-508</td>
<td>41125</td>
<td>1459</td>
<td>2.0</td>
<td>31.8</td>
<td>25.8</td>
<td>80.8</td>
<td>3.3</td>
<td>27.5</td>
</tr>
<tr>
<td>8.</td>
<td>CIM-632</td>
<td>27855</td>
<td>1560</td>
<td>2.6</td>
<td>42.1</td>
<td>28.0</td>
<td>81.2</td>
<td>4.7</td>
<td>28.1</td>
</tr>
<tr>
<td>9.</td>
<td>CIM-785</td>
<td>38973</td>
<td>1836</td>
<td>2.8</td>
<td>41.7</td>
<td>27.7</td>
<td>81.8</td>
<td>5.0</td>
<td>27.4</td>
</tr>
<tr>
<td>10.</td>
<td>CIM-678</td>
<td>39331</td>
<td>2433</td>
<td>2.7</td>
<td>42.3</td>
<td>28.0</td>
<td>80.9</td>
<td>4.3</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Sowing date = 30.03.2022

2.5 Breeding Material

2.5.1 Selection from Breeding Material

Single plants were selected from the filial generation in different segregating populations for further testing and screening against biotic and a biotic stresses. Details of breeding material planted and number of plants selected during 2022-23 are given in Table 2.20.

Table 2.20 Detail of single plants selected from breeding material

<table>
<thead>
<tr>
<th>Generation/Trial</th>
<th>No. of plants Selected</th>
<th>Lint (%age)</th>
<th>Staple length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT</td>
<td>302</td>
<td>37.7-43.5</td>
<td>28.3-30.2</td>
</tr>
<tr>
<td>MVT</td>
<td>422</td>
<td>39.3-43.7</td>
<td>28.1-30.9</td>
</tr>
<tr>
<td>F₆ single lines</td>
<td>773</td>
<td>38.2-44.6</td>
<td>28.2-30.2</td>
</tr>
<tr>
<td>F₅ single lines</td>
<td>913</td>
<td>38.0-42.2</td>
<td>28.2-30.2</td>
</tr>
<tr>
<td>F₄ generation</td>
<td>1199</td>
<td>38.7-42.5</td>
<td>28.7-30.5</td>
</tr>
<tr>
<td>F₃ generation</td>
<td>1922</td>
<td>37.2-42.5</td>
<td>27.1-30.5</td>
</tr>
<tr>
<td>F₂ generation</td>
<td>2475</td>
<td>36.9-42.9</td>
<td>27.6-31.5</td>
</tr>
<tr>
<td>Others</td>
<td>637</td>
<td>37.3-45.6</td>
<td>27.1-32.7</td>
</tr>
</tbody>
</table>

2.5.2. Hybridization program

Detail of the crossing program of the Section for the development of breeding material to evolve cotton varieties of high yield potential equipped with desirable fibre traits and wider adoptability along with inbuilt resistance/tolerance against insect-pest. Details are given in Table-2.21-to 2.25.
Table-2.21. CROSS REFERENCE CHART F₁ HB-1 OF BREEDING AND GENETICS SECTION AT CENTRAL COTTON RESEARCH INSTITUTE, MULTAN DURING 2022-23

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Stage</th>
<th>Hybrid No.</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>02 x CKC-6</td>
<td>2298</td>
<td>CIM-343 x MNH-1090</td>
</tr>
<tr>
<td>06</td>
<td>04 x CKC-6</td>
<td>2297</td>
<td>CIM-343 x MNH-1090</td>
</tr>
<tr>
<td>05</td>
<td>05 x CKC-5</td>
<td>2295</td>
<td>CIM-343 x MNH-1090</td>
</tr>
<tr>
<td>07</td>
<td>07 x CKC-5</td>
<td>2296</td>
<td>CIM-343 x MNH-1090</td>
</tr>
<tr>
<td>08</td>
<td>08 x CKC-5</td>
<td>2294</td>
<td>CIM-343 x MNH-1090</td>
</tr>
</tbody>
</table>

Table-2.22. CROSS REFERENCE CHART F₁ HB-2 OF BREEDING AND GENETICS SECTION AT CENTRAL COTTON RESEARCH INSTITUTE, MULTAN DURING 2022-23

<table>
<thead>
<tr>
<th>Hybrid No.</th>
<th>Parentage</th>
<th>Hybrid No.</th>
<th>Parentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-2303</td>
<td>H-2371 x H-2240</td>
<td>H-2311</td>
<td>H-2378 x CM-11/23</td>
</tr>
<tr>
<td>H-2304</td>
<td>H-2372 x CKC-6</td>
<td>H-2312</td>
<td>H-2371 x CM-19/23</td>
</tr>
<tr>
<td>H-2305</td>
<td>H-2373 x CIM-790</td>
<td>H-2317</td>
<td>CIM-651 x Okara Leaf</td>
</tr>
<tr>
<td>H-2306</td>
<td>H-2373 x CIM-791 (Big Boll)</td>
<td>H-2313</td>
<td>H-2372 x Cyto-547</td>
</tr>
<tr>
<td>H-2307</td>
<td>H-2374 x CIM-790</td>
<td>H-2314</td>
<td>H-2373 x H-2377</td>
</tr>
<tr>
<td>H-2308</td>
<td>H-2375 x H-2385</td>
<td>H-2315</td>
<td>CIM-651 x Cyto-547</td>
</tr>
<tr>
<td>H-2309</td>
<td>H-2376 x H-2377</td>
<td>H-2316</td>
<td>CIM-651 x H-2373</td>
</tr>
<tr>
<td>H-2310</td>
<td>H-2377 x Okara Leaf</td>
<td>H-2317</td>
<td>CIM-651 x Okara Leaf</td>
</tr>
</tbody>
</table>

Table-2.23. CROSS REFERENCE CHART F₁ HB-3 OF BREEDING AND GENETICS SECTION AT CENTRAL COTTON RESEARCH INSTITUTE, MULTAN DURING 2022-23

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parentage</th>
<th>Sr. No.</th>
<th>Parentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-2318</td>
<td>Pronto X GH-Uhud</td>
<td>H-2329</td>
<td>GH-Sanabal x G. Okra</td>
</tr>
<tr>
<td>H-2319</td>
<td>SAS-1 x GH-Sanabal</td>
<td>H-2330</td>
<td>FH-189 x Cyto-537</td>
</tr>
<tr>
<td>H-2320</td>
<td>Pronto x GH-Sultan</td>
<td>H-2331</td>
<td>GH-Sanabal x MNH-1090</td>
</tr>
<tr>
<td>H-2321</td>
<td>CKC-2 x MNH-1090</td>
<td>H-2332</td>
<td>GH-Sultan x MNH-1090</td>
</tr>
<tr>
<td>H-2322</td>
<td>NIAB-868 x Cyto-537</td>
<td>H-2333</td>
<td>NIAB-868 x GH-Sanabal</td>
</tr>
<tr>
<td>H-2323</td>
<td>NIAB-868 x Cyto-537</td>
<td>H-2334</td>
<td>Cyto-533 x MNH-1090</td>
</tr>
<tr>
<td>H-2324</td>
<td>GH-Sanabal x GH-Hamalia</td>
<td>H-2335</td>
<td>SAS-1 x GH-Hadi</td>
</tr>
<tr>
<td>H-2325</td>
<td>GH-Sanabal x MNH-1090</td>
<td>H-2336</td>
<td>SAS-1 x GH-Sanabal</td>
</tr>
<tr>
<td>H-2326</td>
<td>SASI x Cyto-537</td>
<td>H-2337</td>
<td>Cyto-535 x MNH-1090</td>
</tr>
<tr>
<td>H-2327</td>
<td>GH-Sanabal x MNH-1090</td>
<td>H-2338</td>
<td>GH-Hadi x Cyto-533</td>
</tr>
<tr>
<td>H-2328</td>
<td>GH-Sanabal x CIM-343</td>
<td>H-2339</td>
<td>GH-Sanabal x CIM-343</td>
</tr>
</tbody>
</table>

Table-2.24. CROSS REFERENCE CHART F₁ HB-3 OF BREEDING AND GENETICS SECTION AT CENTRAL COTTON RESEARCH INSTITUTE, MULTAN DURING 2022-23

<table>
<thead>
<tr>
<th>Hybrid No.</th>
<th>Origin</th>
<th>Hybrid No.</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-2339</td>
<td>CIM-343 x MNH-1090</td>
<td>H-2344</td>
<td>431/SDK x MNH-1050</td>
</tr>
<tr>
<td>H-2340</td>
<td>CIM-785 x MNH-1090</td>
<td>H-2345</td>
<td>MNH-1050 x CIM-663</td>
</tr>
</tbody>
</table>
2.6 Maintenance of Genetic Stock of World Cotton Collection

2.6.1 Maintenance/Preservation of Cotton Genetic Stock at CCRI Multan

Six thousand one hundred and forty three genotypes are being maintained at the Cold Room of CCRI Multan for Long (100 years), medium (50 years) and short term (25 years). One third of the seed was planted in the field for production of fresh seed as well as to utilize in the hybridization program. Detail of genetic stock is given in Table 2.26. The seed of genetic stock were also supplied, locally and abroad, to different scientists, cotton growers, academia and different institutes/research stations for their research/breeding programs. The detail is given in Table 2.26.

Table 2.26 Detail of Genetic Stock of World Cotton Collection

<table>
<thead>
<tr>
<th>Local genotypes</th>
<th>Exotic genotypes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1310</td>
<td>4933</td>
<td>6243</td>
</tr>
</tbody>
</table>

Species-Wise Detail

Gossypium herbaceum L. | 556
Gossypium arboreum L. | 1025
Gossypium hirsutum L. | 4553
Gossypium barbadense L. | 109

Total Accessions | 6243

2.7 Comparison of exotic versus local cotton varieties at the agro-climatic condition of Multan

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of varieties</th>
<th>Name of country</th>
<th>Seed cotton yield (Kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MNH-1035</td>
<td>Pakistan (Punjab)</td>
<td>1148</td>
</tr>
<tr>
<td>2</td>
<td>Israr Shaheed DIK</td>
<td>Pakistan (K.P.)</td>
<td>2654</td>
</tr>
<tr>
<td>3</td>
<td>CIM-663</td>
<td>Pakistan (Punjab)</td>
<td>1148</td>
</tr>
<tr>
<td>4</td>
<td>SLH-Chandi</td>
<td>Pakistan (Sindh)</td>
<td>1419</td>
</tr>
<tr>
<td>5</td>
<td>Sindh-1</td>
<td>Pakistan (Sindh)</td>
<td>1435</td>
</tr>
<tr>
<td>6</td>
<td>GH-Sultan</td>
<td>Pakistan (Sindh)</td>
<td>646</td>
</tr>
<tr>
<td>7</td>
<td>USA Acala-5-918</td>
<td>USA</td>
<td>717</td>
</tr>
</tbody>
</table>
2.8. Study of Phenotypic diversity

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Genotype</th>
<th>Peculiar Characters</th>
<th>Picture show</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acala 63-69</td>
<td>Open Bushy type plant</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Acala SJ4</td>
<td>Open Bushy type plant</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>BW-76-31DH</td>
<td>Open Bushy type plant</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Coker-310</td>
<td>Open type plant</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gumbo Okra</td>
<td>Okra Leaf</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>HG-11</td>
<td>Nectariless</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>LA-23897</td>
<td>Frego Bract and Nectariless</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>LB-609</td>
<td>Open type plant with long sympodia</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCN-2-65</td>
<td>Open type plant</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PD-695</td>
<td>Open type plant</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Red Leaf Cotton</td>
<td>Red plant color with red leaves</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Stoneville</td>
<td>Nectariless and Low Gossypol</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Green Lint</td>
<td>Green colored lint</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Khaki Cotton</td>
<td>Brown colored lint</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Chure 2A-121</td>
<td>Long Sympodia</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>DPL-61</td>
<td>Okra Leaf</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Pronto</td>
<td>Okra leaf with susceptibility to drought</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Reshmi</td>
<td>Thick leaf open type</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Xiao YiMian</td>
<td>Open type plant with long sympodia</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>H88-8-J-69-J-70</td>
<td>Open type plant with long sympodia</td>
<td></td>
</tr>
</tbody>
</table>

2.7. Early Generation Seed production of commercial varieties

Single lines of Bt. and non Bt. approved varieties were sown in the fields. All the agronomic practices were made sure throughout the cropping season. Single plants were selected from pure and uniform families. These single plants were ginned for further fibre traits testing and multiplication of pure seed. The selected plants will be sown next year. The detail is given in Table 2.28.

Table 2.28 Detail of pre-basic seed produced during 2022-23

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Variety</th>
<th>Total Families</th>
<th>Seed weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bt.CIM-632</td>
<td>39</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>Bt.CIM-785</td>
<td>26</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>Bt.CIM-678</td>
<td>39</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Bt.CIM-602</td>
<td>26</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>Bt.CIM-600</td>
<td>26</td>
<td>31</td>
</tr>
</tbody>
</table>
2.8 Study of gene flow in Cotton crop.

2.8.1 Three cotton varieties i.e. CIM-496, Bt.CIM-632 and Russian red leaf with distinguishable morphological traits (Lear color normal green and red colors) were sown. Normal plant protection and agronomic practices were adopted to get normally formed bolls. Bolls were and ginned and the seed will sown next year to study the gene flow/out crossing.

2.9 Pak-US ICARDA Cotton Project CCRI Multan Component

2.10 Ratooning of resistant/tolerant USA cotton germplasm for flower induction

44 accessions of US germplasm were ratooned for the last 6-8 years at the research farm CCRI Multan. Out of these 44 accessions square formation and flower induction were started in only few accessions in the month of December 2022 as detailed in Table 2.24. In Set-D accessions USG-1087/13 one boll was formed. While in Set K only one accession USG-618/14 having flowers and bolls formations were observed. In Set N in only one accession i.e. USG-2269/14 buds formation and flower induction were observed. The seed formed in all bolls were found non-viable due to the harsh climatic condition of this year.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Set No.</th>
<th>Year</th>
<th>No of total Accessions</th>
<th>Resistant accessions</th>
<th>Accessions having buds and flower formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>C</td>
<td>2013</td>
<td>200</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>D</td>
<td>2013</td>
<td>200</td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>3.</td>
<td>K</td>
<td>2014</td>
<td>200</td>
<td>3</td>
<td>01</td>
</tr>
<tr>
<td>4.</td>
<td>N</td>
<td>2014</td>
<td>600</td>
<td>28</td>
<td>01</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1200</td>
<td></td>
<td>46</td>
<td>03</td>
</tr>
</tbody>
</table>

Besides the above facts Breeding and Genetics were made successes by developing to high yielding strains i.e. Bt.CIM-990 and Bt..CIM-909 (First year) were tested in NCVT of Pakistan Central Cotton Committee trails.