PAKISTAN CENTRAL COTTON COMMITTEE

RESEARCH PROGRAMME

CENTRAL COTTON RESEARCH INSTITUTE,

MULTAN

(2015-2016)

PO Box 572
Old Shuja Abad Road,
Multan, Pakistan

Phone : 061-9200340-41
Fax : 061-9200342
Email : ccri.multan@yahoo.com

RESEARCH PROGRAMME

CENTRAL COTTON RESEARCH INSTITUTE,

MULTAN

(2015-2016)

C O N T E N T S

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 June (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 potential yield.

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 :

- 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 1st March produced maximum yield (3884 kg ha^{-1}), while minimum by 15th May (2070 kg ha^{-1}).
- Averaged across the sowing dates, *Bt*.CIM-616 produced significantly higher seed cotton yield than *Bt*.Cyto-177 and *Bt*.CIM-598.
- The reduction in yield was 4.3, 14.3, 22.6, 41.6 and 46.7% by delay in sowing of crop up to March 01.

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
[Main: genotypes]

Replications : 4

Plot size : 20' x 30'

Sowing date : 1st 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

Potassium fertilizer (kg $ha^{-1)}$	Time of application
0	-----
100	Full at sowing
	2 splits (1/2 at sowing+1/2 at 45 DAP
200	Full at sowing
	4 splits (1/2 at sowing+1/2 at 30 DAP+1/2 at 45 DAP+1/2 at 60 DAP

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

Soil applied K (kg K_2O ha^{-1})	Foliar application of 2 % K_2SO_4
0	No spray
	Four foliar spray of water
100	4 foliar spray of K_2SO_4
200	4 foliar spray of K_2SO_4

Layout : RCBD

Plot size : Available Experimental Area

Variety : 01 Variety *Bt.* CIM-616

Year : 1st

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:

T_1 Cotton as sole crop (Fallow land) early, farmers practice

T_2 Cotton sowing in standing wheat [Row to Row Distance 75 cm]

T_3 Cotton sowing in standing wheat [Row to Row Distance 150 cm]

T_4 Cotton planting after wheat harvesting, conventional method

Layout **:** RCBD

Plot size **:** Available Experimental Area

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

Year **:** 2nd

Sowing date (Tentative):

T_1 2nd or 3rd week of March
T_2 2nd or 3rd week of March
T_3 2nd or 3rd week of March
T_4 2nd or 3rd week of May

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

Layout **:** R.C.B.D.

Replications **:** 4

Plot size **:** 20' x 30'

Variety **:** *Bt.*CIM-178

Year of Expt. **:** **Continuous**

Observations:

- Weed intensity
- Plant structure
- Data on seed cotton yield and its components

==========

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-I

Objective		To test the performance of commercial varieties under Multan conditions
Varieties	**25**	CIM-446,CIM-482,CIM-473, CIM-506, CIM-707,CIM-496, CIM-534,CIM-554, CIM-573, BH-160,FH-901,NIAB-111, NIAB-846,NIAB-777, MNH-786, CRSM-38, NIBGE-2, CRIS-134, CRIS-342,Shahbaz,Marvi, Sindh-1, Malmal,Gomal-93, CIM-608
Design		Randomized complete block
Repeats	**3**	
Plot Size		30' x 10'
Year of Expt:		Continuous

2.2.2 Standard Varietal Trial-II

Objective		To test the performance of commercial *Bt*. varieties under Multan conditions
Varieties	**17**	CIM-598,CIM-599, CIM-602,A-1,A-555 AA-703,AA-802, MNH-886,NS-121,*Bt*.141 Sitara-008,CEMB-33, IUB-222,FH-114, FH-142,IR-3701, Tarzan-1
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 F_1 Hybrids

Objective		To raise F_2 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 F_2 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

2.4.3 F_2 Generation Block-2

Objective		To select the desirable segregates and screening against CLCuD
Families	**25**	(H-1483 to H-1507)
Standard		CIM-602
Plot Size		50' x 15'
Locations	**3**	(Multan, Khanewal, Kot Addu)
Year of Expt:		First

2.4.4 F_2 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

2.4.5 F_2 Generation Block-4

Objective		To select the desirable segregates and screening against CLCuD
Families	**25**	(H-1533 to H-1557)
Standard		CIM-602
Plot Size		50’ x 15’
Locations	**3**	(Multan, Khanewal, Kot Addu)
Year of Expt:		First

2.4.6 F_2 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 F_4 to F_6 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 F_4 to F_6 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 (F_3 Single Lines)

Objective		Testing and screening of selected F_2 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.

Previous Year's Results

Grown in field and maintained the following genetic material:

- 28 Species of *Gossypium*
- 12 Diploid and 4 tetraploid hybrids
- 4 Triploid and 2 hexaploid hybrids
- 3 Pentaploid hybrids
- 5 Tri-species and 1 tetra-species combinations
- 5 *G. hirsutum* races
- 1 *G. barbadense* race

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* x *G. herbaceum*
- *G. arboreum* x *G. anomalum*
- *G. arboreum* x *G. gossypioides*
- *G. arboreum* x *G. laxum*
- *G. arboreum* x *G. stocksii*
- *G. arboreum* x *G. somalense*
- *G. arboreum* x *G. areysianum*
- *G. arboreum* x *G. longicalyx*
- *G. hirsutum* x *G. herbaceum*
- *G. hirsutum* x *G. capitis viridis*
- *G.hirsutum x G.gossypioides*
- *G. hirsutum* x *G. laxum*
- *G .hirsutum* x *G. stocksii*
- *G. hirsutum* x *G. somalense*
- *G. hirsutum* x *G. areysianum*
- *G. hirsutum* x *G. longicalyx*
- **Planting of freshly obtained seeds of inter-specific hybrids following**
- F_4 of {2 (*G.hirs*. x *G. stock*.)} x *G. hirs* .
- F_1 of BC_5 {*G.hirs.* x2(*G.arbo.* x *G. anom.*) x ^{5}*G. hirs*. (*Bt*)
- F_2 of BC_4 {*G.hirs.* x2(*G.arbo.* x *G. anom.*) x ^{4}*G. hirs*. (*Bt*)
- F_3 of BC_3 {*G.hirs.* x2(*G.arbo.* x *G. anom.*) x ^{3}*G. hirs*. (*Bt*)
- F_1 of BC_5 [{2(*G.hirs.* x *G. anom.*) x *G. barba*.] x ^{5}*G. hirs* (*Bt*)
- F_2 of BC_4 [{2(*G.hirs.* x *G. anom.*) x *G. barba*.] x ^{4}*G. hirs* (*Bt*)
- F_3 of BC_3 [{2(*G.hirs.* x *G. anom.*) x *G. barba*.] x ^{3}*G. hirs* (*Bt*)

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

Previous Year's Results

- 6333 pollinations were attempted in 60 combinations.
- Boll setting was obtained in 52 combinations.
- One interspecific hybrid was studied cytologically.

3.3 Search for homozygous resistance against CLCuD under field conditions

3.3.1 Screening of F_6 material to obtain homozygous lines

[{2(*G. hirs.*x *G. anom.*) x ^{3}*G. hirs*.} x {2*(G. arbo.* x *G. anom.*) x ^{2}*G. hirs.* }x ^{2}*G. hirs*.]

- Screening of F_6 material as single plant progeny for obtaining homozygous virus resistant lines
- Data on economic and fibre quality traits

Methodology:
No. of F_6 families: 111
Plot size: Variable
Lay-out: Sick plot technique

Previous Year's Results

69 plants showed resistance against CLCuD up-to maturity.

3.3.2 Screening of F_7 material to obtain homozygous lines

[{2(*G. hirs.*x *G. anom.*) x ^{3}*G. hirs*.} x {2*(G. arbo.* x *G. anom.*) x ^{2}*G. hirs.* }x ^{2}*G. hirs*.]

- Screening of F_7 material will be tested in progeny row trail for obtaining homozygous virus resistant lines
- Data on economic and fibre quality traits

Methodology:
No. of F_7 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 F_6 material having desirable lint percentage and fiber quality

3.4 Conversion of interspecific material into transgenic lines

3.4.1 F_1 Generation

Objective:
To raise F_1 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 F_2 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 F_3 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)
Plot size: Variable
Year of Exp. Continuous

3.4.4 F_4 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)
Lay-out 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 1327.63kg 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 protocoal 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

A) Sex pheromone traps

- Male moth catches of *P.gossypiella, E. vittella, E. insulana,S. litura, S. exigua, H. armigera were 123, 44, 32, 29, 2238 and 207 percent higher than 2013* respectively at CCRI, Multan
- Male moth catches of *P.gossypiella, E. vittella, S. litura, S. exigua, H. armigera were 182, 12, 85, 2944 and 175 percent higher than 2013* respectively higher than last year at farmer's field
- Overall increasing trend of bollworm was observed at both the locations.

B) Light traps

- Moth catches of *E.* vittella, *S. litura, S. exigua* were 23, 17, & 1969 % higher while those of *E. insulana* and *H. armigera* were 31, 5% respectively lower as compared to 2013.

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

Parameters	Maximum	Minimum
Sucking Pests/leaf (Set-I)		
A.devastans	CIM-573 (0.71)	CIM-620 (0.62)
B. tabaci	CIM-573 (5.7)	Cyto-120 (4.8)
T. tabaci	Cyto-120 (1.4)	CIM-573 (0.68)
Bollworms damage (%) (Set-II)		
Earias spp.	CIM-573 (4.3)	CIM-620 (2.9)
P. gossypiella	CIM-620 (36.4)	CM-573 (15.2)
Seed cotton yield (kg ha^{-1})		
Set-I	Cyto-120 (1293)	CIM-620 (1223)
Set-II	Cyto-120 (1524)	CIM-573 (1246)
Set-III	Cyto-120 (2518)	CIM-573 (1325)

4.2.2 *Bt* strains

Treatments:

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

Cultivars : Variable

Layout : RCBD

Replications : 4

Plot size : 30' x 30'

Year of Expt. : Continuous

Observations :

- Sucking pests' population
- Bollworms' damage and live larval population
- Seed cotton yield

Previous Year's Results

Parameters	Maximum	Minimum
Sucking Pests/leaf (Set-I)		
A.devastans	CIM-616 (0.9)	CIM-622 (0.6)
B. tabaci	Cyto-177 (7.8)	CIM-616 (3.9)
T. tabaci	*CIM-616* (0.8)	CIM-602 (0.5)
Spotted bollworm damage (%)		
Set-I	Cyto-177 (1.2)	CIM-622 (0.13)
Set-II	CIM-616 (2.5)	CIM-622 (0.5)
Pink Bollworm damage (%)		
Set-I	Cyto-178 (30.3)	CIM-616 (15.2)
Set-II	CIM-616 (51.5)	Cyto-178 (42.4)
Seed cotton yield (kg ha^{-1})		
Set-I	Cyto-177 (3241)	CIM-622 (1725)
Set-II	CIM-616 (2283)	CIM-622 (1539)

4.2.3 National Coordinated Varietal Trials

Cultivars : Variable

Layout : RCBD

Replications : 3

Year of Expt. : Continuous

Observations:

- Population of sucking pests
- Bollworms infestation and live larval population

Previous Year's Results

A. Non *Bt* strains (Set-A)

Jassid and whitefly remained dominant among sucking pests and their intensity was maximum during July and was above ETL on all the strains. Maximum number of jassid was on A-1 and minimum on A-7. Whitefly was highest on A-10 and minimum on A-6. Spotted bollworm was maximum on A-3 and minimum on A-12. Pink bollworm infestation was high on A-7 and minimum on A-9.

B. *Bt* strains (Set-B)

Jassid in August and whitefly in July was above ETL in all strains. Jassid was maximum on B-14 and lower on B-5 whereas whitefly was maximum on B-1 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.

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 $\geq$ 70 % at 60 DAE was observed only on Cyto-178 and IUB-222. At 90 DAE the larval mortality further dropped and $\geq$ 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 ug/g fresh weight.

4.4 Development of natural enemies of sucking pests on treated and un-treated 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 : **2**
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/fruiting 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 : Continue

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 fittness 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 bolls)

Replications : 3

Year of Expt. : 2nd

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.

Previous Year's Results

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 : 2

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
7. Hibiscus
8. Milky weed

Pest Stages : 3

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

Previous Year's Results

Target pest	No. of insecticides tested
Jassid	19
Thrips	19
Whitefly	18
Mites	06

==========

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 *Pantoa 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

Previous Year's Results

i) 214 lines included in NCVT, National Coordinated Hybrid Trial, Bt Trial, PCCT and Standard Varietal Trials, showed susceptibility to CLCuD except one in MVT-1 under field conditions.
ii) 400 accessions of US germplasm (Ratoon) screened under field conditions and sixty four accessions did not show any symptoms of CLCuD.
iii) Out of 1050 US germplasm only 114 lines showed resistance to CLCuD under field condition.
iv) Graft transmission studies indicated that one line showed resistance against Virus

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 ~ 36.8ºC and minimum temperature at 27.4~ 29.5ºC 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)

Previous Year's Results

i) The progression of disease was low on crop planted earlier, whereas moderately high on crop planted in 15th May.
ii) Average across cultivars, minimum disease index was recorded on crop planted on 1st March and 15th March.
iii) Averaged across sowing time, minimum disease incidence was observed in cv Cyto-616
iv) Fortnightly increase of disease when compared with weather parameter, indicated that disease incidence was maximum during mid-July to end of August.
v) Maximum temperature of 35.2~ 36.8ºC and minimum temperature of 27.4 ~ 29.5ºC with relative humidity of 71.2 ~ 81.4 % were favoured fortnightly increases of CLCD in Bt cotton

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 viruleferance 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
ii) 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 P_2O_5 kg ha^{-1} (Farmer's practice)
T2: 400 N + 150 P_2O_5 + 125 K_2O kg ha^{-1}
T3: 300 N + 110 P_2O_5 + 90 K_2O kg ha^{-1} + Zn, B
T4: 225 N (170 kg from Urea + 56 kg from FYM)+ 80 P_2O_5 + 70 K_2O kg ha^{-1} + Zn, B
T5: 225 N + 80 P_2O_5 + 70 K_2O + 50 HA, kg ha^{-1} + Zn, B
T6: 225 N + 80 P_2O_5 + 70 K_2O, kg ha^{-1} + Zn, B
T7: 225 N + 80 P_2O_5 + 70 K_2O, kg ha^{-1} + Zn + B

**In T6 and T7 treatments cotton seed will be sown after treatment with Biozote @ 500g $acre^{-1}$ and Gibberrelic 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 P_2O_5 + 125 K_2O, kg ha^{-1} yielded máximum 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 ± 0.2 MPa LWP (ψ_w)]
Water stress (-2.4 ± 0.2 MPa LWP ψ_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

Biochemical treatment	Method of application
Control (water)	Seed priming
	Foliar spray
L-Proline	Seed priming
	Foliar spray
L-Glycine	Seed priming
	Foliar spray
Gibberalic acid	Seed priming
	Foliar spray

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.: 2nd

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

==========

7. TRANSFER OF TECHNOLOGY SECTION (2015-16)

7.1 Integrated Multi-Media Publicity Campaign

Objectives **:**

i) Development of multi-media publicity materials on seed production & cotton production technology.

ii) 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 <u>Publications</u>

i) Management of Cotton cultivation
ii) Recommendations for better germination of cotton seed
iii) Management of sucking pests
iv) Management of bollworms
v) Weed management in cotton
vi) Production technology for approved CCRI varieties.
vii) Balanced use of fertilizers
viii) Management of Mealy bug
ix) Management of CLCuV
x) Importance of nozzle for better spray coverage (insecticide & weedicides).
xi) Micronutrients
xii) Production technology of Bt. cotton
xiii) Clean cotton picking and its storage.
xiv) Articles on various aspects of cotton production for newspapers and journals
xv) Preparation of technical reports

B <u>Press Releases</u>

Variable.

7.1.2 Electronic Media

A <u>T.V. Programs</u>

i) Participation of scientists/experts in agriculture programs of different channels
ii) TV Seminar
iii) TV Tellops
iv) TV Discussion
v) Video stock-shots of different cultivation practices in cotton.

B <u>Radio Programs</u>

Dissemination of new cotton production technology.

<u>Previous Year's Activities</u>	
1. Leaflet on recommendations for better germination of cotton seed	= 4000
2.Technical Reports	= 02

Programs	**Number**
Radio Programs	
Radio Talks	-
Radio News/Press releases	38
Interviews	-
TV Programs	
Participation in PTV and other local TV Channels	03
TV Coverage	04
Meetings / Visits	
TV Tellops	01
Press releases	38
Press coverage	02
Press Advertisement	04
Articles in newspapers & magazines	05

7.2 Training Programs

Objectives **:** Training Programs / Refresher Courses for :

i) Cotton Production Technology
ii) Seed Production technology
iii) Integrated Crop Management (ICM)
iv) Integrated Pest Management (IPM)

Target Groups **:**

i) Officers and staff of the Department of Agriculture Extension
ii) Cotton growers
iii) Technical / Field staff of pesticide, fertilizer & seed industry.

Activities **:**

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

Previous Year's Activities		
Organized/ Coordinated by	**Participant**	**No. of Participants**
Mintex & CCRI, Multan	i)Master Trainees	51
	ii) Farmers	469
Mintex & PCCC	newly inducted SO's of PCCC	24

PCSI, Multan	Cotton Selectors	63
Mintex	Staff of CCRI, Multan	44
Agri.(Ext.), KP & NGO (Evolution)	i)Master Trainees ii) Farmers	16 72
WWF-Pakistan (RYK) & CCRI, Multan	Master Trainees	14
Fisheries Development Board	Fish Farmers	45
State Bank & HBL	i)Master Trainees ii) Farmers iii) Bank Officials	04 74 05

7.3 E-mail & face book page CCRI, Multan

- Updating cotton research & development (RD) activities on link www.facebook.com/CCRI.MTN

Email : ccri.multan@yahoo.com	
Email sent	> 1476
Email received	> 2508

7.4 Seminars/Workshops

Participation in seminars, workshops and conferences organized by different institutions:

Previous Year's Activities	
Seminars/ Workshops/Conference	Numbers
Seminars	08
Workshops	04
Conference	04

7.5 Other Activities

i) Making arrangements of meetings, seminars & workshops.

ii) Facilitate the visits of dignitaries and students of different institutions.

iii) Participation in Agricultural Exhibitions.

Previous Year's Activities	
Meetings	**Presided over by**
ARSC (PCCC)	Vice President , PCCC
Cotton Crop Management Group (CCMG)	Agriculture Minister, Punjab
Cotton Crop Assessment Committee (03)	Federal Secretary, Mintex
Technical Advisory Committee	Director General, Pak-EPA
ICARDA Cotton Project	Chairman, PARC

Visits to Institute

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

Institutions	No. of Participants
University of Agriculture, Faisalabad	297
University College of Agriculture, BZU, Multan	201
Agriculture college Bahawalpur	81
College of Agriculture, D.G. Khan	143
Government College of Technology, Multan	113
Nawaz Sharif Agri. University, Multan	129

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

Previous Year's Result	
Departments	**No. of Samples**
Breeding, CCRI, Multan	23430
Cytogenetics, CCRI Multan	6134
Fibre Tech, CCRI, Multan	462
Entomology, CCRI, Multan	82
Agronomy, CCRI, Multan	57
CCRI, Sakrand	2074
CRS, Ghotki	4446
CRS, D.I.Khan	1404
CRI, Faisalabad	60
Total	**43126**

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

Previous Year's Result	
Department	**No. of Samples**
PICR&T, Karachi	4977
Survey conducted by PICR&T, Karachi and samples were tested at CCRI, Multan	

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

Previous Year's Result
03 samples were received from Faser Institute, Germany for fibre analysis during the period under report.

==========

9. STATISTICS SECTION

9.1 Statistical Analysis and Experimental Design

Objective:

To make lay out plan for National Cordinated 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 wil be provided for the interpretation of the analysis.

Previous Year's Work	
C.R.D	20
R.C.B.D.	270
Split Plot.	72
Split-Split.	11
F-Pool	3
Regression.	22
Corelation	32
Graphical Representation	28
Covariance	18
PCA	3
Description Analysis	18
Total:	**497**

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

Previous Year's Prices (Average Price Rs per 40 Kg at Multan)	
Seedcotton	2397
Cottonseed	1129
Cottonseed Cake	1157
Cottonseed Oil	4076
Lint	5502

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

==========