PAKISTAN CENTRAL COTTON COMMITTEE

CENTRAL COTTON RESEARCH INSTITUTE,
MULTAN

(2015-2016)
RESEARCH PROGRAMME
CENTRAL COTTON RESEARCH INSTITUTE,
MULTAN
(2015-2016)
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PREFACE

The Annual Programme of Research Work for the year 2015-2016 of Central Cotton Research Institute, Multan has been prepared keeping in view cotton production problems / constraints which limit the growers to improve cotton productivity and their profitability. The programme has been thoroughly reviewed and discussed with the scientists of Central Cotton Research Institute, Multan. The research studies will be focused on cotton production technology, CLCuV disease management, efficient fertilizer use, seed health improvement and technology dissemination.

This Programme is being submitted for approval by the Agricultural Research Sub-Committee (ARSC) of Pakistan Central Cotton Committee.

Suggestions for further improvement of the Programme will be highly appreciated and duly acknowledged.

SAJID MASOOD SHAH
Director
Central Cotton Research Institute
Multan

March 2015
1. AGRONOMY SECTION

1.1 Effect of time of sowing on productivity of advanced genotypes

Objective: To determine the optimum sowing time of different advanced genotypes for their productivity

Treatments:
(a) Sowing Date = 5
   [April 15, May 01, May 15, June 01, June 15]
(b) Genotype = 3
   [CIM-620, Cyto-120, CIM-608]

Layout: Split plot
         [main: sowing date]
Replications: 4
Plot size: 30’ x 30’
Year of Expt.: Continuous

Observations:
- Plant growth and development
- Data on CLCuD incidence
- Data on seed cotton yield and its components
- Fibre characteristics

Previous Year’s Results
- Crop planted on 15th April produced maximum yield (3362 kg ha⁻¹), while minimum by 15th May (1624 kg ha⁻¹).
- Averaged across the sowing dates, CIM-608 produced higher seed cotton yield compared to Cyto-124 and CIM-620.
- The reduction in yield was 3.7, 21.6, 39.3 and 51.7% by delay in sowing of crop.
- The cyto-124 proved to be most virus tolerant genotype over tested genotypes.

1.2 Effect of time of sowing on production of transgenic cotton

Objective: To determine the optimum sowing time of different advanced genotypes to harvest their yield potential

Treatments:
(a) Sowing Date = 6
   [March 01, March 15, April 01, April 15, May 01, May 15]
(b) Genotype = 4
   [Bt.CIM-622, Bt. Cyto -178, Bt. Cyto -179, Bt.CIM-602]

Layout: Split plot
         [Main: sowing date]
Replications: 4
Plot size: 35’ x 30’
Year of Expt.: Continuous

Observations:
- Seed cotton yield differed significantly due to genotypes and nitrogen levels.
- Crop fertilized with 150 kg N ha⁻¹ gave significant increase in yield than 0, 50 and 100 kg N ha⁻¹.
- CIM-612 produced significantly higher seed cotton yield over CIM-608 and Cyto-124.

1.3 Evaluation of new genotypes at different levels of nitrogen fertilizer

Objective: To determine the nitrogen requirement of different advanced genotypes to harvest their yield potential

Treatments
(a) Genotype = 3
   [CIM-620, Cyto-124, CIM-608]
(b) Nitrogen = 5
   [0, 50, 100, 150, 200 kg N ha⁻¹]

Layout: Split plot
         [main: genotypes]
Replications: 4
Plot size: 20’ x 30’
Sowing date: 1st week of May
Year of Expt.: Continuous

Observations:
- Plant structure
- Seed cotton yield and its components
- Fibre characteristics

Previous Year’s Results
- Seed cotton yield differed significantly due to genotypes and nitrogen levels.
- Crop fertilized with 150 kg N ha⁻¹ gave significant increase in yield than 0, 50 and 100 kg N ha⁻¹.
- CIM-612 produced significantly higher seed cotton yield over CIM-608 and Cyto-124.
1.4 Evaluation of transgenic cotton at different levels of nitrogen fertilizer

**Objective:**
To determine the nitrogen requirement of different advanced genotypes to harvest their yield potential

**Treatments**
(a) Genotype = 4
[Bt.CIM-622, Bt.Cyto-178, Bt.Cyto-179, Bt.CIM-602]
(b) Nitrogen levels = 5
[0, 100, 200, 300, 400 kg ha\(^{-1}\)]

**Layout:** Split plot

**Replications:** 4

**Plot size:** 20’ x 30’

**Sowing date:** 1\(^{st}\) week of April

**Year of Expt.:** Continuous

**Observations:**
- Plant growth and development
- Seed cotton yield and its components
- Fibre characteristics

**Previous Year’s Results**
- Seed cotton yield was significantly affected by genotypes and nitrogen levels.
- Crop fertilized with 400 kg N ha\(^{-1}\) gave significant increase in yield than 0, 100, 200 and 300 kg N ha\(^{-1}\).
- Bt.CIM-616 produced significantly higher seed cotton yield than Bt.Cyto-177 and Bt.CIM-598.

1.5 Studies on response of cotton to potassium fertilizer under arid environment in southern Punjab, Pakistan

**Objective:**
I. To determine potassium requirement of transgenic cotton
II. To quantify the effects of soil and/or foliar applied potassium on transgenic cotton
III. To appraise and communicate the benefits of added potassium fertilizer to farmers, seed and fertilizer industry and other stakeholders

**Treatments:**
Set 1: Interactive effects of doses of potassium fertilizer and its top dressing soil application on the productivity of cotton

<table>
<thead>
<tr>
<th>Potassium fertilizer (kg ha(^{-1}))</th>
<th>Time of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-----</td>
</tr>
<tr>
<td>100</td>
<td>Full at sowing</td>
</tr>
<tr>
<td></td>
<td>2 splits (1/2 at sowing+1/2 at 45 DAP)</td>
</tr>
<tr>
<td>200</td>
<td>Full at sowing</td>
</tr>
<tr>
<td></td>
<td>4 splits (1/2 at sowing+1/2 at 30 DAP+1/2 at 45 DAP+1/2 at 60 DAP)</td>
</tr>
</tbody>
</table>

Set 2: Enhancing efficiency of soil applied potassium fertilizer through exogenously applied potassium sulphate for improving quality and quantity of cotton crop

<table>
<thead>
<tr>
<th>Soil applied K (kg K(_2)O ha(^{-1}))</th>
<th>Foliar application of 2 % K(_2)SO(_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No spray</td>
</tr>
<tr>
<td>100</td>
<td>Four foliar spray of water</td>
</tr>
<tr>
<td>200</td>
<td>4 foliar spray of K(_2)SO(_4)</td>
</tr>
</tbody>
</table>

**Layout:** RCBD

**Plot size:** Available Experimental Area

**Variety:** 01 Variety Bt. CIM-616

**Year:** 1\(^{st}\)

**Sowing date** (Tentative):

**Observations:**
- Plant Structure
- Yield and its components
- Fibre characteristics

1.6 Cotton as Relay Crop “Cotton Sowing in Standing Wheat”

**Objective:**
i. To increase the cotton production by early planting without sacrificing wheat crop
ii. To minimize cotton cultivation cost.
iii. To increase farm income of small farmers by adopting modified planting technique.
Treatments:

T1 Cotton as sole crop (Fallow land) early, farmers practice

T2 Cotton sowing in standing wheat [Row to Row Distance 75 cm]

T3 Cotton sowing in standing wheat [Row to Row Distance 150 cm]

T4 Cotton planting after wheat harvesting, conventional method

Observations:

- Plant Structure
- Yield and its components
- CLCuV incidence (fortnightly up to 150 DAP)
- Fibre characteristics
- Economics of cotton as relay crop

Previous Year’s Results

- Cotton sowing in standing wheat (RxR=75 cm) produced maximum bolls (384 m⁻²) and seed cotton yield (4618 kg ha⁻¹).
- The minimum bolls per plant (96 m⁻²) and seed cotton yield (2249 kg ha⁻¹) were produced by cotton crop sown after wheat harvesting.

1.7 Screening of Pre- and Post-emergence weedicides in cotton

Objective:

To screen out pre- and post-emergence weedicides for effective weed control in cotton.

Treatments:

Weedicides : Variable
# 2. BREEDING & GENETICS SECTION

## 2.1 Testing of New Strains Developed at CCRI, Multan

### 2.1.1 Varietal Trial-1

**Objective**: Evaluation of medium long staple Bt. strains against commercial varieties.

**Strains**: 6 Bt.CIM-616, Bt.CIM-622, Bt.CIM-625, Bt.CIM-627, Bt.CIM-629, Bt.CIM-630

**Standards**: 2 MNH-886, Bt.CIM-602

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 50’ x 10’

**Locations**: 2 (Multan, Khanewal)

**Year of Expt:** Continuous

### 2.1.2 Varietal Trial-2

**Objective**: Evaluation of medium long staple strains against commercial varieties

**Strains**: 7 CIM-610, CIM-620, CIM-716, CIM-717, CIM-718, CIM-719, CIM-720

**Standard**: CIM-573

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 50’ x 10’

**Locations**: 2 (Multan, Khanewal)

**Year of Expt.**: Continuous

### 2.1.3 Micro-Varietal Trial-1

**Objective**: Evaluation of newly bulked medium long staple Bt. strains against commercial varieties

**Strains**: 10 1/2015 to 10/2015

**Standard**: Bt.CIM-602

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

### 2.1.4 Micro-Varietal Trial-2

**Objective**: Evaluation of newly bulked high lint percentage Bt. strains

**Strains**: 10 11/2015 to 20/2015

**Standard**: Bt.CIM-602

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

### 2.1.5 Micro-Varietal Trial-3

**Objective**: Evaluation of newly bulked long staple strains

**Strains**: 10 21/2015 to 30/2015

**Standard**: CIM-573

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

### 2.1.6 Micro-Varietal Trial-4

**Objective**: Evaluation of newly bulked strains

**Strains**: 10 31/2015 to 40/2015

**Standard**: CIM-573

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

## 2.2 Testing of Commercial Varieties

### 2.2.1 Standard Varietal Trial-1

**Objective**: To test the performance of commercial varieties under Multan conditions


**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

### 2.2.2 Micro-Varietal Trial-1

**Objective**: Evaluation of newly bulked medium long staple Bt. strains against commercial varieties

**Strains**: 10 1/2015 to 10/2015

**Standard**: Bt.CIM-602

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First

### 2.2.3 Micro-Varietal Trial-2

**Objective**: Evaluation of newly bulked high lint percentage Bt. strains

**Strains**: 10 11/2015 to 20/2015

**Standard**: Bt.CIM-602

**Design**: Randomized complete block

**Repeats**: 3

**Plot Size**: 30’ x 10’

**Year of Expt.**: First
2.2.2 Standard Varietal Trial-II

Objective: To test the performance of commercial Bt. varieties under Multan conditions.


Design: Randomized complete block

Repeats: 3

Plot Size: 30' x 10'

Year of Expt: Continuous

2.3 Testing of Promising Strains of Cotton Breeders under National Coordinated Variety Testing Programme

2.3.1 National Coordinated Varietal Trial (Set-A)

Objective: To test the performance of Bt. hybrids.

Strains: Variable (seed to be provided by PCCC)

Design: Randomized complete block

Repeats: 4

Plot Size: 30' x 10'

Year of Expt: Continuous

2.3.2 National Coordinated Varietal Trial (Set-B)

Objective: To test the performance of Bt. strains of private sector.

Strains: Variable (seed to be provided by PCCC)

Design: Randomized complete block

Repeats: 4

Plot Size: 30' x 10'

Year of Expt: Continuous

2.3.3 National Coordinated Varietal Trial (Set-C)

Objective: To test the performance of Bt. strains of public sector.

Strains: Variable (seed to be provided by PCCC)

Design: Randomized complete block

Repeats: 4

Plot Size: 30' x 10'

Year of Expt: Continuous

2.3.4 National Coordinated Varietal Trial (Set-D)

Objective: To test the performance of non Bt. strains.

Strains: Variable (seed to be provided by PCCC)

Design: Randomized complete block

Repeats: 4

Plot Size: 30' x 10'

Year of Expt: Continuous

2.3.1 Provincial Coordinated Cotton Trial-I

Objective: To test the performance of promising Bt. strains of the Punjab.

Strains: Variable (Seed to be provided by Director, Cotton Research Inst., Faisalabad).

Design: Randomized complete block

Repeats: 3

Plot Size: 15' x 10'

Year of Expt: Continuous

2.3.2 Provincial Coordinated Cotton Trial-II

Objective: To test the performance of promising strains of the Punjab.

Strains: Variable (seed to be provided by Director, Cotton Research Inst., Faisalabad).

Design: Randomized complete block

Repeats: 3

Plot Size: 15' x 10'

Year of Expt: Continuous

2.4 Propagation and Selection from Hybrids.

2.4.1 F1 Hybrids

Objective: To raise F2 seed for further selection and screening against CLCuD.

Hybrids: 85 (H-1585 to H-1669)

Standard: 1 CIM-602

Plot Size: Variable

Year of Expt: First
2.4.2 F₂ Generation Block 1
Objective: To select the desirable segregates and screening against CLCuD
Families: 25 (H-1458 to H-1482)
Standard: 1 CIM-602
Plot Size: 50' x 15'
Locations: 3 (Multan, Khanewal, Kot Addu)
Year of Expt: 1st

2.4.4 F₂ Generation Block-3
Objective: To select the desirable segregates and screening against CLCuD
Families: 25 (H-1508 to H-1532)
Standard: CIM-602
Plot Size: 50' x 15'
Locations: 3 (Multan, Khanewal, Kot Addu)
Year of Expt: First

2.4.6 F₂ Generation Block-5
Objective: To select the desirable segregates and screening against CLCuD
Families: 27 (H-1558 to H-1584)
Standard: CIM-602
Plot Size: 50' x 15'
Locations: 3 (Multan, Khanewal, Kot Addu)
Year of Expt: First

2.5 Testing of Advanced Strains at Farmers’ Fields
2.5.1 Zonal Varietal Trial-1 (Bt.)
Objective: To test performance of promising Bt. strains at the farmers’ fields
Strains: 2 Bt.CIM-622, Bt.CIM-625
Standard: Bt.CIM-602
Plot Size: 200' x 50'
Locations: 10
Year of Expt: Continuous

2.5.2 Zonal Varietal Trial-2
Objective: To test performance of promising strains at the farmers’ fields
Strains: 2 CIM-610, CIM-620
Standard: CIM-573
Plot Size: 200' x 50'
Locations: 20
Year of Expt: Continuous

2.6 Performance of Promising Strains in Bigger Block
2.6.1 Testing of advanced strains
Objective: To test the performance of advanced strains at Punjab Seed Corporation Farms, Khanewal
Strain: 2 Bt. CIM-622, Bt. CIM-625
Plot Size: 0.5 hectare
Location: Khanewal
Year of Expt: First
2.6.2 Nucleus Seed Blocks

Objective: To produce pre-basic seed of approved commercial varieties of CCRI, Multan

Varieties: 7 CIM-496, CIM-506, CIM-554, CIM-573, Bt CIM-598, Bt.CIM-599, Bt. CIM-602

Plot Size: Variable

Year of Expt: Continuous

2.7 Screening of Breeding Material against CLCuD

2.7.1 Progeny Row Trials (Medium staple with high lint %age)

Objective: Testing and screening of promising families in F4 to F6 generations against CLCuD

Families: 190

Design: Compact Family Block

Repeats: 2

Plot Size: 20 ' x 7.5'

Year of Expt: First

2.7.2 Progeny row trials (Long Staple)

Objective: Testing and screening of promising long staple families in F4 to F6 generations against CLCuD

Families: 45

Design: Compact Family Block

Repeats: 2

Plot Size: 20 ' x 7.5'

Year of Expt: First

2.7.3 Plant to Progeny rows (F3 Single Lines)

Objective: Testing and screening of selected F2 segregates in plant to progeny rows against CLCuD

Families: 875

Design: Simple

Repeat: 1

Plot Size: 20 ' x 7.5'

Year of Expt: First

2.8 Fresh Crosses

Objective: Development and widening of genetic base for the inducing desirable traits for evolution of new varieties through:
- Direct crosses
- Back crosses
- Three-way crosses

Crosses with exotic material

Year of Expt: Continuous

2.9 Maintenance of Genetic Stock of World Cotton Collection

Objective: Maintaining of Genetic stock
- Exchange of germplasm.

Germplasm: 2705

Plot Size: 15' x 5'

Year of Expt: Continuous

2.10 Coordination with other Sections

Section: Area of research

Agronomy: Agronomic assessment of advanced strains:
- Sowing dates
- Irrigation
- Fertilizer
- Spacing

Cytogenetics: Inter specific hybridization

Entomology: Screening of advanced strains for insect pest tolerance

Fibre technology: Testing of breeding material for fibre quality traits

Pathology: Screening of breeding material against CLCuD

Physiology/Chemistry: Screening of advanced strains:
- Heat tolerance
- Drought tolerance

================================================================================
3. CYTOGENETICS SECTION

3.1 Collection and maintenance of *Gossypium* germplasm

- 33 culturable species of *Gossypium* along with 14 diploid and 6 tetraploid hybrids; 5 triploid and 3 hexaploid hybrids; 3 pentaploid hybrids, 5 tri- and 1 tetra- species combinations, 5 *G. hirsutum* races and 1 *G. barbadense* race will be maintained.
- Utilization of this wider genetic base for hybridization.
- Exotic collection of missing culturable species for strengthening germplasm.

<table>
<thead>
<tr>
<th>Previous Year's Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grown in field and maintained the following genetic material:</td>
</tr>
<tr>
<td>➢ 28 Species of <em>Gossypium</em></td>
</tr>
<tr>
<td>➢ 12 Diploid and 4 tetraploid hybrids</td>
</tr>
<tr>
<td>➢ 4 Triploid and 2 hexaploid hybrids</td>
</tr>
<tr>
<td>➢ 3 Pentaploid hybrids</td>
</tr>
<tr>
<td>➢ 5 Tri-species and 1 tetra-species combinations</td>
</tr>
<tr>
<td>➢ 5 <em>G. hirsutum</em> races</td>
</tr>
<tr>
<td>➢ 1 <em>G. barbadense</em> race</td>
</tr>
</tbody>
</table>

3.2 Species hybridization

3.2.1 Development of new hybrids involving species of different genomes by incorporating specific genes of wild species i.e. CLCuD resistance, drought resistance and fibre quality traits into upland cotton. The following crossing programme will be attempted depending upon the availability of flowers.

- *G. arboreum* × *G. herbaceum*
- *G. arboreum* × *G. anomalum*
- *G. arboreum* × *G. gossypioide*
- *G. arboreum* × *G. laxum*
- *G. arboreum* × *G. stocksii*
- *G. arboreum* × *G. somalense*
- *G. arboreum* × *G. areysianum*
- *G. arboreum* × *G. longicalyx*
- *G. hirsutum* × *G. herbaceum*
- *G. hirsutum* × *G. capitis viridis*
- *G. hirsutum* × *G. gossypioide*
- *G. hirsutum* × *G. laxum*
- *G. hirsutum* × *G. stocksii*
- *G. hirsutum* × *G. somalense*
- *G. hirsutum* × *G. areysianum*
- *G. hirsutum* × *G. longicalyx*

- Planting of freshly obtained seeds of inter-specific hybrids following

  - F₁ of (2 (*G. hirs.* x *G. stock.*)) x *G. hirs.*
  - F₁ of BC₅₅ (*G. hirs.* × 2(G. arb. × *G. anomalum*)) x 3 (*G. hirs.* (Bi)
  - F₂ of BC₄₅ (*G. hirs.* x 2(G. arb. × *G. anomalum*)) x 3 (*G. hirs.* (Bi)
  - F₃ of BC₃₅ (*G. hirs.* x 2(G. arb. × *G. anomalum*)) x 3 (*G. hirs.* (Bi)
  - F₁ of BC₃₅ [(2(*G. hirs.* x *G. anomalum*)) x *G. barba.] x 3 (*G. hirs.* (Bi)
  - F₂ of BC₂₅ [(2(*G. hirs.* x *G. anomalum*)) x *G. barba.] x 3 (*G. hirs.* (Bi)
  - F₃ of BC₂₃ [(2(*G. hirs.* x *G. anomalum*)) x *G. barba.] x 3 (*G. hirs.* (Bi)

Cytological and morphological studies will be carried out by doubling the chromosome number where necessary.

<table>
<thead>
<tr>
<th>Previous Year’s Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>6333 pollinations were attempted in 60 combinations.</td>
</tr>
<tr>
<td>Boll setting was obtained in 52 combinations.</td>
</tr>
<tr>
<td>One interspecific hybrid was studied cytotologically.</td>
</tr>
</tbody>
</table>

3.3 Search for homozygous resistance against CLCuD under field conditions

3.3.1 Screening of F₆ material to obtain homozygous lines

[(2(*G. hirs.* x *G. anomalum*)) x 3 (*G. hirs.*)] x [2(*G. arb. x *G. anomalum*)) x 2 (*G. hirs.* ) x 2 (*G. hirs.*)] ×

- Screening of F₆ material as single plant progeny for obtaining homozygous virus resistant lines
- Data on economic and fibre quality traits

**Methodology:**

- **No. of F₆ families:** 111
- **Plot size:** Variable
- **Layout:** Sick plot technique

<table>
<thead>
<tr>
<th>Previous Year’s Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>69 plants showed resistance against CLCuD up-to maturity.</td>
</tr>
</tbody>
</table>
3.3.2 Screening of F7 material to obtain homozygous lines

\[
[2(G. hirs. x G. anomal.) x 3G. hirs.] x
{2(G. arbo. x G. anomal.) x 2G. hirs.}
\]

- Screening of F7 material will be tested in progeny row trial for obtaining homozygous virus resistant lines
- Data on economic and fibre quality traits

Methodology:
No. of F7 Families: 286
Design: Compact Family Block design
Repeat: 3
Plot size: 20’ x 10’
Year of Exp.: Continuous

Previous Year’s Results
286 plants were selected from the F6 material having desirable lint percentage and fibre quality

3.4 Conversion of interspecific material into transgenic lines

3.4.1 F4 Generation

Objective:
To raise F4 seed for further selection and screening against CLCuD

Methodology:
Hybrids: 52 (1-1/15 to 52-1/15)
Standard: 2 (FH-142 & MNH-886)
Plot size: Variable
Year of Exp.: Continuous

3.4.2 F2 Generation

Objective:
To select the desirable segregates having Bt with concurrent tolerance against CLCuD

Methodology:
Families: 192(1-2/15 to 192-2/15)
Standard: 2 (FH-142 & MNH-886)
Plot size: Variable
Year of Exp.: Continuous

3.4.3 F3 Generation

Objective:
To select the desirable segregates having Bt gene with concurrent tolerance against CLCuD

Methodology:
Families: 298(1-3/15 to 298-3/15)
Standard: 2 (FH-142 & MNH-886)

3.4.4 F4 Generation

Objective:
To select the desirable segregates having Bt gene with concurrent tolerance against CLCuD

Methodology:
Families: 350(1-4/13 to 350-4/15)
Standard: 2 (FH-142 & MNH-886)
Plot size: Variable
Year of Exp.: Continuous

3.5 Search for Aneuploids/haploids
- Continuous search for aneuploids especially monosomes to identify individual chromosomes and haploids to make homozygous lines in cotton
- Tagging of suspected plants, screening and analyses for confirmation of their chromosome number/ploidy level.

Previous Year’s Results

(i) Five abnormal plants suspected to be aneuploid were studied cytologically.
(ii) All the plants were disomic having 26II’s at Metaphase-I.

3.6 Testing of Cyto-material developed through multiple species hybrids in varietal trials

3.6.1 Varietal Trial-1 (Non Bt)

Objective:
Testing of virus tolerant material for economic and fibre quality traits

Treatments:
Strains: 5 (Cyto-120, Cyto-161, Cyto-162, Cyto-164 & Cyto-180)
Standard: 1 (CIM-573)
Layout: RCBD
Repeats: 3
Plot size: 50’x10’
Year of expt.: 3rd

Previous Year’s Results

Five virus tolerant Cyto-strains were evaluated for their economic and fibre characteristics. Maximum yield was produced by Cyto-122 (2911.73 kg ha\(^{-1}\)) followed by Cyto-124 (2734.07 kg ha\(^{-1}\)) as compared to CIM-573 having 1327.63 kg ha\(^{-1}\).
3.6.2 Varietal Trial-2

Objective:
Testing of transgenic/virus tolerant material for economic and fibre quality traits.

Treatments:

Strains: 4 (Bt Cyto-178, Bt Cyto-179, Bt Cyto-300 & Bt Cyto-301 )

Standard: 2 (FH-142 & MNH-886)

Lay-out: RCBD

Repeats: 3

Plot size: 50'x10'

Year of expt. 2nd

Previous Year’s Results
Five CLCuD tolerant Cyto-strains were evaluated in varietal trial-1 for their specific traits as well as yield, GOT (%age) and fibre characteristics against MNH-886 as standards. All Cyto strains viz. Bt.Cyto-177 (4068.80 kg ha\(^{-1}\)), Bt.Cyto-178 (4161.70 kg ha\(^{-1}\)) and Bt.Cyto-179 (5077.3 kg ha\(^{-1}\)) produced better seed cotton yield as compared to standard MNH886 (3805.63 kg ha\(^{-1}\)). All Cyto strains maintained better fibre traits than the standard.

3.6.3 Micro Varietal Trial-1

Objective:
Testing of transgenic/virus tolerant material for economic and fibre quality traits.

Treatments:

Strains: 5(Cyto-306 to 310)

Standard: 2 (FH-142 & MNH-886)

Lay-out: RCBD

Repeats: 3

Plot size: 30'x10'

Year of expt. 1st

Previous Year’s Results
Maximum yield was produced by Cyto-304 (3239.27 kg ha\(^{-1}\)) followed by Cyto-303 (3142.03 kg ha\(^{-1}\)) as compared to MNH-886 having 2742.33 kg ha\(^{-1}\). All Cyto strains maintained better fibre traits than the standards.

3.7 Evaluation of new strain Bt.Cyto-178 & Bt. Cyto-179 under varied ecological zones

Objective:
1. Strain Bt.Cyto-178 to be included in NCVT during cropping season 2015-16 for its adaptability.

Year of expt. 2nd

2. Strain Bt. Cyto-179 to be included in NCVT during cropping season 2015-16 for its wider adaptability.

Year of expt. 1st

3.8 Karyotyping analysis of G.arboreum/G.hirsutum.

Objective:
To develop the methodology for karyotyping analysis and to standardized the protocol for of Gossypium arboreum and hirsutum.

Year of Expt. 1st
4. ENTOMOLOGY SECTION

4.1 Monitoring of population dynamics of different lepidopterous pests

Objective:
To record fluctuations in the population of different lepidopterous pests of cotton by using sex pheromone and light traps

Methodology:
- Installation of sex pheromone baited traps for lepidopterous pests at CCRI, Multan and farmer’s field at Khanewal for:
  - *Earias* species
  - *Helicoverpa armigera*
  - *Pectinophora gossypiella*
- Installation of light traps for lepidopterous pests at CCRI, Multan for:
  - *Earias* species
  - *Helicoverpa armigera*
  - *Spodoptera litura*
  - *Spodoptera exigua*

Year of Expt.: Continuous

Observations:
- Recording male moth catches of different lepidopterous pests through sex pheromone baited traps daily at Multan and weekly at farmer’s field throughout the year.
- Recording the moth catches through light traps daily throughout the year.

Previous Year’s Results

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucking Pests/leaf (Set-I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>A. devastans</em> CIM-573</td>
<td>(0.71)</td>
<td>(0.62)</td>
</tr>
<tr>
<td><em>B. tabaci</em> CIM-573</td>
<td>(5.7)</td>
<td>(4.8)</td>
</tr>
<tr>
<td><em>T. tabaci</em> Cyto-120</td>
<td>(1.4)</td>
<td>(0.68)</td>
</tr>
<tr>
<td><em>Earias</em> spp. CIM-573</td>
<td>(4.3)</td>
<td>(2.9)</td>
</tr>
<tr>
<td><em>P. gossypiella</em> CIM-620</td>
<td>(36.4)</td>
<td>(15.2)</td>
</tr>
<tr>
<td>Seed cotton yield (kg ha⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-I Cyto-120 (1293)</td>
<td>CIM-620 (1223)</td>
<td></td>
</tr>
<tr>
<td>Set-II Cyto-120 (1524)</td>
<td>CIM-573 (1246)</td>
<td></td>
</tr>
<tr>
<td>Set-III Cyto-120 (2518)</td>
<td>CIM-573 (1325)</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Studies on tolerance level of cotton genotypes to insect pest complex

Objective
To assess the tolerance level in the promising genotypes to sucking pests and bollworms

4.2.1 Non-Bt strains

Treatments:
- Set-I Plant protection against bollworms
- Set-II Plant protection against sucking insect pests.
- Set-III Plant protection against sucking insect pests and bollworms.

Cultivars: Variable

Layout: RCBD

Replications: 4

Plot size: 30’ x 30’

Year of Expt.: Continuous

Observations:
- Sucking pests population (Set-I) and bollworms damage (Set-II)
- Seed cotton yield.

Previous Year’s Results

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bollworms damage (%) (Set-II)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Earias</em> spp. CIM-573</td>
<td>(4.3)</td>
<td>(2.9)</td>
</tr>
<tr>
<td><em>P. gossypiella</em> CIM-620</td>
<td>(36.4)</td>
<td>(15.2)</td>
</tr>
<tr>
<td>Seed cotton yield (kg ha⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-I Cyto-120 (1293)</td>
<td>CIM-620 (1223)</td>
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</tr>
<tr>
<td>Set-II Cyto-120 (1524)</td>
<td>CIM-573 (1246)</td>
<td></td>
</tr>
<tr>
<td>Set-III Cyto-120 (2518)</td>
<td>CIM-573 (1325)</td>
<td></td>
</tr>
</tbody>
</table>

4.2.2 Bt strains

Treatments:
- Set-I Plant protection against sucking insect pests.
- Set-II Unsprayed

Cultivars: Variable
and minimum on B-17. Thrips was higher on B-4 and lower on B-9. Bollworms infestation in immature fruiting parts was higher on B-9 while no infestation was recorded on 11 candidate strains. Pink bollworm infestation was recorded higher on B-8.

C. Bt strains (Set-C) 
Whitefly remained above ETL in July on all the testing strains which declined in August. Overall its intensity was higher on C-10 and lower on C-3 & C-2. Jassid was maximum on C-5 and minimum on C-1. Thrips remained below ETL on all the strains except C-6. Low level of spotted bollworm infestation was observed on C-13, C-14 & C-17. Pink bollworm infestation was observed in all the strains except C-3 & C-13 with maximum in C-4 & C-14.

D. Bt Strains (Set-D) 
Jassid was above ETL on D-1 & D-3 whereas whitefly was above ETL on all strains throughout the study period. Thrips remained below ETL. Spotted bollworm infestation remained <1% in immature fruiting parts. Pink bollworm larvae were found in D-2 and D-3.

4.3 Heliocoverpa armigera survival on transgenic Bt-cotton strains having different protein levels

Objective:
- To determine the effects of Bt-toxin (Cry1Ac) on the larval survival, development time and pupal weight of H. armigera larvae fed on leaves, flowers & bolls of transgenic Bt and non-Bt strains
- To correlate larval survival and development to the amount of endotoxin present in Bt strains

Cotton strains : Variable (Bt & non Bt strains)

Year of Expt. : 1st

Methodology:
- Quantitative test will be done at 50-70, 80-100, 110-130 days after seedling emergence. For qualitative test Agdia Immuno Strips and for quantitative test Agdia ELISA Plates will be used.
- Insect Bioassays will be conducted to determine optimum protein level (Cry1Ac) to control the insects. H. armigera larvae collected from different host plants will be reared on artificial diet in laboratory. Second instars from F1 generation will be used for bioassay.

Observations: 
Data on different life stages will be recorded.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucking Pests/leaf (Set-I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. devastans CIM-616 (0.9)</td>
<td>CIM-622 (0.6)</td>
<td></td>
</tr>
<tr>
<td>B. tabaci Cyto-177 (7.8) CIM-616</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>C. tabaci CIM-616 (0.8) CIM-602</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Spotted bollworm damage (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-I Cyto-177 (1.2) CIM-622</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Set-II CIM-616 (2.5) CIM-622</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Pink Bollworm damage (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-I Cyto-178 (30.3) CIM-616</td>
<td>15.2</td>
<td></td>
</tr>
<tr>
<td>Set-II CIM-616 (51.5) Cyto-178</td>
<td>42.4</td>
<td></td>
</tr>
<tr>
<td>Seed cotton yield (kg ha(^{-1}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-I Cyto-177 (3241) CIM-622</td>
<td>1725</td>
<td></td>
</tr>
<tr>
<td>Set-II CIM-616 (2283) CIM-622</td>
<td>1539</td>
<td></td>
</tr>
</tbody>
</table>
Previous Year's Results

All the Bt strains proved effective against the spotted bollworm at 30 days after emergence. Efficacy of Bt strains gradually start decreasing. Larval mortality $>70\%$ at 60 DAE was observed only on Cyto-178 and IUB-222. At 90 DAE the larval mortality further dropped and $>50\%$ larval mortality was observed on Bt strains CIM-602, Cyto-178, MNH-886 and IUB-222.

Cry1Ac protein concentrations varied in all the tested varieties/strains and ranged from 2.851 to 1.356 µg/g fresh weight at 30 days after emergence and expression level gradually dropped afterward and was 1.776 to 0.653 µg/g at 90 DAE.

Preliminary study revealed that Earias spp at the moment are sensitive to the Bt strains having Cry1Ac gene protein even at $<1.0$ µg/g fresh weight.

### 4.4 Development of natural enemies of sucking pests on treated and untreated seed of GM cotton at different planting dates

**Objective**
To determine the trend of predators and parasitoids at different planting dates of cotton

**Variety**
Bt.CIM-599

**Sowing time (Main):**
- i. Early April
- ii. Early May

**Treatments (Sub):**
- 3
  - T1 = Seed treated with Imidacloprid 70 WS @ 10 g/kg seed
  - T2 = Seed treated with Thiamethoxam ST 70 WS @ 10 g/kg seed
  - T3 = Untreated

**Design**
Split

**Replications**
3

**Year of Expt.**
2nd

**Observations:**
- Population of sucking pests and predators under field conditions
- Recording of parasitism from field collected samples

### Previous Year's Results

Comparatively seed treated with Guacho 70WS proved more effective against whitefly in early planting and Confidor 70WS remained effective in normal sowing block.

Jassid appeared late in the early sowing block and all the seed treatment insecticides remained effective till 7th week of sowing except Actara 70Ws which remained effective till 6th week after sowing.

Seed treated with Actara 70WS and Guacho 70WS proved effective against thrips.

Seed treated insecticide didn't show any negative effect on the predators.

### 4.5 Pink bollworm and red cotton bug infestation in green bolls

**Objective:**
- To conduct survey for pink bollworm and red cotton bug infestation in green bolls
- Comparison of PBW infestation with previous years
- Presence of Bt roxin

**Locations**
Variable

**Year of Expt.**
Continuous

**Survey timing:**
- i. Mid-September
- ii. Early November

**Observations:**
- Collection of susceptible green bolls from Bt & non-Bt cotton varieties
- Dissection of collected bolls to record PBW and red cotton bug infestation

### Previous Year’s Results

All the Varieties/strains either Bt or conventional present in the field were susceptible to pink bollworm. Maximum percentage damage and live larvae were recorded in MNH-992 followed by AA-703, MNH-886, FH-142, FH-Lalazar and CIM-616. Maximum pink bollworm damage and live larvae were recorded from Lodhran followed by Vehari, Bahawalpur and Multan. Moreover, early planting seems more vulnerable to pink bollworm attack than normal sowing.

Low level of Red cotton bug infestation was observed in all the varieties either Bt or conventional
4.6 Studies on dusky cotton bug

4.6.1 Assessment of losses caused by dusky cotton bug in controlled cage condition

Objective
To determine the qualitative and quantitative losses caused by dusky cotton bug.

Cotton cultivar: Bt CIM-599

Treatments: 4
- T1: No pest released
- T2: 10 pairs of bug/fruited body
- T3: 20 pairs of bug/FB
- T4: 30 pairs of bug/FB

Releases time: 2
(Flower buds & split bolls)

Replications: 3

Year of Expt.: Continuous

Methodology:
- Having four plants per cage
- Retaining counted number of fruiting parts
- Maintaining pest population
- Recording fruit positioning
- Bolls picking at harvest

Observations:
- Flower buds shedding, %drying and development into bolls
- Quantitative losses (boll, seed & lint weight, oil contents)
- Qualitative losses (fiber characters & seed germination)

Previous Year’s Results
Dusky cotton bug has significant impact on squares/bolls shedding, bolls recovery and boll weight. Overall minimum shedding was recorded in controlled cages.

Among the released cages, minimum square shedding was recorded in T-2 which gradually rose with every increase in pest number and was the maximum in T-4 and minimum in T-2.

Overall shedding percentage in squares was comparatively higher than in mature/split bolls

4.6.2 Impact of dusky cotton bug infestation on early and normal planting periods

Objective
To determine the impact of dusky cotton bug infestation on fruiting bodies and yield of treated and untreated seed sown on different dates

Sowing dates (Main): i. Mid March
ii. Mid May

Treatments (Sub):
B) T1 Dusky cotton bug allowed
T2 Dusky cotton bugs controlled

Design: Split Split

Repeats: 3

Year of study: Continuous

Variety: Bt. CIM-599

Methodology:
- Five randomly selected plants from each treatment will be observed for dusky cotton bug weekly
- Data will be collected from seedling to harvest stage
- Control plots will be sprayed with suitable insecticides when needed

Observations:
- Data on dusky cotton bug
- Qualitative and quantitative parameters of seed cotton

Previous Year’s Results
Population of dusky bug was higher on early sown crop as compared to normal sowing throughout the crop season. Initially its infestation was higher on squares and gradually shifted to open bolls in both the planting periods, seemingly that dusky bug has less preference to small and mature bolls

4.6.3 Comparative efficacy of different insecticides against dusky cotton bug

Objective:
To determine the comparative efficacy of different insecticides against dusky cotton bug
Insecticides : Variable
Replications : 3
Year of Expt. : Continuous

Methodology:
- Sprayed population and treated plant parts will be kept in plastic jars
- Unsprayed population will be exposed to treated plant parts in plastic jars

Observation:
- Pest mortality after 1, 3 and 7 days of treatment

Previous Year’s Results
- Nurelle-D 505 EC, Cedox 360 EC, Lasenta 80 WG, Boltan 31 EC, X-tall, Polytrin-C 440 EC, Stake 40 EC and Big Hope 5 SC proved effective and gave more than 80% pest mortality 72 hours after spray
- Big Hope 5 SC, Trunk 20 SC, Cedox 360 EC, Stake 40 EC and Nurelle-D 505 EC proved most effective and gave more than 87% pest mortality after one week of the treatment.

4.6.4 Bio control of dusky cotton bug

A) Identification and biology of native predators and parasites

Objective:
1. To identify the natural enemies of dusky cotton bug in cotton Agro-ecosystem
2. Biological studies of dusky cotton bug on Okra and cotton under lab conditions

Year of Expt.: First year

Methodology:
- Mass collection of dusky cotton bug from different host plants throughout the year

Observation:
- Search and identify predators and parasites

B) Feeding efficiency of Chrysoperla carnea, Coccinellids, Assassin bug against dusky cotton bug

Objective:
- To observe comparative potential and fitness of natural enemies against dusky bug

Methodology:
- Field collection of the predators and pest
- Establish culture for further studies

Observation:
- To record feeding efficiency of predators
- To record fitness of natural enemies on different stages of dusky cotton bug

4.7 Studies on red cotton bug
4.7.1 Assessment of losses caused by red cotton bug under controlled cage condition

Objective
To determine the qualitative and quantitative losses caused by red cotton bug

Cotton cultivar: Bt CIM-599

Treatments : 4
T1 = No pest released
T2 = 10 bugs / cage
T3 = 20 bugs / cage
T4 = 40 bugs / cage

Releases time : 3
(FLOWER BUDS, IMMATURE & MATURE BOCKS)

Replications : 3

Year of Expt. : 2

Methodology:
- Having four plants per cage
- Retaining counted number of fruiting parts
- Maintaining pest population
- Bolls picking at harvest for qualitative and quantitative studies

Observations:
- Fruit shedding
- Quantitative losses (boll, seed & lint weight, oil contents)
- Qualitative losses (fiber characters & seed germination)
- Record preferred fruiting bodies.
Overall maximum flower buds shedding was recorded in T-3 where red cotton bugs were released @ 40 followed by T-2 and T-1 while lowest shedding was observed in T-0 (check cages).

The studies revealed that red cotton bug has a tendency to infest flower buds and their shedding directly related with pest population. Care should be undertaken when red cotton bug infestation occurred during fruit setting period.

### 4.7.2 Host preference and loss assessment of cotton stainer

**Objective:**
To determine the most preferred host and voracious stage of the pest

**Treatments**
- T1. Host plant seeds kept with pest
- T2. Host plant seeds without pest

**Host Plants:**
1. Cotton  2. Silk cotton tree  
3. Hollyhock  4. Okra  
5. Millet  6. Sorghum  

**Pest Stages**
- 1. 3rd instar nymphs
- 2. Male adults
- 3. Female adults

**Year of Expt.**
1st.

**Replications**
3

**Lay out**
RCBD

**Methodology:**
- 3 gram seed of each host will be kept separately at equal distance.
- 40 bugs will be released in centre of the cage
- Cage temperature and relative humidity will be maintained at 25-30°C and 60-70% respectively
- Pest numbers on each host will be counted twice a day upto one week

**Observations:**
- Seed weight
- Percent germination

### 4.7.3 Biological control of Red cotton bug

**A) Development of feasible rearing technique for Antilochus coqueberti (Heteroptera: Pyrrhocoridae)**

**Objective:**
To develop efficient rearing technique for mass rearing of the predator

**Year of Expt.**
First year

**Methodology:**
Different rearing techniques will be assessed and modified that perfectly suits in our local environment.

**B) Identification of native predators and parasites**

**Objective:**
Identification and feeding efficiency of red cotton bug bio-control agents

**Year of Expt.**
Continuous

**Methodology:**
- Survey for natural enemies of red cotton bug
- Collection and rearing of natural enemies
- Feeding efficiency of these natural enemies on red cotton bug nymphs and adults under Lab. conditions

**Observations:**
- Bio-control agents feeding efficiency on nymphs & adults
- Record developmental period of red cotton bug

### 4.7.4 Comparative efficacy of different insecticides against red cotton bug

**Objective:**
To determine the comparative efficacy of different insecticides against red cotton bug

**Insecticides**
Variable

**Replicates**
3

**Year of Expt**
Continuous
Methodology:

- Sprayed population and treated plant parts will be kept in plastic jars
- Unsprayed population will be exposed to treated plant parts in plastic jars

Observation:

Pest mortality after 1, 3 and 7 days of treatment

4.8 Monitoring of insecticide resistance

Objectives:

- To monitor the levels of resistance in field strains of cotton pests
- To develop management strategies

Year of Expt. : Continuous

Methodology:

- Collection of sucking pests from different locations
- Collection of bollworms from different locations and establishing their culture in the laboratory
- Determining resistance in F1 generation

Previous Year’s Results

Toxicological studies could not be carried out due to non-availability of desired infestation in nearby fields.

4.9 Screening of new insecticides

Objective:

To determine comparative efficacy of new insecticides against major insect pests

Insecticides : Variable

Lay out : RCBD

Replicates : 3

Location : CCRI, Multan / Farmer’s field

Year of Expt. : Continuous

<table>
<thead>
<tr>
<th>Target pest</th>
<th>No. of insecticides tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jassid</td>
<td>19</td>
</tr>
<tr>
<td>Thrips</td>
<td>19</td>
</tr>
<tr>
<td>Whitefly</td>
<td>18</td>
</tr>
<tr>
<td>Mites</td>
<td>06</td>
</tr>
</tbody>
</table>

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5. PLANT PATHOLOGY SECTION

5.1 Survey on Prevalence of Diseases and Collection of Diseased Plant samples

Objective:

i) To estimate the incidence and severity of cotton leaf curl Disease (CLCuD) and other diseases in cotton growing areas.

ii) To collect the diseased cotton plants and other alternate hosts of CLCuV for virological studies.

iii) Survey will be conducted with the Collaboration of ICARDA

Detail:

i) Documentation of CLCuD incidence and severity on cotton varieties.

ii) Collection of samples of cotton and other possible alternate hosts of whitefly infected with CLCuV

iii) Virological studies for the presence of CLCuV using graft transmission techniques.

Year of Experiment: Second

Previous Year’s Results

i) The maximum CLCuD was recorded in Rahim yar Khan followed by Bahawalnagar and Dera Ghazi Khan districts.

ii) Minimum incidence of the disease was recorded in Khanewal, Lodhran and Multan districts.

iii) Average severity level of disease remained medium i.e. rating scale 0.97 to 2.99 in all the survey areas.

iv) The incidence of boll rot varied from 1 to 3 percent.

v) Boll rot due to *Pantoca agglomerans* bacteria through red cotton bug vector was also observed in traces.

vi) The occurrence of stunting phenomenon was very low.

5.2 Evaluation of Breeding Material against CLCuD

Objective:

Evaluation of cotton varieties /strains for their reaction to CLCuD.

Detail:

i) The material developed by the Breeding, Cyto-genetics, US germplasm and other stations will be screened against CLCuD.

ii) Confirmation of materials for their resistance to CLCuD through petiole-graft-transmission technique.

Year of Experiment: Continuous

5.3 Epidemiological Studies of CLCuD

Objective:

To find out the factors for incidence and progression severity of Cotton Leaf Curl Disease

A: None Bt Genotypes

Treatments

(a) Sowing Date = 5
   [April 15, May 01, May 15, June 01 June 15]

(b) Genotype = 3
   [CIM-620, Cyto-120, CIM-608]

Layout: Split plot (main: sowing date)

Repeats: Four

Detail:

i) Data on incidence of disease at fortnightly interval after sowing.

ii) Main stem height

iii) Data on weather parameters

Year of Experiment: Second

(In Collaboration with Agronomy Section)

Previous Year’s Results

i) The progression of disease was gradually low on crop planted earlier, whereas sharply high on crop planted in June.

ii) Average across cultivars, minimum disease index was recorded on crop planted on 15th April

iii) Averaged across sowing time, minimum disease incidence was observed in cv Cyto-124

iv) Fortnightly increase of disease when compared with weather parameter, indicated that disease incidence was maximum in mid-July to mid-August

v) Maximum temperature at 35.2 ~ 36.8°C and minimum temperature at 27.4~ 29.5°C with relative humidity of 71.2 ~ 81.4 favoured the fortnightly increase of CLCD.
B: Bt Genotypes

Treatments

(a) Sowing Date = 6
   [March 01, March 15, April 01, April 15, May 01, May 15]

(b) Genotype = 4
   Bt.Cyto-178, Bt.Cyto-179, Bt.CIM-622, Bt.CIM-602

Layout : Split plot
          (main: sowing date)

Repeats : Four

Detail:

i) Data on incidence of disease at fortnightly interval after sowing.
ii) Main stem height
iii) Data on weather parameters

Year of Experiment : Second

(In Collaboration with Agronomy Section)

5.4 Evaluation of Advanced Strains in National Co-coordinated Varietal Trial (NCVT) in tolerance to Cotton Diseases.

Objective:
To determine comparative resistance /tolerance of NCVT strains to different diseases of cotton

Details:
Data on following diseases:
- Stunting
- Cotton Leaf Curl
- Bacterial Blight
- Wilt
- Boll rot

Year of Experiment : Continuous

Previous Year’s Results

i) All strains showed susceptibility against CLCuD.
ii) In Set A minimum CLCuD severity and disease index was recorded on V-6 followed by V-12, The incidence of disease index ranged from 75(V-6) to 83%(V-2).
iii) In Set B a maximum CLCuD severity and disease index was recorded on V-18. The incidence of disease index ranged from 68(V-18) to 63%(V-21).
iv) In Set C maximum CLCuD severity and disease index was recorded on V-17. The incidence of disease index ranged from 73(V-12) to 85%(V-17).
v) In Set D maximum CLCuD severity and disease index was recorded in V-3.
vi) Graft transmission studies of Set-A indicated that none of the material had inbuilt resistance against Virus
vii) In Set A maximum boll rot was observed in V-5 (2%). Values ranged from 0.18% to 2%. In Set B maximum boll rot was recorded in V-7- (141%). Values ranged from 0.00 to 1.41%. In Set C and set D boll rot disease was recorded in traces.
5.5 Effect of whitefly virulence to healthy plants.

Objective:
  i) To investigate the virulence of whitefly during the cotton season
  ii) Development of control strategy.

Details:
  i) Collection of infested whiteflies on monthly basis.
  ii) Released on healthy plants (at true leaf stage) under green house
  iii) Data on CLCuD/severity recorded on the appearance of symptoms

Year of Experiment: First

5.6 Screening of fungicides against boll rot of cotton disease

Objective:
  i) In vivo isolation, identification of pathogens
  ii) To screen fungicides effective against boll rot pathogens

Chemicals: On the availability

Details:
  i) Collection of infested cotton bolls from different fields
  ii) Isolation from infested bolls
  iii) Identification of causal organism
  iii) Screening of fungicides for Lab. Conditions with different concentrations.

Year of experiment First

5.7 Studies on Immature Seed Rot due to Stain Bug, Pathogen involvement and their Management

Objective:
  i) To develop the management strategy, especially chemical control

Details:
  i) Screening of fungicides/antibiotics under Lab. and Field conditions

Year of experiment Second

Previous Year's Results

i) Two antibiotics were sprayed on selected plants before inoculation by red cotton bug
ii) Treated bolls were plucked and examined.
iii) All the two tested antibiotics checked the growth of pathogen, streptomycin proved to be more effective.
6. PLANT PHYSIOLOGY / CHEMISTRY SECTION

6.1 Studies on genotype - Environment Interactions

6.1.1 Adaptability of genotypes to high temperature stress

Objectives
(i) Comparative performance of promising genotypes under high temperature stress
(ii) To quantify physiological traits contributing to heat tolerance

Genotypes: Promising
Planting date: mid-April
Design: RCB
Replications: 4
Year of experiment: Continuous

Observations
1. Physiological traits contributing to heat tolerance
2. Seed cotton yield

Previous Year’s Results
1. Genotypes showed variable responses to thermal stress.
2. Genotypes NAIB-878 and Cyto-178 showed better adaptability to high temperature by maintaining highest dehiscence of anthers and other physiological parameters.
3. Genotypes Cyto-178, CIM-616 and NIAB-878 produced better seed cotton yield as compared to other genotypes.
4. There were positive relationships between fully dehiscent anthers, percent boll set on first position along sympodia and seed cotton yield.
5. There were negative correlations between cell injury, cell membrane thermostability and seed cotton yield.

6.1.2 Screening of NCVT varieties against heat tolerance

Objectives
(i) Comparative performance of NCVT varieties under prevailing thermal stress environment

Genotypes: NCVT Bt trial
Year of experiment: 1st
Observations: Physiological traits contributing to heat tolerance

6.2 Plant Nutrition

6.2.1 Nutrient management for cotton productivity by conjoint use of organic and inorganic fertilizers under extended cultivation regimes

Objective
To determine appropriate nutrient requirement of Bt cotton as well as traditional non-Bt cotton in Multan Division using organic and inorganic sources

Treatments
T1: 200 N + 50 P₂O₅ kg ha⁻¹ (Farmer’s practice)
T2: 400 N + 150 P₂O₅ + 125 K₂O kg ha⁻¹
T3: 300 N + 110 P₂O₅ + 90 K₂O kg ha⁻¹ + Zn, B
T4: 225 N (170 kg from Urea + 56 kg from FYM)+ 80 P₂O₅ + 70 K₂O kg ha⁻¹ + Zn, B
T5: 225 N + 80 P₂O₅ + 70 K₂O + 50 HA, kg ha⁻¹ + Zn, B
T6: 225 N + 80 P₂O₅ + 70 K₂O, kg ha⁻¹ + Zn, B
T7: 225 N + 80 P₂O₅ + 70 K₂O, kg ha⁻¹ + Zn + B

*In T6 and T7 treatments cotton seed will be sown after treatment with Biozote @ 500g acre⁻¹ and Gibberellic acid @ 0.01% solution. Boron and Zinc will be applied as foliar sprays @ 0.05% solution; 3 times during the cropping season

Design: Randomized Complete Block
Locations: 4 (CCRI, Multan & Farmers’ fields)

Previous Year’s Results
1. Cotton crop treated with 400 N + 150 P₂O₅ + 125 K₂O, kg ha⁻¹ yielded maximum seed cotton at all the locations of the trial viz. CCRI and farmer’s fields.
2. Addition of FYM and humic acid with chemical fertilizers and seed treatment with Biozote & Gibberellic acid improved seed cotton yield over farmer’s practice at all locations.
3. Value cost ratio remained generally low (1.17 to 1.96) due to lower cotton prices. The lowest VCR values were observed at all locations where highest dose of NPK fertilizers was added.
4. Addition of potassium, B, Zn, FYM, humic acid and seed treatment with Biozote and GA at lower rates of N & P improved VCR over higher doses.

Observations
- Plant structure development
- Fruit production
- Dry matter yield
- Nutrient concentration and uptake
Seed cotton yield

6.3 Soil-Plant-Water Relationships

6.3.1 Adaptability of genotypes to water stress conditions

Objectives
i) Evaluating the performance of transgenic genotypes under water stress conditions
ii) Quantifying physiological traits contributing to water stress tolerance

Treatments
Water stress 2:
- No stress \([-1.6 \pm 0.2 \text{ MPa LWP } (\psi_w)]\)
- Water stress \((-2.4 \pm 0.2 \text{ MPa LWP } \psi_w)\)

Genotypes: Multiple
Design: Split plot (Main: water stress)
Replications: 4
Year of Expt.: Continuous
Location: CCRI, Multan

Observations
1. Crop growth parameters
2. Gas exchange characteristics
3. Seed cotton yield and its parameters
4. Water use efficiency

Previous year's studies
1. Seed cotton yield, number of bolls per plant and boll weight decreased with the imposition of water stress among different varieties.
2. The decrease, due to water stress, was 12\% in seed cotton yield, 10\% in bolls per plant and 3\% in boll weight.
3. The genotype CIM-616 performed better in terms of seed cotton yield and physiological traits.

6.4 Seed Physiology

6.4.1 Investigating the role of amino acids and growth regulator on seed health and cotton production

Objective
To evaluate the efficacy of applied amino acids and growth regulator on seed health and transgenic cotton production

<table>
<thead>
<tr>
<th>Biochemical treatment</th>
<th>Method of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (water)</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>L-Proline</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>L-Glycine</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>Gibberalic acid</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
</tbody>
</table>

Recommended dose of NPK, B and Zn will be applied in all plots

Design: Split plot
Replications: 4
Variety: Promising Bt
Date of sowing: May, 2015
Year of Expt.: 2

Previous Year's Studies
1. Seed cotton yield varied from 2045 to 2623 kg ha\(^{-1}\) in different treatments. The maximum yield was observed in treatment that received recommended fertilizers along with seed priming and foliar spray of proline.
2. Seed germination varied from 47-68\%, seed index from 7.00-8.00g, oil content from 17.7 to 19.6\% and crude protein from 20.5 to 24.8\% in different treatments

Observations
i. Plant structure development
ii. Fruit production
iii. Seed cotton yield and components
iv. Seed health parameters

===================================================================

\[
\begin{align*}
\text{Previous year's studies} \\
1. & \text{Seed cotton yield, number of bolls per plant and boll weight decreased with the imposition of water stress among different varieties.} \\
2. & \text{The decrease, due to water stress, was 12\% in seed cotton yield, 10\% in bolls per plant and 3\% in boll weight.} \\
3. & \text{The genotype CIM-616 performed better in terms of seed cotton yield and physiological traits.}
\end{align*}
\]

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<tbody>
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<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>L-Proline</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>L-Glycine</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
<tr>
<td>Gibberalic acid</td>
<td>Seed priming</td>
</tr>
<tr>
<td></td>
<td>Foliar spray</td>
</tr>
</tbody>
</table>
7. TRANSFER OF TECHNOLOGY SECTION (2015-16)

7.1 Integrated Multi-Media Publicity Campaign
Objectives:
1. Development of multi-media publicity materials on seed production & cotton production technology.
2. Use of media campaign to disseminate the new technology/research findings to different target groups.
   - Extension workers
   - Cotton growers
   - Field staff of private pesticide / fertilizer / seed industry
   - Students from Agriculture Colleges/ Universities

7.1.1 Print Media
A Publications
1. Management of Cotton cultivation
2. Recommendations for better germination of cotton seed
3. Management of sucking pests
4. Management of bollworms
5. Weed management in cotton
6. Production technology for approved CCRI varieties.
7. Balanced use of fertilizers
8. Management of Mealy bug
9. Management of CLCuV
10. Importance of nozzle for better spray coverage (insecticide & weedicides).
11. Micronutrients
12. Production technology of Bt. cotton
14. Articles on various aspects of cotton production for newspapers and journals
15. Preparation of technical reports

B Press Releases
Variable.

7.1.2 Electronic Media
A T.V. Programs
1. Participation of scientists/experts in agriculture programs of different channels
2. TV Seminar
3. TV Tellops
4. TV Discussion
5. Video stock-shots of different cultivation practices in cotton.

B Radio Programs
Dissemination of new cotton production technology.

---

### Previous Year’s Activities

<table>
<thead>
<tr>
<th>Programs</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Programs</td>
<td></td>
</tr>
<tr>
<td>Radio Talks</td>
<td>-</td>
</tr>
<tr>
<td>Radio News/Press releases</td>
<td>38</td>
</tr>
<tr>
<td>Interviews</td>
<td>-</td>
</tr>
<tr>
<td>TV Programs</td>
<td></td>
</tr>
<tr>
<td>Participation in PTV</td>
<td>03</td>
</tr>
<tr>
<td>and other local TV Channels</td>
<td></td>
</tr>
<tr>
<td>TV Coverage</td>
<td>04</td>
</tr>
<tr>
<td>Meetings / Visits</td>
<td></td>
</tr>
<tr>
<td>TV Tellops</td>
<td>01</td>
</tr>
<tr>
<td>Press releases</td>
<td>38</td>
</tr>
<tr>
<td>Press coverage</td>
<td>02</td>
</tr>
<tr>
<td>Press Advertisement</td>
<td>04</td>
</tr>
<tr>
<td>Articles in newspapers &amp; magazines</td>
<td>05</td>
</tr>
</tbody>
</table>

### Training Programs
Objectives:
Training Programs / Refresher Courses for:
1. Cotton Production Technology
2. Seed Production technology
3. Integrated Crop Management (ICM)
4. Integrated Pest Management (IPM)

Target Groups:
1. Officers and staff of the Department of Agriculture Extension
2. Cotton growers
3. Technical / Field staff of pesticide, fertilizer & seed industry.

Activities:
- Planning, development and execution of training / refresher courses
- Production for training materials

---

<table>
<thead>
<tr>
<th>Organized/ Coordinated by</th>
<th>Participant</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mintex &amp; CCRI, Multan</td>
<td>Master Trainees</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Farmers</td>
<td>469</td>
</tr>
<tr>
<td>Mintex &amp; PCCC</td>
<td>newly inducted SO's of PCCC</td>
<td>24</td>
</tr>
</tbody>
</table>
Visits to Institute

<table>
<thead>
<tr>
<th>Dignitaries/Delegation</th>
<th>Dated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Arshad Yaqoob, Deputy Secretary, PCCC</td>
<td>05.03.2014</td>
</tr>
<tr>
<td>Mr. Sikandar Masood, Deputy Secretary (Cotton), MinTex</td>
<td>02.05.2014</td>
</tr>
<tr>
<td>Six member Agri. Experts delegation from China &amp; Baluchistan</td>
<td>09.05.2014</td>
</tr>
<tr>
<td>Dr. Abdul Majeed, Country manager, ICARDA</td>
<td>26.06.2014</td>
</tr>
<tr>
<td>Mr. Shoukat Hayat Khan Bosan, MPA</td>
<td>19.08.2014</td>
</tr>
<tr>
<td>Dr. Don L. Keim , Agri, Business Associates Corporation, USA</td>
<td>27.08.2014</td>
</tr>
<tr>
<td>Dr. Dhuri (Manager Technical - Excel Crop Care Limited India)</td>
<td>16.09.2014</td>
</tr>
<tr>
<td>Dr. Khalid Abdullah, Vice President, PCCC</td>
<td>24.12.2014</td>
</tr>
<tr>
<td>Ch. Ramzan Ali, Deputy Secretary (Cotton) Ministry of Textile</td>
<td>16.02.2015</td>
</tr>
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</table>

Institutions

<table>
<thead>
<tr>
<th>Institutions</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Agriculture, Faisalabad</td>
<td>297</td>
</tr>
<tr>
<td>University College of Agriculture, BZU, Multan</td>
<td>201</td>
</tr>
<tr>
<td>Agriculture college Bahawalpur</td>
<td>81</td>
</tr>
<tr>
<td>College of Agriculture, D.G. Khan</td>
<td>143</td>
</tr>
<tr>
<td>Government College of Technology, Multan</td>
<td>113</td>
</tr>
<tr>
<td>Nawaz Sharif Agri. University, Multan</td>
<td>129</td>
</tr>
</tbody>
</table>

Presentations

| Multimedia slides for presentations for Meetings / seminars/Workshops | >1176 |
8. FIBRE TECHNOLOGY SECTION

8.1 Testing of Lint Samples

Objective:
To provide technical support to different sections of the Institute and other PCCC Research Institutes/ Stations in testing of fibre characteristics and spinning of their research material.

Year of Experiment: Continuous

<table>
<thead>
<tr>
<th>Departments</th>
<th>No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding, CCRI, Multan</td>
<td>23430</td>
</tr>
<tr>
<td>Cytogenetics, CCRI Multan</td>
<td>6134</td>
</tr>
<tr>
<td>Fibre Tech, CCRI, Multan</td>
<td>462</td>
</tr>
<tr>
<td>Entomology, CCRI, Multan</td>
<td>82</td>
</tr>
<tr>
<td>Agronomy, CCRI, Multan</td>
<td>57</td>
</tr>
<tr>
<td>CCRI, Sakrand</td>
<td>2074</td>
</tr>
<tr>
<td>CRS, Ghotki</td>
<td>4446</td>
</tr>
<tr>
<td>CRS, D.I.Khan</td>
<td>1404</td>
</tr>
<tr>
<td>CRI, Faisalabad</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>43126</td>
</tr>
</tbody>
</table>

8.2 Testing of Commercial Samples

Objective:
To extend fibre testing facilities to private sector in testing of lint samples.

Year of Experiment: Continuous

8.3 Effect of environment on fibre characteristics on different commercial cotton cultivars on different sowing dates.

Objective:
To study the different fibre characteristics of lint produced from cotton bolls developed at different growth period.

Year of Experiment: First

Treatments:
(a) Varieties: Variable
(b) Methodology:
   i. Tagging of flowers at seven days interval after appearance of first flower.
   ii. Picking of the cotton bolls at maturity.
   iii. Ginning of seed cotton samples.
   iv. Testing of different fibre characteristics.
   v. Germination percentage of seed of different flowering dates.

8.4 To study the effect of cotton leaf curl virus on fibre characteristics of some cotton cultivars

Objective:
Cotton Leaf Curl Virus (CLCuV) is a very serious disease for cotton crop. Therefore, it necessitates studying the effects of this disease on fibre quality.

Treatments:
Varieties: Variable

Methodology:
   i. Collection of opened bolls from healthy plants.
   ii. Collection of opened bolls from virus affected plants.
   iii. Ginning of seed cotton samples for various fibre characteristics.
   vi. Testing of different fibre characteristics

Observations:
   - Lint (%age)
   - Fibre Length
   - Uniformity Index
   - Micronaire Value
   - Maturity Ratio
   - Fibre Strength
   - Color Grade

Year of Experiment: Continuous

8.5 Quality survey of lint collected from ginning factories

Objective:
A quality survey will be conducted to know the lint quality of the ginning factories during the cotton season.
Methodology:

- Collection of lint samples from the ginning factories of different districts in Punjab.

Observations:

- Fibre Length
- Uniformity Index
- Micronaire
- Fibre Strength
- Trash (%age)
- Color Grade

**Year of Experiment:** Continuous

<table>
<thead>
<tr>
<th>Department</th>
<th>No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICR&amp;T, Karachi</td>
<td>4977</td>
</tr>
<tr>
<td>Survey conducted by PICR&amp;T, Karachi and samples were tested at CCRI, Multan</td>
<td></td>
</tr>
</tbody>
</table>

**8.6 International Cotton Check Tests Programme**

**Objective:**

To keep the fibre testing equipment in calibrated form. Moreover analysis of fibre at par with other fibre testing facilities in the world.

**Detail:**

A number of lint samples will be received from the Faser Institute, Bremen, Germany. The samples will be tested for different fibre characteristics. The results will be sent to Faser institute, Germany for comparative study.

**Year of Experiment:** Continuous

<table>
<thead>
<tr>
<th>Previous Year's Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 samples were received from Faser Institute, Germany for fibre analysis during the period under report.</td>
</tr>
</tbody>
</table>

=================================
9. STATISTICS SECTION

9.1 Statistical Analysis and Experimental Design

Objective:

To make lay out plan for National Coordinated Varietal Trials for Director Research, PCCC, Karachi. To perform Statistical analysis of experimental data submitted by sections of the institute. The analysis facility will also be provided to Cotton Research Stations and Directorate of Research, PCCC Head Quarter.

Detail:

In collaboration with sections of the institutes lay out plan for different experimental design will be chalked out. Data tables of experiments will be analyzed statistically. Guidance will be provided for the interpretation of the analysis.

<table>
<thead>
<tr>
<th>Previous Year’s Work</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C.R.D</td>
<td>20</td>
</tr>
<tr>
<td>R.C.B.D.</td>
<td>270</td>
</tr>
<tr>
<td>Split Plot</td>
<td>72</td>
</tr>
<tr>
<td>Split-Split</td>
<td>11</td>
</tr>
<tr>
<td>F-Pool</td>
<td>3</td>
</tr>
<tr>
<td>Regression</td>
<td>22</td>
</tr>
<tr>
<td>Correlation</td>
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<td>Graphical Representation</td>
<td>28</td>
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<tr>
<td>Covariance</td>
<td>18</td>
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<td>PCA</td>
<td>3</td>
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<tr>
<td>Description Analysis</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>497</strong></td>
</tr>
</tbody>
</table>

9.2 Maintenance of Cotton Statistics

Objective:

To maintain the record of cotton statistics and rates of cotton commodities.

Detail:

The record of cotton statistics and daily rates of cotton commodities will be maintained.

Year: Continuous

<table>
<thead>
<tr>
<th>Previous Year's Prices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Seedcotton</td>
<td>2397</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>1129</td>
</tr>
<tr>
<td>Cottonseed Cake</td>
<td>1157</td>
</tr>
<tr>
<td>Cottonseed Oil</td>
<td>4076</td>
</tr>
<tr>
<td>Lint</td>
<td>5502</td>
</tr>
</tbody>
</table>

Source: Market Committee Multan. (September 2014 to January 2015)