

## **2. PLANT BREEDING AND GENETICS**

The word cotton was derived from Arabic word qutn/qutun, English word cotoun, French word coton and an old Italian word cotone. Cotton is an indigenous crop of Pakistan and is mainly grown as source of fiber, food and feed. Cotton fiber is an economic component and plays a vital role in uplifting country's economy. It earns 65% foreign exchange annually and accounts for 8.2% of value added income in Agriculture and 2% in GDP of Pakistan. Pakistan ranks fourth in area (3.2 million hectares) and production (14.3 million bales). Sindh produced 2.4 million bales, from 0.65 million hectares. In Pakistan yield/unit area is very low as compared to other major cotton growing countries of the world.

Cotton is grown on about three million hectares annually with average lint production of 670 kg ha<sup>-1</sup>. Globally, Pakistan is one of the largest cotton producing and consuming countries in the world. In the context of Muslim world, 29 countries produce cotton. Traditional plant breeding techniques have had a major impact on the Pakistan cotton industry through the production of the widely successful Cotton varieties released by Central Cotton Research Institute, Sakrand. Scientists are currently working on varieties that will address future challenges, like climate change, disease and pest threats, and industrial demand.

For attaining the envisaged cotton production target given in Cotton Vision 2015, besides ensuring adequate and timely availability of necessary inputs and technology transfer at the grass root level with particular reference to scientific crop and pest management, the research institutes have additionally been mandated to expedite development of cotton leaf curl virus resistant varieties, transgenic cotton varieties (Bt. cotton).

Plant breeders that are crucial to increasing the sustainability of agricultural production. Next to yield increase, plant breeders will have to work on enhancing yield stability assuring satisfying levels of production in low external input systems, increasing crop resistance to disease and pests, developing varieties that perform better under multiple cropping conditions and conserving biodiversity etc.

### **TEXTILE NEEDS**

For most end uses the textile mills want a fiber that runs efficiently on their textile machines and that produces a competitive quality end product at a competitive cost. In processing and in determining the end use of cotton, the following properties are critical (not in order of importance) Fiber length, fiber strength, micronaire, foreign matter, short fiber content, maturity, stickiness, fiber cohesion, and contaminants. Textile mills

continually modernize so that they can produce world-class quality yarns and fabrics at the highest possible efficiency and lowest cost. Modernizing equipment, however, is not the whole answer; the raw material (ginned lint) also plays a major role in accomplishing this objective. The yarn making system used determines which fiber properties are important. Generally, fibers are desirable if they are strong, fine, mature, long, uniform, and relatively free from neps, small trash, seed coat fragments, and dust. Cotton breeders should be encouraged to spend more effort on improving the strength, uniformity and fineness/maturity of most upland varieties. The use of proper harvesting and ginning techniques can preserve the properties of the lint and remove the objectionable non lint material to produce yarns of world-class quality. The research conducted by section is on right track to achieve following objectives:

- ❖ Evolution of high yielding cotton varieties with desirable fiber characteristics
- ❖ Early maturing
- ❖ Short stature
- ❖ Heat & drought tolerance
- ❖ Disease & insect pest resistance specially for cotton leaf curl virus (CLCuV) disease
- ❖ High ginning out-turn percentage or High Lint percent
- ❖ Longer fiber or Longer staple Length
- ❖ Stronger and finer fiber
- ❖ Development of new breeding material with transgenic/biotech cotton
- ❖ Low input requirements
- ❖ Production of Pre-basic seed of approved varieties
- ❖ Demonstration plots of new varieties at growers' field
- ❖ Collection and maintenance of Gene Pool

Testing and evaluation phases of newly developed high yielding, early maturing, heat and drought tolerant strains with better fiber qualities, tolerance against insect pests and Pathogen diseases specially for Cotton Leaf Curl Virus (CLCuV) disease are in progress at CCRI-Sakrand. New breeding material of different segregating generations has been selected on the basis of yield and other fiber characteristics. Efforts were taken to develop new breeding Bt. material with improved yield and other fiber traits.

National Coordinated Varietal Trials are conducted by Pakistan central Cotton Committee (PCCC) with the objective of testing promising breeding material/strains, developed by various cotton breeders of federal and provincially administrated institutions/private sector for adaptability under the different climatic/soil conditions of the varied ecological zones in the country. Candidate strains are tested in various trials under National Coordinated Varietal Trials (NCVT) programme under secret code in a uniform experimental design throughout the cotton belt of the country.

Pre-basic seed of standard varieties viz. CRIS-9, CRIS-5A, CRIS-134, CRIS-467, CRIS-121, CRIS-342 and CRIS129 has been produced for supply to public and private companies for further multiplication. The genetic stock of 500 local and 3076 exotic germplasm was also maintained and utilized in hybridization program to develop new breeding material.

## 2.1. Testing of Advanced Strains

### 2.1.1. Zonal Varietal Trial-1

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains for the development of standard varieties.

Six advanced strains viz. CRIS-537, CRIS-538, CRIS-542, CRIS-543, CRIS-547 and CRIS-550 were tested against standard variety CRIS-342.

**Table 2.1: Yield and fiber quality characters of new strains in Zonal Varietal Trial-1 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-537	3742	3.3	40.7	28.1	4.7	30.7	84.0	46207
CRIS-538	4028	3.5	42.4	28.4	4.5	28.6	81.2	42590
CRIS-542	3157	3.4	40.5	28.8	4.1	27.7	84.1	41423
CRIS-543	4531	3.9	43.7	29.2	4.4	31.3	80.0	38553
CRIS-547	4128	3.7	41.0	28.5	5.0	30.5	82.3	40467
CRIS-550	4371	3.4	43.0	28.9	3.2	28.0	86.0	44198
CRIS-342 (Std.)	3871	3.1	39.2	27.4	4.5	27.5	81.0	39232

**CD 5% = 452.1**

**CV% = 11.37**

The data presented in Table 2.1 shows that, advanced strain CRIS-543 produced highest seedcotton yield (4531 kg ha<sup>-1</sup>) followed by CRIS-550 (4371 kg ha<sup>-1</sup>) and CRIS-547 (4128 kg ha<sup>-1</sup>) as compared with standard variety CRIS-342 (3871 kg ha<sup>-1</sup>). The maximum boll weight (3.9 g) was given by CRIS-543 followed by CRIS-547 (3.7 g) and CRIS-538 (3.5 g) compared with standard variety CRIS-342 (3.1 g).

For quality evaluation, new strain CRIS-543 gave highest GOT (43.7%) followed by CRIS-550 (43.0%) and CRIS-538 (42.4%) compared with standard variety CRIS-342 (39.2%). CRIS-543 produced longer staple length (29.2 mm) followed by CRIS-550 (28.9 mm) and CRIS-542 (28.8 mm) compared with standard variety CRIS-342 (27.4 mm). CRIS-550 produced best micronaire value (3.2  $\mu\text{g inch}^{-1}$ ) followed by CRIS-542 (4.1  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.5  $\mu\text{g inch}^{-1}$ ). Maximum fiber strength produced by CRIS-550 (31.3  $\text{G tex}^{-1}$ ) followed by CRIS-547 (30.5  $\text{G tex}^{-1}$ ) and CRIS-537 (30.7  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (27.5  $\text{G tex}^{-1}$ ). Among all the advanced strains CRIS-550 also showed maximum fiber uniformity index (86.0%) followed by CRIS-542 (84.1%) compared with standard variety CRIS-342 (81.0%).

### 2.1.2. Zonal Varietal Trial-2

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains for the development of standard varieties.

Five advanced strains viz. CRIS-552, CRIS-553, CRIS-554, CRIS-558 and CRIS-559 were tested against CRIS-342 standard variety.

**Table 2.2: Yield and fiber quality characters of new strains in Zonal Varietal Trial-2 conducted at CCRI- Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength ( $\text{G tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-552	4458	3.3	42.8	28.6	4.6	28.6	87.0	41787
CRIS-553	3732	3.4	39.8	30.1	4.0	30.4	85.2	44728
CRIS-554	4387	3.6	41.2	28.3	4.2	31.3	86.3	42894
CRIS-558	3875	3.7	39.6	29.4	4.1	29.8	87.1	44106
CRIS-559	4064	3.3	40.3	30.0	4.5	29.0	88.6	37512
CRIS-342	3912	3.0	38.5	27.3	4.6	27.1	85.4	40394

CD 5% = 292.6

CV%= 7.18

Data presented in Table 2.2 indicate that, advanced strain CRIS-552 produced highest seed cotton yield (4458 kg ha<sup>-1</sup>) followed by CRIS-554 (4387 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3912 kg ha<sup>-1</sup>). In case of boll weight CRIS-558 was also better to have maximum boll weight (3.7 g) among all strains and standard variety CRIS-342 (3.0 g).

Advance strain CRIS-552 gave the highest GOT (42.8%) followed by CRIS-554 (41.2%) and CRIS-559 (40.3) compared with standard variety CRIS-342 (38.5%). For staple length CRIS-553 produced maximum staple length (30.1 mm) followed by CRIS-559 (30.0 mm) as compared with standard variety CRIS-342 (27.3 mm). CRIS-553 produced desirable micronaire value (4.0  $\mu\text{g inch}^{-1}$ ) followed by CRIS-558 (4.1  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.6  $\mu\text{g inch}^{-1}$ ). CRIS-554 showed better fiber strength (31.3  $\text{G tex}^{-1}$ ) followed by CRIS-553 (30.4  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (27.1  $\text{G tex}^{-1}$ ). The new strain CRIS-559 showed maximum fiber uniformity index (88.6 %) followed by CRIS-558 (87.1  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (85.4%).

### 2.1.3. Zonal Varietal Trial-3

#### Objectives

Testing and evaluation of high yielding, high GOT% and medium long staple advance strains against standard variety.

Six advanced strains viz. CRIS-560, CRIS-562, CRIS-567, CRIS-569, CRIS-574 and CRIS-575 were tested against Standard variety CRIS-342.

**Table 2.3: Yield and fiber quality characters of new strains in Zonal Varietal Trial-3 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength ( $\text{G tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-560	3931	3.0	41.5	28.6	4.8	29.2	83.5	44599
CRIS-562	3845	3.2	39.8	30.8	4.2	31.6	82.2	42858
CRIS-567	4078	3.1	42.6	28.7	4.5	30.3	83.3	40754
CRIS-569	4226	3.6	41.5	28.9	4.2	32.7	82.0	43911
CRIS-574	3753	3.5	40.9	30.1	4.1	29.8	82.5	40180
CRIS-575	4473	3.7	43.4	28.4	4.4	29.6	82.5	41155
CRIS-342 (Std.)	3824	3.2	38.8	27.2	4.7	27.4	81.6	39415

CD 5% = 257.9

CV% = 6.41

Table 2.3 reveals that new advanced strain CRIS-575 gave highest seed cotton yield (4473 kg ha<sup>-1</sup>) followed by CRIS-569 (4226 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3824 kg ha<sup>-1</sup>). Whereas, CRIS-575 also gave maximum boll weight (3.7 g) followed by CRIS-569 (3.6 g) compared with standard variety CRIS-342 (3.2 g). New advanced strain CRIS-575 gave the highest GOT (43.4%) followed by CRIS-567 (42.6%) and CRIS-560 (41.5) compared with standard variety CRIS-342 (38.8%). The

advanced strain CRIS-562 showed better staple length (30.8 mm) followed by CRIS-574 (30.1 mm) compared with standard variety CRIS-342 (27.2 mm). CRIS-574 produced desirable micronaire value (4.1  $\mu\text{g inch}^{-1}$ ) followed by CRIS-562 and CRIS-569 (4.2  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.7  $\mu\text{g inch}^{-1}$ )

The strong fiber strength was produced by CRIS-569 (32.7  $\text{G tex}^{-1}$ ) followed by CRIS-562 (31.6  $\text{G tex}^{-1}$ ) followed by CRIS-567 (30.3  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (27.4  $\text{G tex}^{-1}$ ). The maximum fiber uniformity index showed by advanced strain CRIS-560 (83.5%) followed by CRIS-567 (83.3%) compared with standard variety CRIS-342 (81.6%).

#### 2.1.4. Bt. Advanced Strain Test Trial-1

##### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard Bt. variety.

Five advanced strains viz. Bt. CRIS-596, Bt. CRIS-599, Bt. CRIS-600, Bt. CRIS-601 and Bt. CRIS-603 were tested against standard Bt. variety IR-3701.

**Table 2.4: Yield and fiber quality characters of new strains in Bt. Advanced Strain Trial-1 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength ( $\text{G tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
Bt. CRIS-596	3724	3.2	40.1	28.9	4.5	29.1	86.4	45158
Bt. CRIS-599	4065	3.4	39.4	30.8	4.6	29.6	85.1	44679
Bt. CRIS-600	4258	3.7	40.8	28.7	4.3	28.3	84.7	39512
Bt. CRIS-601	3618	3.5	41.8	28.5	4.5	29.7	85.2	41808
Bt. CRIS-603	4034	3.1	41.7	28.6	4.7	27.8	83.9	42382
IR-3701 (Std.)	3748	3.1	39.6	27.6	4.8	27.4	84.5	40373

CD 5% = 247.62

CV% = 6.33

Data presented in Table 2.4 shows that, advanced strain Bt. CRIS-600 gave highest seedcotton yield (4258 kg ha<sup>-1</sup>) followed by Bt. CRIS-599 (4065 kg ha<sup>-1</sup>) and Bt. CRIS-603 (4034 kg ha<sup>-1</sup>) compared with standard variety IR-3701 (3748 kg ha<sup>-1</sup>). In case of boll weight Bt. CRIS-600 gave maximum boll weight (3.7 g) followed by Bt. CRIS-601 (3.5 g) and Bt. CRIS-599 (3.4 g) compared with standard variety IR-3701 (3.1 g).

Advanced strain Bt. CRIS-601 produced highest GOT (41.8%) followed by Bt. CRIS-603 (41.7%) and Bt. CRIS-600 (40.8%) compared with standard Bt. variety IR-3701 (39.6%). The new advanced strain Bt.CRIS-599 showed longer staple length (30.8 mm) followed by Bt.CRIS-596 (28.9 mm) followed by CRIS-Bt.CRIS-600 (28.7 mm) compared to standard Bt. variety IR-3701 (27.6 mm). Desirable micronaire value was produced by Bt.CRIS-600 (4.3  $\mu\text{g inch}^{-1}$ ) followed by Bt.CRIS-596 and Bt.CRIS-601 (4.5  $\mu\text{g inch}^{-1}$ ) compared with standard variety IR-3701 (4.8  $\mu\text{g inch}^{-1}$ ).

Bt.CRIS-601 showed stronger fiber strength (29.7 G  $\text{tex}^{-1}$ ) followed by Bt.CRIS-599 (29.6 G  $\text{tex}^{-1}$ ) compared with standard Bt. variety IR-3701 (27.4 G  $\text{tex}^{-1}$ ). Bt.CRIS-596 showed maximum fiber uniformity index (86.4%) followed by Bt.CRIS-601 (85.2%) compared with standard Bt. variety IR-3701 (84.5%).

### 2.1.5. Advanced Strain Test Trial-2

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard variety.

Six advanced strains viz. CRIS-576, CRIS-577, CRIS-578, CRIS-579, CRIS-582 and CRIS-607 were tested against standard variety CRIS-342.

**Table 2.5: Yield and fiber quality characters of new strains in Advanced Strain Trial-2 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength (G $\text{tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-576	3576	3.2	39.1	30.1	4.3	29.5	86.5	43915
CRIS-577	4482	3.8	43.5	28.9	4.4	31.0	84.7	44820
CRIS-578	4074	3.0	38.9	29.6	4.5	30.3	87.3	40270
CRIS-579	3528	3.6	42.7	27.5	3.5	29.7	83.2	42219
CRIS-582	4151	4.1	42.6	28.2	4.7	31.3	86.1	41360
CRIS-607	4281	3.9	42.2	27.6	4.6	29.1	84.3	43820
CRIS-342 (Std.)	3911	3.0	38.1	27.1	4.9	27.4	85.6	38254

CD 5% = 325.48

CV% = 8.17

Table 2.5 indicate that, CRIS-577 produced higher seed cotton yield (4482 kg ha<sup>-1</sup>) followed by CRIS-607 (4281 kg ha<sup>-1</sup>) and CRIS-582 (4151 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3911 kg ha<sup>-1</sup>). Whereas CRIS-582 gave maximum boll weight (4.1 g) followed by CRIS-607 (3.9 g) compared with standard variety CRIS-342 (3.0 g).

CRIS-577 gave the highest GOT (43.5%) followed by CRIS-579 (42.7%) and CRIS-582 (42.6%) compared with standard variety CRIS-342 (38.1%). New advanced strain CRIS-576 gave longer staple length (30.1 mm) followed by CRIS-578 (29.6 mm) and CRIS-577 (28.9 mm) compared with standard variety CRIS-342 (27.1 mm). CRIS-579 produced best micronaire value (3.5 µg inch<sup>-1</sup>) followed by CRIS-576 (4.3 µg inch<sup>-1</sup>) compared to standard variety CRIS-342 (4.9 µg inch<sup>-1</sup>).

CRIS-582 showed stronger fiber strength (31.3 G tex<sup>-1</sup>) followed by CRIS-577 (31.0 G tex<sup>-1</sup>) followed by CRIS-578 (30.3 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.4 G tex<sup>-1</sup>). Among all the new strains CRIS-578 showed maximum fiber uniformity index (87.3%) followed by CRIS-576 (86.5 %) compared with standard variety CRIS-342 (85.6 %).

### 2.1.6. Advanced Strain Test Trial-3

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard variety.

Four advanced strains viz. CRIS-583, CRIS-584, CRIS-588 and CRIS-590 were tested against standard variety CRIS-342.

**Table 2.6: Yield and fiber quality characters of new strains in Advanced Strain Trial-3 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-583	4076	3.3	40.6	28.5	4.9	30.2	86.8	42336
CRIS-584	4232	3.1	42.2	28.0	5.2	29.6	86.2	40582
CRIS-588	3293	3.8	41.7	27.8	4.8	30.4	85.5	42655
CRIS-590	3065	3.0	40.1	29.0	4.6	27.5	88.2	39545
CRIS-342 (Std.)	3691	3.2	39.0	27.3	4.8	27.6	84.7	39283

**CD 5% = 548.61**

**CV% = 14.4**



Table 2.6 indicate that, advanced strain CRIS-584 gave maximum seedcotton yield (4232 kg ha<sup>-1</sup>) followed by CRIS-583 (4076 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3691 kg ha<sup>-1</sup>). Regarding maximum boll weight (3.8 g) was produced by CRIS-588 followed by CRIS-583 (3.3 g) compared with standard variety CRIS-342 (3.2 g).

Candidate Strain CRIS-584 gave the highest GOT (42.2%) followed by CRIS-588 (41.7%) and CRIS-583 (40.6%) compared with standard variety CRIS-342 (39.0%). CRIS-590 produced longer staple length (29.0 mm) followed by CRIS-583 (28.5 mm) compared with standard variety CRIS-342 (27.3 mm). CRIS-590 produced better micronaire value (4.6 µg inch<sup>-1</sup>) followed by CRIS-588 (4.8 µg inch<sup>-1</sup>) compare with standard variety CRIS-342 (4.8 µg inch<sup>-1</sup>).

CRIS-588 showed Stronger fiber strength (30.4 G tex<sup>-1</sup>) followed by CRIS-583 (30.2 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.6 G tex<sup>-1</sup>). CRIS-590 showed maximum uniformity index (88.2%) followed by CRIS-583 (86.8%) compared with standard variety CRIS-342 (84.7%).

#### 2.1.7. Advanced Strain Test Trial-4

##### Objectives

Testing and evaluation of high yielding, high GOT% and medium long staple strains against standard Variety.

Six advanced strains viz. CRIS-591, CRIS-592, CRIS-593, CRIS-594, CRIS-597 and CRIS-609 were tested against standard variety CRIS-342.

**Table 2.7: Yield and fiber quality characters of new strains in Advanced Strain Trial-4 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-591	3381	3.5	40.7	27.6	4.5	28.0	86.9	44010
CRIS-592	3062	3.2	41.3	28.3	4.7	29.7	87.0	41427
CRIS-593	2931	3.4	40.1	28.5	4.8	30.1	84.2	44679
CRIS-594	3652	3.2	41.4	27.9	4.2	30.8	85.0	39130
CRIS-597	4035	3.6	41.9	28.8	4.1	28.9	84.3	45924
CRIS-609	3977	3.3	42.6	28.5	4.0	28.4	85.7	41234
CRIS-342 (Std.)	3822	3.1	38.7	27.2	4.8	27.3	83.8	39610

CD 5% = 438.14

CV% = 12.3

Data presented in Table 2.7 exhibited that, CRIS-597 gave maximum seedcotton yield (4035 kg ha<sup>-1</sup>) followed by CRIS-609 (3977 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3822 kg ha<sup>-1</sup>). In case of boll weight, CRIS-597 gave maximum boll weight (3.6 g) followed by CRIS-591 (3.5 g) and CRIS-593 (3.4 g) compared with standard variety CRIS-342 (3.1 g).

CRIS-609 produced the highest GOT (42.6%) followed by CRIS-597 (41.9%) and CRIS-594 (41.4%) compared with standard variety CRIS-342 (38.7%). Longer staple length produced by new advanced strain CRIS-597 (28.8 mm) followed by CRIS-593 and CRIS-609 (28.5 mm) compared with standard variety CRIS-342 (27.2 mm). CRIS-609 produced better micronaire value (4.0 µg inch<sup>-1</sup>) followed by CRIS-597 (4.1 µg inch<sup>-1</sup>) compared with standard variety CRIS-342 (4.8 µg inch<sup>-1</sup>). Maximum fiber strength produced by CRIS-594 (30.8 G tex<sup>-1</sup>) followed by CRIS-593 (30.1 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.3 G tex<sup>-1</sup>). Out of all new strains CRIS-592 gave maximum fiber uniformity index (87.0%) followed by CRIS-591 (86.9%) compared with standard variety CRIS-342 (83.8%).

### 2.1.8. Advanced Strain Test Trial-5

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard variety.

Four advanced strains viz. CRIS-610, CRIS-611, CRIS-612 and CRIS-613 were tested against standard variety CRIS-342.

**Table 2.8: Yield and fiber quality characters of new strains in Advanced Strain Trial-5 conducted at CCRI-Sakrand during 2014-15.**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-610	3788	3.3	40.8	29.8	4.9	31.8	89.0	40728
CRIS-611	3916	3.0	41.3	28.1	4.8	29.3	85.5	42437
CRIS-612	3996	3.4	42.2	28.9	4.4	29.0	84.4	44213
CRIS-613	4177	3.7	42.9	28.7	5.2	29.5	86.2	43536
CRIS-342 (Std.)	3816	3.0	38.4	27.2	4.9	27.6	84.5	40113

**CD 5% = 156.8**

**CV% = 3.98**

Data presented in Table 2.8 exhibit that, CRIS-613 gave highest seed cotton yield (4177 kg ha<sup>-1</sup>) followed by CRIS-612 (3996 kg ha<sup>-1</sup>) and CRIS-611 (3916 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3816 kg ha<sup>-1</sup>), whereas CRIS-613 gave maximum boll weight (3.7 g) followed by CRIS-612 (3.4 g) compared with standard variety CRIS-342 (3.0 g).

CRIS-613 gave the highest GOT (42.9%) followed by CRIS-612 (42.2%) and CRIS-611 (41.3%) compared with standard variety CRIS-342 (38.4%). CRIS-610 showed longer staple length (29.8 mm) followed by CRIS-612 (28.9 mm) followed by CRIS-613 (28.7 mm) compared with standard variety CRIS-342 (27.2 mm). CRIS-612 produced better micronaire value (4.4 µg inch<sup>-1</sup>) followed by CRIS-611 (4.8 µg inch<sup>-1</sup>) compared with standard variety CRIS-342 (4.9 µg inch<sup>-1</sup>). CRIS-610 showed desirable fiber strength (31.8 G tex<sup>-1</sup>) followed by CRIS-613 (29.5 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.6 G tex<sup>-1</sup>). CRIS-610 showed maximum fiber uniformity index (89.0%) followed by CRIS-613 (86.2%) compared with standard variety CRIS-342 (84.5%).

### 2.1.9. Advanced Strain Test Trial-6

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard variety.

Five advanced strains viz. CRIS-617, CRIS-618, CRIS-619, CRIS-620 and CRIS-621 were tested against standard variety CRIS-342.

**Table 2.9: Yield and fiber quality characters of new strains in Advanced Strain Trial-6 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-617	4238	3.2	42.1	28.5	4.4	30.6	84.7	41984
CRIS-618	3845	3.3	41.5	28.5	4.9	27.8	86.1	43825
CRIS-619	3786	3.1	42.3	28.6	5.3	28.4	83.5	44155
CRIS-620	3699	3.0	41.3	28.0	4.5	30.7	84.2	40948
CRIS-621	3623	3.2	42.6	27.4	4.7	27.8	82.9	42781
CRIS-342 (Std.)	3712	3.1	39.1	27.3	4.8	27.6	82.4	40128

CD 5% = 219.8

CV% = 5.75

Table 2.9 reveals that new candidate strain CRIS-617 gave highest seedcotton yield (4238 kg ha<sup>-1</sup>) followed by CRIS-618 (3845 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3712 kg ha<sup>-1</sup>). Whereas, CRIS-618 gave maximum boll weight (3.3 g) followed by CRIS-617 and CRIS-621 (3.2g) compared with standard variety CRIS-342 (3.1 g).

CRIS-621 gave the highest GOT (42.6%) followed by CRIS-619 (42.3%) and CRIS-617 (42.1%) compared with standard variety CRIS-342 (39.1%). CRIS-619 produced maximum staple length (28.6 mm) followed by CRIS-617 and CRIS-618 (28.5mm) compared with standard variety CRIS-342 (27.3 mm). Better micronaire value produced by CRIS-617 (4.4 µg inch<sup>-1</sup>) followed by CRIS-620 (4.5 µg inch<sup>-1</sup>) compared with standard variety CRIS-342 (4.8 µg inch<sup>-1</sup>). Desirable fiber strength was showed by CRIS-620 (30.7 G tex<sup>-1</sup>) followed by CRIS-617 (30.6 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.6 G tex<sup>-1</sup>). Maximum fiber uniformity index produced by CRIS-618 (86.1%) followed by CRIS-617 (84.7%) compared with standard variety CRIS-342 (82.4%).

### 2.1.10. Advanced Strain Test Trial-7

#### Objectives

Testing and evaluation of high yielding high GOT% and medium long staple advance strains against standard variety.

Five advanced strains viz. CRIS-623, CRIS-629, CRIS-631, CRIS-632 and CRIS-634 were tested against standard variety CRIS-342.

**Table 2.10: Yield and fiber quality characters of new strains in Advanced Strain Trial-7 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-623	4278	3.1	40.3	29.3	4.5	31.3	86.8	43391
CRIS-629	3645	3.0	42.7	27.6	3.5	30.4	88.6	41542
CRIS-631	4057	3.3	40.2	26.8	4.4	28.1	85.2	44598
CRIS-632	4313	3.6	41.8	25.9	5.0	30.5	85.5	40644
CRIS-634	3731	3.3	41.3	27.5	4.6	31.2	84.2	43155
CRIS-342 (Std.)	3673	3.2	38.1	27.0	5.0	27.6	84.1	39835

CD 5% = 359.7

CV% = 9.0

Table 2.10 shows that CRIS-632 gave highest seedcotton yield (4313 kg ha<sup>-1</sup>) followed by CRIS-623 (4278 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3673 kg ha<sup>-1</sup>). Whereas, CRIS-632 also gave maximum boll weight (3.6 g) followed by CRIS-631 and CRIS-634 (3.3 g) compared with CRIS-342 (3.2 g).

CRIS-629 gave the highest GOT (42.7%) followed by CRIS-632 (41.8%) and CRIS-634 (41.3%) compared with standard variety CRIS-342 (38.1%). CRIS-623 produced maximum staple length (29.3 mm) followed by CRIS-629 (27.6 mm) and CRIS-634 (27.5mm) compared with standard variety CRIS-342 (27.0 mm). Among all the new advanced strain CRIS-629 produced best micronaire value (3.5µg inch<sup>-1</sup>) followed by CRIS-631 (4.4 µg inch<sup>-1</sup>) compared with standard variety CRIS-342 (5.0 µg inch<sup>-1</sup>). CRIS-623 showed maximum fiber strength (31.3 G tex<sup>-1</sup>) followed by CRIS-634 (31.2 G tex<sup>-1</sup>) and CRIS-632 (30.5 G tex<sup>-1</sup>) compared with standard variety CRIS-342 (27.6 G tex<sup>-1</sup>). CRIS-629 showed maximum fiber uniformity index (88.6%) followed by CRIS-623 (86.8%) compared with standard variety CRIS-342 (84.1%).

### 2.1.11. Advanced Strain Test Trial-8

#### Objectives

Testing and evaluation of high GOT% and medium long staple advance strains against standard variety CRIS-342.

Three advanced strains viz. CRIS-633, CRIS-636 and CRIS-638 were tested against standard variety CRIS-342.

**Table 2.11: Yield and fiber quality characters of Advanced Strain Trial-8 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-633	3692	3.0	43.4	28.7	5.3	29.6	88.3	40593
CRIS-636	3566	3.5	41.3	28.0	4.5	29.0	86.5	42337
CRIS-638	3895	3.2	41.6	27.9	4.2	28.0	85.1	41678
CRIS-342 (Std.)	3755	3.1	39.2	27.6	4.8	27.4	85.0	40628

**CD 5% = 328.0**

**CV% = 8.49**

Data presented in Table 2.11 indicate that, CRIS-638 produced maximum seedcotton yield (3895 kg ha<sup>-1</sup>) followed by CRIS-633 (3692 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3755 kg ha<sup>-1</sup>). Whereas, maximum boll weight (3.5 g) was produced by CRIS-636 followed by CRIS-638 (3.2 g) compared with standard variety CRIS-342 (3.1 g).

CRIS-633 gave the highest GOT (43.4%) followed by CRIS-638 (41.6%) and CRIS-636 (41.3%) compared with standard variety CRIS-342 (39.2%). CRIS-633 produced maximum staple length (28.7 mm) followed by CRIS-636 (28.0 mm) compared with standard variety CRIS-342 (27.6 mm). Better micronaire value produced by CRIS-638 (4.2  $\mu\text{g inch}^{-1}$ ) followed by CRIS-636 (4.5  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.8  $\mu\text{g inch}^{-1}$ ).

CRIS-633 showed desirable fiber strength (29.6  $\text{G tex}^{-1}$ ) followed by CRIS-636 (29.0  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (27.4  $\text{G tex}^{-1}$ ). CRIS-633 showed maximum fiber uniformity index (88.3%) followed by CRIS-636 (86.5%) compared with standard variety CRIS-342 (85.0%).

## 2.2. Testing of New Strains

### 2.2.1. Strain Test Trial-1

#### Objectives

Testing and evaluation of high GOT% and medium long staple strains against standard variety.

Five advanced strains viz. CRIS-642, CRIS-644, CRIS-646, CRIS-647 and CRIS-648 were tested against standard variety CRIS-342.

**Table 2.12: Yield and fiber quality characters of new strains in Strain Test Trial-1 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength ( $\text{G tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-642	3915	3.4	42.6	28.3	5.4	27.9	82.4	42577
CRIS-644	3870	3.2	40.3	28.0	5.5	29.1	81.3	40185
CRIS-646	3645	3.0	39.3	27.6	4.0	28.8	80.9	40422
CRIS-647	3587	2.9	41.2	27.8	4.9	28.6	82.7	39288
CRIS-648	3712	3.6	40.8	28.5	5.0	29.0	82.6	45926
CRIS-342 (Std.)	3657	3.1	38.5	27.2	4.8	27.6	81.1	40745

**CD 5% = 132.0**

**CV% = 3.53**

Data presented in Table 2.12 indicate that CRIS-642 gave maximum seedcotton yield (3915 kg ha<sup>-1</sup>) followed by CRIS-644 (3870 kg ha<sup>-1</sup>) and CRIS-648 (3712 kg ha<sup>-1</sup>) compared with (3657 kg ha<sup>-1</sup>) standard variety CRIS-342. Whereas, maximum boll weight (3.6 g) was produced by CRIS-648 followed by CRIS-642 (3.4 g) compared with standard variety CRIS-342 (3.1 g).

CRIS-642 produced highest GOT (42.6%) followed by CRIS-647 (41.2%) and CRIS-648 (40.8%) compared with standard variety CRIS-342 (38.5%). Longer staple length produced by CRIS-648 (28.5 mm) followed by CRIS-642 (28.3 mm) compared with standard variety CRIS-342 (27.2 mm). Better micronaire value produced by CRIS-646 (4.0  $\mu\text{g inch}^{-1}$ ) followed by CRIS-647 (4.9  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.8  $\mu\text{g inch}^{-1}$ ).

CRIS-644 showed desirable fiber strength (29.1  $\text{G tex}^{-1}$ ) followed by CRIS-648 (29.0  $\text{G tex}^{-1}$ ) compared with standard variety CRIS-342 (27.6  $\text{G tex}^{-1}$ ). Maximum fiber uniformity index produced by CRIS-647 (82.7) followed by CRIS-648 (82.6%) compared to standard variety CRIS-342 (81.1%).

### 2.2.2. Strain Test Trial-2

#### Objectives

Testing and evaluation of high yielding high GOT% and medium long staple advance strains against standard variety.

Six advanced strains viz. CRIS-650, CRIS-652, CRIS-656, CRIS-657, CRIS-658 and CRIS-659 were tested against standard variety CRIS-342.

**Table 2.13: Yield and fiber quality characters of new strains in Strain Test Trial-2 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield ( $\text{kg ha}^{-1}$ )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength ( $\text{G tex}^{-1}$ )	Uniformity index (%)	Plant population ( $\text{ha}^{-1}$ )
CRIS-650	3711	3.3	40.3	29.1	4.5	33.2	87.8	38959
CRIS-652	3827	3.5	42.7	28.5	4.3	28.3	83.4	42650
CRIS-656	4138	3.0	42.2	28.4	4.9	29.6	82.8	44085
CRIS-657	3528	3.1	41.3	27.9	4.8	30.2	85.2	43618
CRIS-658	4027	3.4	41.9	28.0	4.9	28.4	84.0	45051
CRIS-659	3678	3.2	40.1	28.9	4.1	30.0	86.5	41722
CRIS-342 (Std)	3716	3.0	39.1	27.3	4.7	27.7	84.3	38414

**CD 5% = 212.0**

**CV% = 5.57**

Table 2.13 exhibited that, CRIS-656 gave maximum seedcotton yield (4138  $\text{kg ha}^{-1}$ ) followed by CRIS-658 (4027  $\text{kg ha}^{-1}$ ) compared with standard variety CRIS-342 (3716  $\text{kg ha}^{-1}$ ). In case of boll weight CRIS-652 produced maximum boll weight (3.5 g) followed by CRIS-658 (3.4 g) compared with standard variety CRIS-342 (3.0 g).



CRIS-652 gave the highest GOT (42.7%) followed by CRIS-656 (42.2%) compared with standard variety CRIS-342 (39.1%). Strain CRIS-650 produced longer staple length (29.1 mm) followed by CRIS-659 (28.9 mm) compared with standard variety CRIS-342 (27.3 mm). Better micronaire value ( $4.1 \mu\text{g inch}^{-1}$ ) produced by CRIS-659 followed by CRIS-652 ( $4.3 \mu\text{g inch}^{-1}$ ) compared to standard variety CRIS-342 ( $4.7 \mu\text{g inch}^{-1}$ ). CRIS-650 showed desirable fiber strength ( $33.2 \text{ G tex}^{-1}$ ) followed by CRIS-657 ( $30.2 \text{ G tex}^{-1}$ ) compared with standard variety CRIS-342 ( $27.7 \text{ G tex}^{-1}$ ).

Maximum fiber uniformity index showed by CRIS-650 (87.8%) followed by CRIS-659 (86.5%) compared with standard variety CRIS-342 (84.3%).

### 2.2.3. Strain Test Trial-3

#### Objectives

Testing and evaluation of high GOT% and medium long staple strains against standard variety.

Seven advanced strains viz. CRIS-664, CRIS-665, CRIS-666, CRIS-667, CRIS-668, CRIS-669 and CRIS-670 were tested against standard variety CRIS-342.

**Table 2.14: Yield and fiber quality characters of new strains in Strain Test Trial-3 conducted at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-664	3643	3.6	39.7	27.5	4.6	28.6	83.7	39029
CRIS-665	3978	3.8	38.9	28.6	4.2	29.7	84.4	45857
CRIS-666	3548	3.6	40.5	27.8	4.5	30.4	83.9	41112
CRIS-667	3259	3.2	41.3	27.8	4.8	29.1	82.7	43228
CRIS-668	3721	3.1	39.2	28.7	4.7	30.8	85.2	44087
CRIS-669	3173	3.3	40.6	28.1	4.4	28.7	83.5	42677
CRIS-670	2881	3.5	41.4	30.2	4.5	29.3	85.3	44304
CRIS-342 (Std.)	3710	3.0	38.5	27.3	4.8	28.2	83.4	40372

**CD 5% = 367.0**

**CV % = 10.49**

Data presented in Table 2.14 indicate that, CRIS-665 produced maximum seedcotton yield (3978 kg ha<sup>-1</sup>) followed by CRIS-668 (3721 kg ha<sup>-1</sup>) compared with standard variety CRIS-342 (3710 kg ha<sup>-1</sup>). Whereas, CRIS-665 gave maximum boll weight (3.8 g) followed by CRIS-664 and CRIS-666 (3.6 g) compared with standard variety CRIS-342 (3.0 g).



CRIS-670 gave the highest GOT (41.4%) followed by CRIS-667 (41.3%) and CRIS-669 (40.6%) compared with standard variety CRIS-342 (38.5%). CRIS-670 produced maximum staple length (30.2 mm) followed by CRIS-668 (28.7 mm) compared with standard variety CRIS-342 (27.3 mm). CRIS-665 has better micronaire value (4.2  $\mu\text{g inch}^{-1}$ ) followed by CRIS-669 (4.4  $\mu\text{g inch}^{-1}$ ) compared with standard variety CRIS-342 (4.8  $\mu\text{g inch}^{-1}$ ). CRIS-668 showed desirable fiber strength (30.8 G  $\text{tex}^{-1}$ ) followed by CRIS-666 (30.4 G  $\text{tex}^{-1}$ ) compared with standard variety CRIS-342 (28.2 G  $\text{tex}^{-1}$ ). CRIS-670 showed maximum fiber uniformity index (85.3%) followed by CRIS-668 (85.2%) compared with standard variety CRIS-342 (83.4%).

#### 2.2.4. Bt. Strain Test Trial-4

##### Objectives

Testing and evaluation of high yielding high GOT% and medium long staple strains against standard Bt. variety.

Four strains viz. Bt.CRIS-671, Bt.CRIS-672, Bt.CRIS-673 and Bt.CRIS-674 were tested against standard Bt. Variety IR-3701.

**Table 2.15: Yield and fiber quality characters of Bt. Strain Test Trial-4 conducted CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value ( $\mu\text{g inch}^{-1}$ )	Fiber Strength (G $\text{tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
Bt. CRIS-671	4015	3.3	39.7	28.7	4.6	30.3	84.1	41322
Bt. CRIS-672	3735	3.0	40.3	29.0	4.4	28.8	83.7	39835
Bt. CRIS-673	4173	3.1	38.8	29.1	4.5	28.1	84.4	40456
Bt. CRIS-674	3542	2.9	42.6	28.5	4.7	30.4	83.6	42285
Bt. IR-3701 (Std)	3788	3.0	38.8	27.6	4.6	28.6	82.7	39788

CD 5% = 246.0

CV% = 6.41

Data presented in Table 2.15 shows that highest seed cotton yield (4173 kg ha<sup>-1</sup>) was produced by Bt.CRIS-673 followed by Bt.CRIS-671 (4015 kg ha<sup>-1</sup>) compared with standard Bt. variety IR-3701 (3788 kg ha<sup>-1</sup>). Whereas, Bt.CRIS-671 gave maximum boll weight (3.3 g) followed by Bt.CRIS-673 (3.1 g) compared with standard Bt. variety IR-3701 (3.0 g).

Bt.CRIS-674 gave the highest GOT (42.6%) followed by Bt.CRIS-672 (40.3%) and Bt.CRIS-671 (39.7%) compared with standard Bt. variety IR-3701 (38.8%). Among all new Bt. strain Bt.CRIS-673 produced longer staple length (29.1 mm) followed by Bt.CRIS-672 (29.0 mm) compared with standard Bt. variety IR-3701 (27.6 mm). Better micronaire value produced by Bt.CRIS-672 ( $4.4 \mu\text{g inch}^{-1}$ ) compared with standard Bt. variety IR-3701 ( $4.6 \mu\text{g inch}^{-1}$ ). Bt.CRIS-674 showed desirable fiber strength ( $30.4 \text{ G tex}^{-1}$ ) followed by Bt.CRIS-671 ( $30.3 \text{ G tex}^{-1}$ ) compared with standard Bt. variety IR-3701 ( $28.6 \text{ G tex}^{-1}$ ). Bt.CRIS-673 showed maximum fiber uniformity index (84.4%) followed by Bt.CRIS-671 (84.1%) compared with standard Bt. variety IR-3701 (82.7%).

### **2.3. Testing of Advanced Strains in Zonal Varietal Trial at Farmers' field.**

#### **Objective**

Testing and evaluation of advanced strains at farmers' field in different cotton growing areas of Sindh Province.

Three high yielding and better fiber characters new strains were tested against standard variety CRIS-342 at 20 locations of Sindh Province. Data presented in Table 2.21 shows that, on an overall average of all locations, CRIS-543 produced the maximum seed cotton yield ( $4339 \text{ kg ha}^{-1}$ ) followed by CRIS-577 ( $4261 \text{ kg ha}^{-1}$ ) and CRIS-641 ( $4105 \text{ kg ha}^{-1}$ ) compared with standard variety CRIS-342 ( $3876 \text{ kg ha}^{-1}$ ).

**Table 2.21: Yield performance (kg ha<sup>-1</sup>) of advanced strains in zonal varietal trial at farmer's field during 2014-15.**

Sr. No.	Name of Grower	District	Strain/variety			Standard
			CRIS-543	CRIS-577	CRIS-641	CRIS-342
1.	Dr. Syed Noor Ali Shah	Umer kot	4239	4188	4019	3935
2.	Mr. Abdul Qadir Baloch	Mir pur khas	4431	4389	4275	3826
3.	Mr . Mansoor A. Cheema	Mir pur khas	4347	4287	4019	3922
4.	Dr. M. Umer Memon	Thatta	4169	4081	4113	3872
5.	Haji Ghulam Qadir Chang	Badin	4049	4136	3995	3918
6.	Mr. Abdul Latif Mangrio	Tando Allahyar	4377	4314	4086	3827
7.	Mr. Niaz Muhammad Nizamani	Tando Allahyar	4454	4384	4129	3965
8.	Mr. Manzoor Ali Lakhier	Hyderabad	4266	4153	4023	3824
9.	Syed Nadim Shah	Matiari	4368	4200	4092	3719
10.	Mr. Ghullam Rasool Ahpan	Sanghar	4593	4440	4267	3966
11.	Qadeer Farm Shahdadpur	Sanghar	4422	4316	4152	3883
12.	Syed Ghulam Sarwar Shah	Shaheed Benazirabad	4314	4178	4092	3726
13.	Mr. Ghulam Abass Rahu	Shaheed Benazirabad	4578	4265	4253	3832
14.	Mr. Jamaldin Khoso	Shaheed Benazirabad	4418	4313	4215	3935
15.	Mr. Tufail Ahmed Jalbani	Naushahro Feroze	4366	4319	4088	4015
16.	Mr. Ishtiaque Ahmed Memon	Naushahro Feroze	4259	4233	4155	3811
17.	Raees Ghulam Qasim Jiskani	Khairpur	4335	4336	3978	3882
18.	Khurshed Ahmed Mandan	Khairpur	4238	4276	4049	3913
19.	Malik Mushtaque Awan	Sukkur	4122	4192	4018	3821
20.	Jam Ikram Dharejo	Ghotki	4438	4227	4075	3928
<b>Average</b>			<b>4339</b>	<b>4261</b>	<b>4105</b>	<b>3876</b>

**Table 2.22: GOT% age of advanced strains at Farmer's field during 2014-15**

Sr. No.	Name of Grower	District	Strain/variety			Standard
			CRIS-543	CRIS-577	CRIS-641	CRIS-342
1.	Dr. Syed Noor Ali Shah	Umer kot	43.5	43.3	42.4	38.1
2.	Mr. Abdul Qadir Baloch	Mir pur khas	42.8	42.9	42.0	38.0
3.	Mr . Mansoor A. Cheema	Mir pur khas	43.1	43.5	41.9	38.9
4.	Dr. M. Umer Memon	Thatta	43.0	42.8	41.8	38.2
5.	Haji Ghulam Qadir Chang	Badin	42.9	43.3	41.2	39.0
6.	Mr. Abdul Latif Mangrio	Tando Allahyar	43.4	43.0	41.9	38.3
7.	Mr. Niaz Muhammad Nizamani	Tando Allahyar	43.0	43.6	41.5	38.7
8.	Mr. Manzoor Ali Lakhier	Hyderabad	43.7	43.1	41.7	38.2
9.	Syed Nadim Shah	Matitari	43.4	43.3	41.3	39.0
10.	Mr. Ghullam Rasool Ahpan	Sanghar	42.7	43.7	42.0	38.5
11.	Qadeer Farm Shahdadpur	Sanghar	43.5	43.0	41.8	38.1
12.	Syed Ghulam Sarwar Shah	Shaheed Benazirabad	42.8	43.4	41.6	38.7
13.	Mr. Ghulam Abass Rahu	Shaheed Benazirabad	43.6	43.2	41.1	38.6
14.	Mr. Jamaldin Khoso	Shaheed Benazirabad	42.6	43.3	41.2	38.2
15.	Mr. Tufail Ahmed Jalbani	Naushahro Feroze	43.3	43.0	41.6	39.0
16.	Mr. Ishtiaque Ahmed Memon	Naushahro Feroze	43.0	42.7	41.7	38.4
17.	Raees Ghulam Qasim Jiskani	Khairpur	43.2	43.4	42.0	39.0
18.	Khurshed Ahmed Mandan	Khairpur	43.4	43.6	41.4	38.1
19.	Malik Mushtaque Awan	Sukkur	43.3	43.1	42.0	38.6
20.	Jam Ikram Dharejo	Ghotki	43.0	43.2	41.9	38.0
<b>Average:</b>			<b>43.1</b>	<b>43.2</b>	<b>41.0</b>	<b>38.4</b>

Table 2.22 shows that, on an overall average of all 20 locations, new strain CRIS-577 gave the highest GOT (43.2%) followed by CRIS-543 (43.1%) compared with standard variety CRIS-342 (38.4 %).

**Table 2.23: Staple length (mm) of advanced strains at Farmer's field during 2014-15**

Sr. No.	Name of Grower	District	Strain/variety			Standard
			CRIS-543	CRIS-577	CRIS-641	CRIS-342
1.	Dr. Syed Noor Ali Shah	Umer kot	29.0	28.7	28.0	27.0
2.	Mr. Abdul Qadir Baloch	Mir pur khas	29.1	28.2	27.9	27.5
3.	Mr . Mansoor A. Cheema	Mir pur khas	28.9	28.1	28.2	27.2
4.	Dr. M. Umer Memon	Thatta	29.2	28.4	28.4	27.3
5.	Haji Ghulam Qadir Chang	Badin	28.8	27.9	28.3	27.1
6.	Mr. Abdul Latif Mangrio	Tando Allahyar	28.7	28.3	28.0	27.4
7.	Mr. Niaz Muhammad Nizamani	Tando Allahyar	29.3	27.8	28.5	27.2
8.	Mr. Manzoor Ali Lakhier	Hyderabad	29.2	28.6	27.9	27.0
9.	Syed Nadim Shah	Matiari	29.0	28.0	28.1	27.4
10.	Mr. Ghullam Rasool Ahpan	Sanghar	29.1	28.3	28.0	27.5
11.	Qadeer Farm Shahdadpur	Sanghar	28.7	28.1	28.5	27.2
12.	Syed Ghulam Sarwar Shah	Shaheed Benazirabad	29.0	28.4	28.1	27.1
13.	Mr. Ghulam Abass Rahu	Shaheed Benazirabad	28.9	28.0	28.3	27.4
14.	Mr. Jamaldin Khoso	Shaheed Benazirabad	29.2	28.2	28.4	27.2
15.	Mr. Tufail Ahmed Jalbani	Naushahro Feroze	29.0	28.5	28.3	27.0
16.	Mr. Ishtiaque Ahmed Memon	Naushahro Feroze	28.9	28.6	28.2	27.5
17.	Raees Ghulam Qasim Jiskani	Khairpur	29.2	28.1	28.5	27.4
18.	Khurshed Ahmed Mandan	Khairpur	29.0	28.3	28.1	27.0
19.	Malik Mushtaque Awan	Sukkur	28.9	28.0	28.4	27.3
20.	Jam Ikram Dharejo	Ghotki	29.0	28.2	28.0	27.1
<b>Average:</b>			<b>29.0</b>	<b>28.3</b>	<b>28.2</b>	<b>27.2</b>

Data presented in Table 2.23 reveals that, on an overall average of all locations, CRIS-533 Measured longer staple length (28.6 mm) followed by CRIS-585 (28.5 mm) compared with standard variety CRIS-342 (27.4 mm).

## 2.4. National Coordinated Variety Testing (NCVT) Programme

The Pakistan Central Cotton Committee is responsible for evaluation of cotton varieties only. These trials determine the suitability, adaptability and disease response of the variety. At provincial level, the agriculture research departments carry out evaluation at agricultural research farms.

### 2.4.1. National Coordinated Varietal Trial (Set-A)

#### Objectives

Testing of promising strains of different cotton breeders of Pakistan under National Coordinated Varietal Trial (NCVT) Programme of Pakistan Central Cotton Committee (PCCC).

One Hybrid Bt. promising coded candidate strains along with two standards were tested at CCRI-Sakrand during 2014-15.

**Table 2.24: Performance of Non-Bt Candidate Strain in NCVT (Set-A) at CCRI-Sakrand during 2014-15.**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
CRIS-533	3319	2.9	41.7	27.6	4.5	30.6	83.3	37942
TH-112	2601	3.9	37.9	27.6	4.5	30.8	80.8	36417
BH-177	2691	3.9	42.2	27.9	4.9	30.6	82.5	29869
MPS-27	2691	3.5	32.8	27.6	4.8	31.6	83.5	36507
CRIS-585	3498	3.5	42.5	29.2	4.4	33.0	84.5	37224
NIAB-414	2691	4.0	36.3	30.7	4.2	33.9	84.8	29780
DNH-40	2247	3.3	33.8	27.5	4.3	34.5	82.2	26909
TH-120	2960	3.3	36.9	26.0	4.7	28.8	83.0	40095
IUB-75	1345	3.8	35.6	27.1	4.7	31.7	85.1	10405
CIM-620	1256	2.8	42.0	28.8	4.8	33.9	86.9	14352
AA-132	2063	3.8	37.7	26.4	4.9	30.3	84.1	17760
GS-433	807	4.0	34.9	27.4	4.7	31.9	85.6	13455
CRIS-342	2889	3.5	38.2	26.9	4.6	30.4	82.8	39108

Data presented in Table 2.24 shows that, CRIS-585 produced maximum seedcotton yield (3498 kg ha<sup>-1</sup>) followed by CRIS-533 (3319 kg ha<sup>-1</sup>) and TH-120 (2960 kg ha<sup>-1</sup>) compared with standard CRIS-342 (2889 kg ha<sup>-1</sup>).

NIAB-414 and GS-433 produced maximum boll weight (4.0 g) followed by TH-112/05 and BH-177 (3.9 g) compared to standard CRIS-342 (3.5 g). Highest GOT% was produced by CRIS-585 (42.5) followed by candidate strain BH-177 (42.2%) compared to Standard CRIS-342 (38.2 %). NIAB-414 produced the maximum staple length (30.7 mm) followed by CRIS-585 (29.2) compared to standard CRIS-342 (26.9 mm). NIAB-414 produced better micronaire value (4.2 µg inch<sup>-1</sup>) followed by DNH-40 (4.3 µg inch<sup>-1</sup>) compared to standard CRIS-342 (4.6 µg inch<sup>-1</sup>). DNH-40 showed stronger fiber strength (34.5 G tex<sup>-1</sup>) followed by NIAB-414 and CIM-620 (33.9 G tex<sup>-1</sup>) compared to standard CRIS-342 (30.4 G tex<sup>-1</sup>). Maximum fiber uniformity index (86.9%) produced by CIM-620 followed by GS-433 (85.6) compared to standard CRIS-342 (82.8 %).

## 2.4.2. National Coordinated Varietal Trial (Set- B)

### Objectives

Testing of promising strains of different Cotton Breeders of Pakistan under National Coordinated Varietal Trial (NCVT) Programme of Pakistan Central Cotton Committee (PCCC).

**Table 2.25: Performance of candidate Strains in NCVT (Set-B) at CCRI-Sakrand during 2041-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant Population (ha <sup>-1</sup> )
IUB-13	1704	3.85	35.5	27.1	4.4	31.4	85.1	19464
IR.NIBGE-6	1884	3.67	36.2	28.6	4.5	33.9	86.5	29510
FH-Lalazar	3229	4.90	36.4	28.7	4.3	32.7	82.6	28793
Cyto-177	2691	3.72	38.6	28.9	4.0	33.6	83.8	31484
VH-305	1973	3.92	41.4	28.1	4.0	32.9	84.6	16684
SLH-8	2063	3.39	35.9	29.5	4.3	32.8	85.4	24667
BH-184	2422	3.25	38.8	29.4	4.2	33.0	84.6	30318
MNH-988	2512	3.55	37.9	27.4	4.8	30.5	85.2	30049
CIM-616	2512	3.82	38.3	28.0	4.8	31.8	83.8	28793
CEMB-66	2332	3.54	35.0	27.8	4.5	32.8	83.2	36776

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Mike Value (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant Population (ha <sup>-1</sup> )
CIM-622	2153	4.11	34.7	27.6	4.8	32.0	86.5	34175
CEMB-77	2960	3.79	36.1	27.6	4.4	31.5	85.1	33278
IR.NIBGE-7	2512	3.82	36.2	27.7	4.8	32.4	86.0	28165
Cyto-178	2781	3.97	38.1	26.0	3.9	33.5	83.8	28165
BH-185	2781	3.18	37.2	29.3	4.3	32.0	84.6	36148
FH-Noor	1884	3.84	35.0	29.0	4.5	31.9	85.2	21617
VH-327	2601	3.86	36.8	29.3	4.6	32.1	84.4	25564
NIAB-874B	2601	3.62	39.7	27.5	4.5	31.1	81.9	31304
Baghdadi	3139	3.52	37.3	27.12	4.2	32.2	84.0	32740
RH-647	2242	3.99	35.8	28.4	4.4	32.9	84.0	24039
TH-21/09	2422	3.82	35.0	28.6	3.5	34.7	83.9	29600
IUB-63	2512	3.16	35.7	25.9	5.0	32.4	83.6	24577
CIM-602 (std. 1)	2332	3.37	38.7	29.5	4.0	33.3	84.5	34892
FH-142 (std. 2)	2691	3.68	38.8	26.8	4.3	31.5	83.5	35520

Data presented in Table 2.25 shows that, FH-Lalazar produced highest seedcotton yield (3229 kg ha<sup>-1</sup>) followed by Bhagdadi (3139 kg ha<sup>-1</sup>) compared with standard-1 CIM-602 (2332 kg ha<sup>-1</sup>) and Standard-2 (2691 kg ha<sup>-1</sup>). FH-Lalazar the candidate strain produced maximum boll weight (4.9 g) followed by CIM-622 (4.1 g) compared to standard-1 CIM-602 (3.8 g) and standard-2 FH-142 (3.6 g). The highest GOT (41.4%) produced by VH-305 followed by NIAB-874B (39.7%) compared to standard-1 (38.7%) and standard-2 (38.8%).

SLH-8 produced the longer staple length (29.5 mm) followed by BH-184 (29.4 mm) compared to standard-1 CIM-602 (29.5 mm) and standard-2 FH-142 (26.8 mm). TH-21/09 produced better micronaire value (3.5 µg inch<sup>-1</sup>) followed by Cyto-178 (3.9 µg inch<sup>-1</sup>) compared to standard-1 CIM-602 (4.0 µg inch<sup>-1</sup>) and standard-2 FH-142 (4.3 µg inch<sup>-1</sup>). TH-21/09 produced stronger fiber strength (34.7 G tex<sup>-1</sup>) followed by IR-NIBGE-6 (33.9 G tex<sup>-1</sup>) compared to standard-1 CIM-602 (33.3 G tex<sup>-1</sup>) and standard-2 FH-142 (31.5 G tex<sup>-1</sup>).



IR-NIBGE-6 and CIM-622 produced maximum fiber uniformity index (86.5%) followed by IR.NIBGE-7 (86.0%) compared with standard-1 CIM-602 (84.5 %) and standard-2 FH-142 (83.5%).

### 2.4.3. National Coordinated Varietal Trial (Set-C)

#### Objectives

Testing of promising strains of different Cotton Breeders of Pakistan under National Coordinated Varietal Trial (NCVT) Programme of Pakistan Central Cotton Committee (PCCC).

**Table 2.26: Performance of candidate strains in NCVT (Set-C) at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Fiber Fineness (µg inch <sup>-1</sup> )	Fiber Strength (G tex <sup>-1</sup> )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
SAHARA-120	2242	3.19	39.1	28.0	4.3	32.3	84.1	36417
Leader-3	1884	4.0	35.9	29.0	4.2	32.2	83.1	34175
Eagle-1	2153	3.8	34.9	26.8	5.1	32.3	85.1	26999
Tarzan-4	1525	3.9	34.7	29.8	4.4	31.6	85.4	22783
AGC-999	1345	3.8	37.9	26.9	4.8	32.2	84.7	21079
Sitara-13	1615	4.3	35.2	28.9	4.6	30.9	85.1	26820
CA-926	1525	3.5	35.4	27.1	4.7	31.8	83.9	27178
Leader-5	1794	3.7	38.5	26.9	4.7	31.6	85.5	29421
JS-733	1884	3.6	37.1	27.3	4.2	30.8	85.9	27358
BS-70	1973	4.1	38.5	26.2	4.7	31.2	84.9	26730
CRYSTAL-1	2063	3.9	38.0	25.4	4.9	31.6	83.2	38301
Tahafuz-3	1525	3.8	38.2	27.4	4.5	31.0	81.9	28703
SAHARA-150	1615	3.6	37.2	27.3	4.1	31.7	82.3	26999
AGC-NAZEER-1	1525	3.9	36.5	26.4	4.4	30.9	81.8	24487
Sitara-14	1794	3.6	38.8	27.4	4.6	30.9	82.0	23321
Auriga-215	1525	4.2	37.8	27.3	4.7	30.0	82.2	22245
CIM-602 (std.1)	1435	3.3	35.9	28.0	4.9	32.0	85.2	20541
FH-142 (std.2)	2332	3.3	39.1	27.0	4.1	31.5	82.9	30138

Sixteen coded candidate Bt. strains along with two standards were tested at CCRI-Sakrand during 2014-15. Table 2.26 indicates that, Non of the variety has produced highest yield (2332 kg ha<sup>-1</sup>) by FH-142 standard 2. Sitara-13 produced maximum boll weight (4.3 g) followed by Auriga-215 (4.2 g) compared to standard-1 CIM-602 (3.3 g) and standard-2 FH-142 (3.3 g). SAHARA-120 produced the highest GOT (39.1%) compared with standard-1 CIM-602 (35.9%) and standard-2 FH-142 (39.%).

Tarzan-4 has produced the longer staple length (29.8 mm) followed by Leader-3 (29.0 mm) compared to standard-1 CIM-602 (28.0 mm) and standard-2 FH-142 (27.0 mm). SAHARA-150 gave better micronaire value (4.1  $\mu\text{g inch}^{-1}$ ) compared to standard-1 CIM-602 (4.9  $\mu\text{g inch}^{-1}$ ) and standard-2 FH-142 (4.1  $\mu\text{g inch}^{-1}$ ). Stronger fibre produced by SAHARA-120 (32.3 G  $\text{tex}^{-1}$ ) and Eagle-1 (32.3 G  $\text{tex}^{-1}$ ) followed by Leader-3 (32.2 G  $\text{tex}^{-1}$ ) and AGC-999 (32.2 G  $\text{tex}^{-1}$ ) compared to standard-1 CIM-602 (32.0 G  $\text{tex}^{-1}$ ) and standard-2 FH-142 (31.5 G  $\text{tex}^{-1}$ ). JS-733 produced maximum fiber uniformity index (85.9 %) followed by Leader-5 (85.5%) compared to standard-1 CIM-602 (85.2%) and standard-2 FH-142 (82.9%).

#### 2.4.4. National Coordinated Varietal Trial (Set-D)

##### Objectives

Testing of promising strains of different Cotton Breeders of Pakistan under National Coordinated Varietal Trial (NCVT) Programme of Pakistan Central Cotton Committee (PCCC).

**Table 2.27: Performance of candidate Strains in NCVT (Set-D) at CCRI-Sakrand during 2014-15**

Strain	Seed cotton yield (kg ha <sup>-1</sup> )	Boll weight (g)	GOT (%age)	Staple length (mm)	Fiber Fineness ( $\mu\text{g inch}^{-1}$ )	Fiber Strength (G $\text{tex}^{-1}$ )	Uniformity index (%)	Plant population (ha <sup>-1</sup> )
Al.Seemi HBt.209	2332	3.1	39.8	27.1	4.6	30.1	82.3	27268
Bt.hybrid-53	2601	3.3	38.3	28.3	4.5	30.4	84.9	29690
CIM-602 (std.1)	2242	3.5	34.5	29.3	4.1	30.4	83.0	37494
FH-142 (std.2)	2601	3.8	37.1	28.1	4.0	30.8	82.2	37763

Data presented in Table 2.27 shows that Bt.Hybrid-53 and standard-2 FH-142 gave highest yield (2601 kg ha<sup>-1</sup>) followed by Alseemi HBt.209 (2332 kg ha<sup>-1</sup>) compared to standard-1 CIM-602 (2242 kg ha<sup>-1</sup>). Both Standard-2 and Standard-1 gave higher boll weight (3.8 g) and (3.5 g) respectively against the candidates strains. Alseemi HBt.209 gave the highest GOT (39.8 %) followed by Bt.Hybrid-53 (38.3%) compared to standard-1 Bt.CIM-602 (34.5 %) and standard-2 FH-142 (37.1%). Standard-1 CIM-602 measured the longer staple length (29.3 mm) followed by Bt.Hybrid-53 (28.3 mm) compared to standard-2 FH-142 (28.1 mm). None of the candidate strain has better micronaire value than both standards.

Standard-2 FH-142 showed strong fiber strength (30.8 G tex<sup>-1</sup>) followed by Bt.Hybrid-53 and standard-1 CIM602 (30.4 G tex<sup>-1</sup>). Bt.Hybrid-53 produced maximum fiber uniformity index (84.9%) compared to standard-1 CIM-602 (83.0%) and standard-2 (82.2%).

## 2.5 Genetic stock

The institute has about 3576 germplasm lines to maintain and increase genetic diversity for future cotton breeding program. The detail is given in Table 2.28.

**TABLE 2.28: DETAIL OF GENETIC STOCK OF WORLD COTTON COLLECTION.**

Local genotypes	500
Exotic genotypes	3076
<b>Species wise detail</b>	
<i>Gossypium hirsutum</i> L.	1890
<i>Gossypium barbadense</i> L.	8
<i>Gossypium arborieum</i> L.	939
<i>Gossypium herbaceum</i> L.	239
<b>Total</b>	<b>3576</b>

## 2.6 Breeding Material

Single plant selection was made from the promising breeding material on different segregating generations for further testing against the bollworms and CLCuV. The details of breeding material and number of plants selected during 2014-15 are given in Table 2.29.

**Table 2.29: Details of breeding material and number of plants and their fiber characteristics.**

Hybrid/ Generations	No. of Combinations	No of single plants selected	Seed cotton yield plant <sup>-1</sup> (g)		GOT (%age)		Staple length (mm)	
			Min.	Max.	Min.	Max.	Min.	Max.
F <sub>1</sub> Hybrid	82	410	91.34	263.00	38.52	43.36	27.5	29.3
F <sub>2</sub> Generation	36	380	76.44	238.0	37.21	41.03	27.8	30.0
F <sub>3</sub> Generation	59	300	62.83	156.95	38.4	43.2	27.6	29.7
F <sub>4</sub> Generation	43	59	84.26	173.07	36.1	43.5	28.4	30.2
F <sub>5</sub> Generation	20	50	68.50	161.52	38.0	44.2	28.4	30.8
F <sub>6</sub> Generation	19	48	90.54	224.90	37.1	43.3	28.1	30.6

## 2.7. Production of Pre-Basic Seed

Pre basic seed of seven standard varieties viz. CRIS-9, Marvi, CRIS-134, CRIS-467, CRIS-121, CRIS-342 and CRIS-129 developed at CCRI-Sakrand was produced for distribution to Foundation Seed Cell, Seed Companies, Progressive Growers and Research Stations of Sindh Province for further multiplication and demonstration plots.

**Table 2.30: Production of Pre-Basic Seed**

Sr. No.	Name of Variety	Quantity of Pre-basic seed (kg)
1.	CRIS-9	20
2.	Marvi (CRIS-5A)	20
3.	CRIS-134	200
4.	CRIS-467	20
5.	CRIS-121	20
6.	CRIS-342	225
7.	CRIS-129	400
<b>Total</b>		<b>905</b>

## 2.8. Development of New Breeding Material

In order to develop new breeding material, fresh crosses were attempted, based on different objectives. Special attention was diverted to develop new breeding material resistant/tolerant against bollworm complex and CLCuV. Fresh crosses were attempted in 107 combinations and successful bolls were collected during 2014-15.

**Table 2.31: List of Fresh Crosses with Bt. Varieties**

Sr. No.	Cross Combination	Crossed bolls
1.	CIM-599 X Sayban-202	01
2.	“ X Tarzon-4	01
3.	“ X RCA-333	02
4.	“ X Sahara-120	02
5.	“ X BZU-75	03
6.	“ X FH-142	02
7.	“ X JS-212	02
8.	PG-38 X Bt.CIM-602	01
9.	CIM-602 X Sayban-202	01
10.	“ X Tarzon-4	01
11.	“ X Sahara-120	04
12.	“ X BZU-75	04

13.	NIA-80	X CIM-616	05
14.	“	X FH-Lalazar	01
15.	“	X JS-212	02
16.	PB-38	X Sayban-202	04
17.	“	X RCA-333	01
18.	“	X Sahara-120	02
19.	“	X BZU-75	05
20.	“	X CIM-616	02
21.	“	X FH-Lalazar	02
22.	“	X FH-142	03
23.	“	X JS-212	02
24.	“	X MNH-886	04
25.	IUB-222	X Tarzon-3	01
26.	“	X Tarzon-4	01
27.	“	X Sahara-120	01
28.	“	XCyto-177	02
29.	“	X FH-142	02
30.	“	X JS-212	01
31.	“	X Bt.CIM-602	01
32.	VH-303	X Tarzon-4	04
33.	“	X Cyto-177	02
34.	“	X FH-Lalazar	01
35.	“	X FH-142	03
36.	“	X JS-212	01
37.	“	X MNH-886	03
38.	“	X Bt.CIM-602	02
39.	MNH-456	X Sayban-202	02
40.	“	X Tarzon-3	01
41.	“	X RCA-333	02
42.	“	X Sahara-120	02
43.	“	X CIM-616	11
44.	“	X Cyto-177	02
45.	“	X FH-Lalazar	02
46.	“	X CIM-602	04
47.	MNH-886	X Sayban-202	01
48.	“	X Sahara-120	03
49.	“	X BZU-75	02
50.	“	X CIM-616	02
51.	“	X FH-142	03
52.	“	X CRIS-560	01
53.	FH-192	X Sayban-202	02
54.	“	X Tarzon-3	02
55.	CIM-612	X Tarzon-4	05
56.	“	X RCA-333	08
57.	“	X Sahara-120	09
58.	“	X CIM-616	04
59.	“	X Cyto-177	05
60.	“	X FH-Lalazar	07
61.	IUB-11	X FH-142	10

62.	“	X JS-212	07
63.	“	X CRIS-560	01
64.	“	X MNH-886	05
65.	“	X Bt.CIM-602	07
66.	NIAB-Bt.1	X Tarzon-3	01
67.	“	X RCA-333	01
68.	“	X Sahara-120	02
69.	“	X BZU-175	01
70.	“	X FH-142	02
71.	“	X MNH-886	01
72.	“	X Bt.CIM-602	01
73.	RCA-2	X Sayban-202	04
74.	“	X Tarzon-3	02
75.	“	X Tarzon-4	01
76.	“	X RCA-333	05
77.	“	X BZU-75	01
78.	“	X CIM-616	03
79.	“	X Cyto-177	02
80.	“	X FH-Lalazar	03
81.	“	X FH-142	05
82.	“	X JS-212	03
83.	“	X CRIS-560	01
84.	“	X MNH-886	05
85.	“	X Bt.CIM-602	02
86.	BGC	X Sayban-202	20
87.	“	X Tarzon-3	02
88.	“	X Tarzon-4	04
89.	“	X RCA-333	01
90.	“	X BZU-75	01
91.	“	X CIM-616	06
92.	“	X FH-Lalazar	04
93.	“	X FH-142	16
94.	“	X JS-212	04
95.	“	X Cyto-124	02
96.	“	X CRIS-560	01
97.	“	X MNH-886	02
98.	“	X Bt.CIM-602	03
99.	CEMB-44	X Sayban-202	04
100.	“	X Tarzon-3	06
101.	“	X Tarzon-4	03
102.	“	X RCA-333	02
103.	“	X Sahara-120	01
104.	“	X BZU-175	01
105.	“	X CIM-616	02
106.	“	X FH-Lalazar	06
107.	“	X Cyto-124	02

## **2.9. Testing of Long and Extra Long Staple Cotton Varieties/Lines in Coastal areas of Sindh and Balochistan (2014-2015)**

### **PREAMBLE**

Cotton is an important cash crop for Pakistan known as “white gold”. It accounts for 8.2 % of the value added in agriculture and about 3.2% to GDP. Cotton is an important economic and fiber crop in 70 countries in the world & over 180 million peoples are associated with the fiber industry. Cotton is main source of foreign exchange and bring about 60% of the total annual earnings from the export of raw cotton material and the furnish products. Pakistan is the 4<sup>th</sup> largest cotton producing country in the world. Cotton has been enjoying very important position in crop production ever since the dawn of civilization. The earliest cottons grown and spun into fabrics were in the Indus Valley as displayed by the excavations at Mohenjo-Daro, dating back to 3500 BC. Cotton seeds about 9,000 years old, the oldest in the world so far, have been found at the foot of Bolan Pass in Balochistan.

Cotton therefore can rightly be called as the lifeline of the economy of country, due to introduction of improved cotton varieties. Breeders in Pakistan are trying since many decades through breeding techniques to achieve substantial improvement in the yield and fibre quality of cotton. Among the fibre qualities which contribute most to spinning value are staple length, fibre fineness and strength. The staple length constitutes the basic norm for evaluation of quality cotton in the Trade and Textile Industry. Historically, staple length classifies into various categories. It has undergone into changes over the years and different parameters have been adopted in Egypt, USA, India and Pakistan with marginal differences. It is the need of the day to develop extra long staple cotton varieties to meet the future demands.

### **CURRENT STANDARDS FOR STAPLE LENGTH CLASSIFICATION OF PAKISTAN COTTON.**

1.	Below 20.6 mm	Short
2.	20.7 – 25.4 mm	Medium
3.	26.2 – 27.8 mm	Medium Long
4.	28.6 – 33.3 mm	Long
5.	Above 33.5 mm	Extra long

Keeping in view the importance for the testing long and extra long staple (ELS) at various locations on farmer’s field in coastal areas of Sindh and Balochistan as proposed by Cotton Commissioner Ministry of Commerce and Textile Industry, Government of Pakistan. It was decided by the house in ARSC meeting held at CCRI Multan on (day-2

Thursday) April 04, 2013 that during this cotton season 2014-15 the testing trials be conducted at 2 locations one each in Sindh and Balochistan. The seed of varieties were provided by different research Institutes/stations. The details are as below:

**Table 2.35: SEED OF VARIETIES PROVIDED BY DIFFERENT RESEARCH INSTITUTES/STATIONS**

S.#	VARIETY	INSTITUTE/STATION
1.	TH-112/05	Tandojam
2.	Chandi-95	Nuclear Institute of Agriculture Tandojam
3.	BH-180	Cotton Research Station Bahawalpur
4.	Cyto-124	Central Cotton Research Institute Multan
5.	CIM-573	Central Cotton Research Institute Multan
6.	Bt.CIM-602	Central Cotton Research Institute Multan
7.	CEMB-33	Centre of Excellence and Molecular Biology Lahore
8.	IUB-264	Islamia University Bahawalpur
9.	MNH-994	Cotton Research Station Multan
10.	NIAB-112	Nuclear Institute of Agriculture Faisalabad
11.	NIAB-852	Nuclear Institute of Agriculture Faisalabad
12.	NIAB-2008	Nuclear Institute of Agriculture Faisalabad
13.	NIAB-Kiran	Nuclear Institute of Agriculture Faisalabad
14.	Alseemi H-61	Alseemi Seeds Multan
15.	Alseemi H-65	Alseemi Seeds Multan
16.	3300	National Institute of Biotechnology & Genetic Engineering, Faisalabad
17.	33-1-1-14	National Institute of Biotechnology & Genetic Engineering, Faisalabad
18.	33-1-1-24	National Institute of Biotechnology & Genetic Engineering, Faisalabad

The trials were conducted according as the approved program of work on two locations in coastal areas of Sindh and Balochistan, one was laid out at Winder Agro Farm Balochistan and other on the field at Gharho, District Thatta.

**DETAILS OF THE EXPERIMENTS:**

DESIGN:	Non- Replicated
PLOT SIZE:	50' X 10' (4 rows) Gharho, Thatta, Sindh
	55' X 7.5' (3 rows) Coconut Agriculture Farm Uthal
ROW TO ROW SPACING:	2.5'
SOWING DATE:	27-05-2014 (Gharho Thatta Sindh)
	27-05-2014 (Uthal Balochistan)
NO. OF VARIETIES:	18

The studies have been carried out on the Seedcotton yield (Kg ha<sup>-1</sup>), Number of Bolls/plant, Boll weight (g), Ginning out turn %age, Staple length (mm), Micronaire (µg inch<sup>-1</sup>), Uniformity Index % and Plant height (cm).



**Table 2.36: Performance of Long and Extra Long Staple cotton varieties/lines conducted at Gahro Thatta during 2014-2015.**

Variety	Seed Cotton Yield (Kg ha <sup>-1</sup> )	No. of bolls/per plant	Boll weight (g)	GOT (%)	Staple length (mm)	Mike Value (µg inch)	Uniformity index (%)	Plant height (cm)
TH-112/05	2932	30.5	3.2	40.5	27.6	4.4	81.6	91.0
Chandi-95	2688	27.0	3.0	38.3	25.6	4.3	80.0	93.0
BH-180	2192	22.1	3.1	39.2	26.3	4.0	80.0	106
Cyto-124	1677	17.4	3.3	40.8	29.0	4.1	81.6	102
CIM-573	2367	24.7	3.3	38.0	29.5	4.1	83.0	101
Bt.CIM-602	1865	18.1	3.1	37.5	28.9	3.6	80.8	90
CEMB-33	1976	21.4	3.1	39.4	23.1	4.0	76.6	96
IUB-264	2960	28.7	3.0	40.2	26.5	3.9	81.1	103
MNH-994	2532	26.9	3.2	39.1	26.4	4.3	80.9	101
NIAB-112	2016	19.6	3.0	38.2	26.3	3.8	80.8	113
NIAB-852	2354	24.2	3.1	38.7	26.9	3.8	79.3	92
NIAB-2008	2067	21.3	3.2	38.0	26.6	4.2	80.4	97
NIAB-Kiran	2355	25.5	3.0	40.1	27.7	3.8	80.8	98
Alseemi H-61	1814	19.6	3.1	39.0	25.6	3.8	79.6	96
Alseemi H-65	1733	17.7	2.8	41.1	26.6	4.6	80.9	97
3300	1978	23.8	3.1	39.8	27.0	4.0	80.4	95
33-1-1-14	1633	18.9	2.8	40.3	27.5	4.1	81.6	102
33-1-1-24	1532	16.2	3.0	35.2	27.5	4.4	81.5	105

Table 2.36 indicates that maximum seed cotton yield (2960 kg/ha<sup>-1</sup>) was produced by IUB-264 followed by TH-112/05 (2932 kg/ha<sup>-1</sup>) and Chandi-95 (2688kg/ha<sup>-1</sup>). Regarding bolls per plant TH-112/05 produced maximum bolls (30.5) followed by IUB-264 (28.3), NIAB-852 and Chandi-95 (27.0). Maximum boll weight was recorded CIM-573 and Cyto-124 (3.3g) followed by TH-112/05 and MNH-994 (3.2g). Alseemi H-65 gave highest ginning out turn (41.1%) followed by Cyto-124 (40.8%) followed by TH-112/05 (40.5%). Longer staple length (29.5 mm) was produced by CIM-573 followed by Cyto-124 (29.0 mm) and Bt. CIM-602 (28.9 mm). Bt.CIM-602 produced better micronaire value (3.6 µg inch<sup>-1</sup>) followed by NIAB-112 and NIAB-852 (3.8 µg inch<sup>-1</sup>). Maximum uniformity index (83.0 %) produced by CIM-573 followed by TH-112/05 and 33-1-1-14 (81.6%).

**Table 2.37: Performance of Long and Extra Long Staple cotton varieties/lines conducted at coconut Agriculture Farm Uthal Balochistan during 2014-2015**

Variety	Seed Cotton Yield (Kg ha <sup>-1</sup> )	No. of bolls/per plant	Boll weight (g)	GOT (%)	Staple length (mm)	Mike Value (µg inch)	Uniformity index (%)	Plant height (cm)
TH-112/05	3218	36.0	3.2	41.2	26.7	4.4	80.6	138.0
Chandi-95	3466	28.0	3.0	38.1	26.9	4.1	81.2	124.3
BH-180	3045	29.0	3.1	38.5	26.6	4.1	80.5	103.5
Cyto-124	2744	27.0	3.3	41.0	27.5	4.1	80.9	106.0
CIM-573	2515	26.0	3.3	38.3	29.7	4.2	82.9	116.0
Bt.CIM-602	2267	23.0	3.1	37.8	28.5	3.5	80.2	118.3
CEMB-33	2488	26.0	3.1	39.0	24.6	4.2	78.3	107.0
IUB-264	2628	29.0	3.0	40.2	26.8	3.7	80.6	102.5
MNH-994	1922	22.0	3.2	39.5	26.9	4.2	80.7	113.0
NIAB-112	2735	28.0	3.0	38.5	27.8	3.8	81.5	122.4
NIAB-852	2899	31.0	3.1	38.0	26.7	3.7	79.5	112.0
NIAB-2008	22678	28.0	3.2	38.4	27.0	4.1	81.0	123.0
NIAB-Kiran	2618	25.0	3.0	40.2	27.0	4.0	81.2	125.0
Alseemi H-61	2316	21.0	3.1	39.1	27.2	3.7	79.7	114.0
Alseemi H-65	1854	18.0	2.8	41.5	26.9	4.5	80.7	124.3
3300	1967	20.0	3.1	39.2	27.6	3.6	81.2	119.6
33-1-1-14	1832	19.0	2.8	40.0	27.9	3.8	81.9	107.8
33-1-1-24	2177	23.0	3.0	35.5	27.8	4.2	81.4	135.2

Table 2.37 depicts that maximum seed cotton yield (3466 kg/ha-1) was produced by Chandi-95 followed by TH-112/05 (3218 kg/ha-1) and BH-180 (3045 kg/ha-1). Regarding bolls per plant TH-112/05 produced maximum bolls (36.0) followed by NIAB-852 (31.0) and BH-180(29.0). Whereas maximum boll weight (3.3g) was produced by Cyto-124 and CIM-573 followed by TH-112/05 and MNH-994 (3.2g). Alseemi H-65 gave highest ginning out turn (41.5%) followed by TH-112/05 (41.2) and Cyto-124 (41.0%). Longer staple length (29.7 mm) was produced by CIM-573 followed by Bt.CIM-602 (28.5 mm) and 3300-1-1-14 (27.9 mm). Bt.CIM-602 produced better micronaire value (3.5 µg inch-1) followed by 3300 (3.6 µg inch-1) and IUB-264 (3.7 µg inch-1). Maximum uniformity index (82.9 %) produced by CIM-573 followed by 300-1-1-14 (81.9%) and NIAB-112 (81.5%).

## **2.10. ICARDA, Pak-US Productivity Enhancement Project, Sakrand Component ID-1198-3**

Under "ICARDA Pak-US Productivity Enhancement Program" one project entitled "Development of CLCuV resistant germplasm by using traditional breeding approaches" is being executed at Central Cotton Research Institute, Sakrand. The main objectives of this project include multiplication and screening of exotic cotton germplasm imported from USA against Cotton Leaf Curl Virus (CLCuV) disease, development of CLCuV disease resistant germplasm through conventional breeding approaches, strengthening of germplasm/gene pool management capacities, germplasm storage and capacity building through adapting integrated phenotyping system.

For the year 2014 the seed of two sets viz., Set-M (comprised of 50 accessions belonging to *G. arboreum* L.) and Set-N (consisted of 600 accessions belonging to *G. hirsutum* L.) was received on 30-05-2014 at Central Cotton Research Institute, Sakrand for sowing purpose during the year 2014-15. CLCuV data were recorded in all 650 accessions 30, 60, 90 and 120 days after sowing. All the accessions were classified into 5 groups based on CLCuV disease incidence. In Set-M out of 50 accessions, 49 were resistant except one USG14-1884 belonging to *G. hirsutum* was susceptible. In Set-N, out of (600) accessions of *G. hirsutum* 108 were resistant, 94 highly tolerant, 288 tolerant, 96 susceptible and 13 were highly susceptible at 120 DAS.

The ratoon crop of 1386 accessions (2012) and 500 accessions (2013) has been maintained at Central Cotton Research Institute, Sakrand to reconfirm the resistance tolerance against CLCuV disease of screened US Germplasm during 2012 and 2013. No symptoms of CLCuV disease have been observed so far in Mac-7 (Set-C) and the CLCuV resistant shifted plants and ratoon crop of 26 accessions of Set-E. Beside this the data regarding days taken to open 1<sup>st</sup> flower, 1<sup>st</sup> sympodial node number, and morphological characters viz., flower color, pollen color, leaf shape, leaf size, leaf color, boll shape, special characters and agronomic data viz., plant height, number of monopodial branches per plant, number of sympodial branches per plant, average boll weight, number of bolls/plant, seed cotton yield per plot, ginning out turn (GOT) percent, seed index and fiber traits were recorded in all 650 accessions. As regard the development of CLCuV disease resistant material, local promising *G. hirsutum* cultivars were crossed with resistant/highly tolerant USDA lines and bolls setting was observed in 29 cross combinations which were planted in green house on 18<sup>th</sup> November 2014 for collecting the seed of F<sub>2</sub> generation which will be planted in field in the month of May 2015. F<sub>2</sub> generation (16 cross combinations) was planted in field of Central Cotton Research Institute, Sakrand on 4-6-2014. The data regarding CLCuV were recorded 30, 60, 90 and 120 DAS in all F<sub>2</sub> populations. The data of plant height, number of monopodial branches per plant, number of sympodial branches per plant, average boll weight, number of bolls/plant, seed cotton yield per plant, GOT % and other fibre traits have been recorded in CLCuV resistant F<sub>2</sub> plants of 16 combinations which will be planted as F<sub>3</sub> generation in 2015 crop season in field condition.

As regards the capacity building of research facilities at CCRI-Sakrand, one seed cold storage has been installed and other equipments such as vacuum sealer, seed moisture content meter, electric balance, dehumidifier, seed dryer and roller ginning machine etc have been purchased under this project during the year 2014.