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## EXECUTIVE SUMMARY

The All India Coordinated Cotton Improvement Project was assigned the task of evaluating Bt cotton hybrids in North Zone. The hybrids were evaluated at five locations under both protected and unprotected conditions. The locations were Ludhiana (PAU, Punjab), Faridkot (PAU, Punjab), Hisar (CCSHAU, Haryana), Sirsa (CICR,RS, Haryana) and Sriganaganagar (RAU, Rajasthan)

### FIRST YEAR EVALUATION

Two Bt cotton hybrids *viz.*, MRC 7017 BG II and MRC 7031 BG II were evaluated along with RCH 134 Bt (Bt hybrid check), LHH 144 and Shresth (non-Bt hybrid checks) and a local check variety.

All the Bt hybrids recorded significantly higher yield over the non-Bt hybrid checks. However, as compared to the Bt check hybrid, the Bt hybrid entries recorded 19 to 22 per cent less yield. The trend was same under both protected and unprotected conditions. Quality wise MRC 7031 BG II was marginally superior to the other entries. The Bt cotton entries recorded very low boll damage as compared to the non-Bt check entries, indicating the effectiveness of the Bt genes in reducing the boll worm damage. The Bt test entry MRC 7017 BG II showed resistance to CLCuV disease at all locations. All the other entries including checks showed the disease in varying intensity.

### SECOND YEAR EVALUATION

Twelve Bt entries were evaluated with RCH 134 Bt (Bt check hybrid), Shresth (non-Bt check hybrid) and a local check variety. The over all incidence of boll worm was low. Most of the Bt cotton hybrids tested recorded considerably lower boll and locule damage as compared to the non-Bt checks.

Bt test entries MRC 6029 Bt and JKCH 1050 Bt were free from CLCuV disease at all locations. RCH 314 Bt did not show CLCuV disease at Ludhiana, Hisar and Sirsa. However, the disease was noticed on RCH 314 Bt at Sriganaganagar (18.9 PDI) and at Faridkot (2.8 PDI). Rest of the entries including check, showed varying intensities of the disease at different locations.

The test entry **RCH 314 Bt** recorded the highest seed cotton yield of 3217 Kg/ha and was superior to the best check RCH 134 Bt (3088 Kg/ha). Both the hybrids recorded 35 per cent ginning out turn. Under unprotected condition the **check hybrid RCH 134 Bt** performed better. Quality wise NCS 570 Bt recorded the highest fibre length of 31.9 mm with a high fibre Strength of 24.7 g/tex. RCH 314 Bt, recorded a lower fibre strength than that of RCH 134 Bt check.

### **COMBINED EVALUATION FOR TWO YEARS**

A combined evaluation of twelve hybrids for two years (2004-05 and 2005-06) was done. MECH 162 Bt was used as the Bt check hybrid during the first year and RCH 134 Bt was the Bt check hybrid during the second year. MECH 162 Bt recorded very low yield during 2004-05. RCH 134 Bt, during the second year performed very well. Most of the biometrical observations showed consistency during both the years. JKCH 226 Bt, MRC 6029 Bt and RCH 314 Bt were consistent in their yield performance. Over the years, all the Bt cotton hybrids tested recorded very low square and locule damage indicating the effectiveness of Bt gene in controlling bollworm damage.

None of the entries was found to be CLCuV disease free at all locations over two year period it was tested. Among the Bt entries MRC 6025 Bt had the least disease followed by NECH 6R. The Bt hybrid NECH 3R Bt was found highly susceptible to CLCuV disease.

Overall, RCH 314 Bt, RCH 308 Bt and MRC 6029 were the three best entries with yield increase of 36, 25 and 20 per cent respectively over the mean Bt check hybrid. As compared with RCH 134 Bt check, only RCH 314 Bt was found to be marginally superior in seed cotton yield. However, its fibre quality was a shade inferior to RCH 134 Bt check.

## **Bt COTTON HYBRIDS EVALUATION REPORT**

The All India Coordinated Cotton Improvement Project (AICCIP) was assigned the task of evaluating the Bt cotton hybrids in the North Zone vide ICAR letter No. 2(4)/2005-CCI/Dt 13.05.05 and 27.05.05.

There were two sets of trials. In the first year trial, two entries MRC 7017 BG II and MRC 7031 BG II from MAHYCO seeds were evaluated with four checks. RCH 134 Bt was the Bt hybrid check. LHH 144 and Shresth were non-Bt check hybrids. A local variety was also used as a varietal check. F 1861 was used as the local check variety at Faridkot and Ludhiana in Punjab, H 1117 at Hisar and Sirsa in Haryana and RS 2013 at Sriganganagar in Rajasthan.

In the second year trial, twelve Bt cotton hybrids were evaluated for the second time for confirmatory results. The hybrids evaluated were NCS 138 Bt, NCS 570 Bt and NCS 913 Bt from Nuziveedu seeds, MRC 6025 Bt and MRC 6029 Bt from MAHYCO seeds, JKCH 226, JKCH 1050 and JKCH 1947 from JK seeds, RCH 308 Bt and RCH 314 Bt from RASI seeds and NECH 3R Bt and NECH 6R Bt from Nath seeds. There were three checks in the trial. RCH 134 Bt was the Bt check hybrid. Shresth was the non-Bt hybrid check. A local check variety was also used. The local check varieties were the same as in the first set.

### **The trial locations were**

1. Punjab Agricultural University, **Ludhiana**, Punjab
2. Punjab Agricultural University, **Faridkot**, Punjab
3. Choudhury Charan Singh Haryana Agricultural University, **Hisar**, Haryana.
4. Central Institute for Cotton Research, Regional Station, **Sirsa**, Haryana.
5. Rajasthan Agricultural University, **Sriganganagar**, Rajasthan.

### **The trial details are**

#### **First year trial**

No. of entries	: 2+4 checks
No. of rows	: Three
Row length	: 6 m
Spacing	: 75 x 60 cm
No. of replications	: Five
Design	: Randomized Block Design
Fertilizers	: As per local recommendations

## **Second year trial**

No. of entries	: 12+3 checks
No. of rows	: Three
Row length	: 6 m
Spacing	: 75 x 60 cm
No. of replications	: Three
Design	: Randomized Block Design
Fertilizers	: As per local recommendations

In each trial, there were two evaluations

### **1. Evaluation under ETL based plant protection**

Weekly observations were recorded from 45 DAS against major sucking pests and boll worms. The insecticide sprayings were based on the threshold levels of sap sucking pests and bollworms. The sprayings were undertaken in all the replications of an entry, even if in one of the replications the threshold level of infestation has exceeded.

### **2. Evaluation under unprotected condition**

Under unprotected conditions, only sap sucking pests were controlled and no protection was given against bollworms.

### **Observations recorded**

The biometrical observations like Germination percentage, Final plant stand, First flowering, 50 % flowering, Bolls/Plant, Boll weight (g), Ginning percentage, Lint index, Seed index and Seed cotton yield (Kg/ha) were recorded in the ETL based plant protection trial. The entomological observations on sap sucking pests, bollworm damage and natural enemies were recorded under both ETL based plant protection trial and unsprayed trial. The pathological evaluations were taken for the incidences of cotton leaf curl disease, other foliar diseases and also for hybrid (Para) wilt.

The trial results have been reported in three parts. In the first part, the first year trials have been reported. In the second part, the second year confirmatory trials have been reported. In the third part, combined data of two years (2004-05 and 2005-06) of the second year trial have been reported.

## FIRST YEAR EVALUATION

In the first year trial, two entries MRC 7017 BG II and MRC 7031 BG II from MAHYCO seeds were evaluated with four checks. RCH 134 Bt was the Bt hybrid check. LHH 144 and Shresth were non-Bt check hybrids. A local variety was also used as a varietal check. F 1861 was used as the local check variety at Faridkot and Ludhiana in Punjab, H 1117 at Hisar and Sirsa in Haryana and RS 2013 at Sriganganagar in Rajasthan. The hybrids were evaluated at five locations both under ETL based plant protection and under unsprayed conditions. The sowings were completed during the last week of May, 2005.

### A. BIOMETRICAL EVALUATION

Biometrical observations were recorded in the ETL based plant protection trial and reported here.

#### Germination and Final plant stand

The Germination of all the entries, in general, was good and ranged from 80 to 90 per cent. Consequently, the plant stand was good at all the locations. However at Sirsa, the germination of LHH 144 (Hy.C) was only 58.8 percent. Due to wind storm there was some seedling mortality at this location (Table 1 and 2).

**Table 1. Germination (%)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	93.1	95.0	92.0	75.8	89.0
MRC 7031 BG II	100.0	95.0	91.3	87.3	93.4
<b>RCH 134 Bt (Bt. C)</b>	100.0	98.0	96.0	89.1	95.8
<b>LHH 144 (Hy.C)</b>	96.4	99.0	92.0	58.8	86.5
<b>SHRESTH (Hy. C)</b>	97.0	97.0	93.3	77.0	91.1
<b>Variety Check</b>	99.5	81.0	82.3	46.7	77.4

**Table 2. Final Plant Stand (Number of plants)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	27.4	30.0	24.2	23.6	24.2	25.9
MRC 7031 BG II	26.4	29.0	25.2	25.0	27.4	26.6
<b>RCH 134 Bt (Bt. C)</b>	27.2	31.0	25.2	28.4	25.6	27.5
<b>LHH 144 (Hy.C)</b>	27.0	30.0	27.2	15.0	23.4	24.5
<b>SHRESTH (Hy. C)</b>	25.8	24.0	26.6	19.2	24.0	23.9
<b>Variety Check</b>	26.4	35.2	39.4	21.2	24.0	29.2

### First flowering and 50% Flowering

First flowering and 50 per cent flowering observations (Table 3 and 4) indicated that MRC 7031 BG II was earlier than the other entries. RCH 134 Bt came to flowering last.

**Table 3. Days for first flowering**

Entries	Faridkot	Ludhiana	Hisar	Mean
MRC 7017 BG II	61	45	64	57
MRC 7031 BG II	57	44	60	54
<b>RCH 134 Bt (Bt. C)</b>	79	60	71	70
<b>LHH 144 (Hy.C)</b>	60	47	60	56
<b>SHRESTH (Hy. C)</b>	65	50	70	62
<b>Variety Check</b>	67	50	70	62

**Table 4. Days for 50% flowering**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	68	54	76	71	48	63
MRC 7031 BG II	64	55	72	55	47	58
<b>RCH 134 Bt (Bt. C)</b>	87	71	83	79	58	76
<b>LHH 144 (Hy.C)</b>	68	58	72	73	46	63
<b>SHRESTH (Hy. C)</b>	71	60	82	73	46	67
<b>Variety Check</b>	80	61	82	75	61	72

### Bolls per Plant

All the Bt hybrids recorded significantly higher bolls per plant, as compared to the non-Bt checks. Mean boll number ranged from 33.3 to 37.4 in the Bt hybrids as against 29.1 to 31.4 bolls in non-Bt checks (Table 5).

**Table 5. Number of Bolls/Plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	47.6	29.0	32.0	57.7	20.5	37.4
MRC 7031 BG II	41.8	24	25.0	52.4	23.4	33.3
<b>RCH 134 Bt (Bt. C)</b>	38.6	23	32.0	61.0	29.6	36.8
<b>LHH 144 (Hy.C)</b>	37.2	16	26.0	48.6	17.9	29.1
<b>SHRESTH (Hy. C)</b>	40.2	16	25.0	49.7	20.8	30.3
<b>Variety Check</b>	36.6	15	27.0	49.2	29.4	31.4
<b>CD at 5%</b>	NS	2.5	5.1	9.4	10.9	
<b>CV%</b>	13.7	9.3	14.1	10.4	15.6	

### Boll weight

All the hybrids tested recorded a mean boll weight ranging from 3.7 to 4.0 gram and were significantly superior to the check variety (Table 6).

**Table 6. Boll weight (g)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	3.4	3.7	3.6	4.0	3.5	3.7
MRC 7031 BG II	3.3	3.9	3.8	4.2	3.6	3.8
<b>RCH 134 Bt (Bt. C)</b>	3.2	3.7	3.5	4.1	4.0	3.7
<b>LHH 144 (Hy.C)</b>	4.1	3.8	3.9	4.1	3.3	3.8
<b>SHRESTH (Hy. C)</b>	4.2	3.8	4.0	4.4	3.9	4.0
<b>Variety Check</b>	3.1	3.6	3.4	2.8	2.5	3.1
<b>CD at 5%</b>	0.4	0.1	1.0	0.5	0.5	
<b>CV%</b>	8.2	2.0	23.6	6.8	4.8	

### Ginning percentage

Ginning percentage ranged from 33 to 35 per cent. RCH 134 Bt check recorded the highest ginning out turn of 35.3 per cent (Table 7).

**Table 7. Ginning Percentage**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	34.7	32.3	34.4	34.1	33.4	33.8
MRC 7031 BG II	33.8	32.2	32.8	32.2	32.9	32.8
<b>RCH 134 Bt (Bt. C)</b>	37.5	33.3	35.9	34.4	35.7	35.3
<b>LHH 144 (Hy.C)</b>	33.4	32.2	34.0	31.5	36.5	33.5
<b>SHRESTH (Hy. C)</b>	34.3	32.3	31.7	31.7	32.9	32.6
<b>Variety Check</b>	32.5	32.2	35.5	32.3	31.9	32.9
<b>CD at 5%</b>	0.9	0.3	0.5	1.1	2.5	-
<b>CV%</b>	2.0	0.7	1.0	2.0	2.5	-

### Lint Index and Seed Index

There was some variation between the hybrids in respect of lint index and seed index (Table 8 and 9). RCH 134 Bt check recorded the highest lint index of 5.2 g with a moderate seed weight of 9.3 g.



**Table 8. Lint Index (g)**

Entries	Faridkot	Ludhiana	Hisar	Mean
MRC 7017 BG II	3.9	4.2	5.1	4.4
MRC 7031 BG II	5.2	3.5	4.8	4.5
<b>RCH 134 Bt (Bt. C)</b>	6.1	4.4	5.3	5.2
<b>LHH 144 (Hy.C)</b>	5.1	4.6	4.5	4.7
<b>SHRESTH (Hy. C)</b>	5.4	4.9	4.4	4.9
<b>Variety Check</b>	3.7	4.3	4.1	4.0
<b>CD at 5%</b>	0.2	0.3	-	-
<b>CV%</b>	2.8	4.4	-	-

**Table 9. Seed Index (g)**

Entries	Faridkot	Ludhiana	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	7.4	8.9	9.7	7.9	8.5
MRC 7031 BG II	10.3	7.3	9.8	9.6	9.2
<b>RCH 134 Bt (Bt. C)</b>	10.1	8.7	9.6	8.7	9.3
<b>LHH 144 (Hy.C)</b>	10.2	9.6	8.7	8.4	9.2
<b>SHRESTH (Hy. C)</b>	10.3	10.3	9.5	9.9	10.0
<b>Variety Check</b>	7.6	9.1	7.4	7.3	7.9
<b>CD at 5%</b>	0.1	0.5	-	1.4	-
<b>CV%</b>	0.9	4.1	-	5.5	-

**Mean seed cotton yield**

The Bt check hybrid RCH 134 Bt recorded the highest mean seed cotton yield of 2893 Kg/ha. Both the test hybrids MRC 7017 BG II and MRC 7031 BG II recorded significantly lower yield than RCH 134 Bt check hybrid at Faridkot, Hisar and Sirsa. At Ludhiana, the test hybrids were superior to the check hybrids (Table 10).

**Table 10. Seed Cotton Yield (kg/ha)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	3070	2124	1481	2864	1807	2269
MRC 7031 BG II	3037	1964	1350	2895	1667	2182
<b>RCH 134 Bt (Bt. C)</b>	4058	1786	1712	4695	2215	2893
<b>LHH 144 (Hy.C)</b>	2845	972	642	1240	1052	1350
<b>SHRESTH (Hy. C)</b>	3325	746	642	1308	1111	1426
<b>Variety Check</b>	3153	935	840	650	1489	1413
<b>CD at 5%</b>	325	170	156	540	707	
<b>CV%</b>	7.6	9.0	10.3	14.0	15.4	

## B. FIBRE QUALITY EVALUATION

The fibre quality evaluation was done location wise (Table 11). The test entry MRC 7031 BG II recorded the highest fibre strength of 24.6 g/tex. MRC 7017 BG II recorded the lowest fibre strength of 21.8 g/tex. In respect of other fibre quality parameters there was not much variation and were within the acceptable norms.

**Table 11. Fibre quality of Bt cotton**

<b>2.5 % Span Length (mm)</b>						
<b>Entries</b>	<b>Ludhiana</b>	<b>Faridkot</b>	<b>Hisar</b>	<b>Sirsa</b>	<b>Sriganga-nagar</b>	<b>Mean</b>
MRC 7017 BG II	28.8	28.5	27.4	28.3	28.3	28.3
MRC 7031 BG II	30.0	29.2	29.3	29.6	30.2	29.7
<b>RCH 134 Bt (Bt. C)</b>	28.4	27.5	27.0	27.6	26.2	27.3
<b>LHH 144 (Hy.C)</b>	29.0	29.0	28.3	27.8	27.0	28.2
<b>SHRESTH (Hy. C)</b>	27.3	28.2	25.6	26.9	27.3	27.1
<b>Variety Check</b>	27.4	26.8	23.8	27.7	24.9	26.1
<b>Uniformity Ratio</b>						
MRC 7017 BG II	45	15	42	47	49	40
MRC 7031 BG II	47	50	46	48	48	48
<b>RCH 134 Bt (Bt. C)</b>	53	54	52	50	50	52
<b>LHH 144 (Hy.C)</b>	49	54	45	50	46	49
<b>SHRESTH (Hy. C)</b>	50	53	47	53	44	49
<b>Variety Check</b>	53	53	48	50	52	51
<b>Micronaire</b>						
MRC 7017 BG II	3.9	4.0	4.4	4.3	4.7	4.3
MRC 7031 BG II	3.0	4.3	4.0	4.0	3.6	3.8
<b>RCH 134 Bt (Bt. C)</b>	4.1	4.7	4.8	4.6	3.9	4.4
<b>LHH 144 (Hy.C)</b>	4.1	4.8	4.4	3.9	3.2	4.1
<b>SHRESTH (Hy. C)</b>	4.9	4.8	4.4	4.2	3.7	4.4
<b>Variety Check</b>	4.7	5.1	5.3	4.5	3.8	4.7
<b>Fibre Strength (g/tex)</b>						
MRC 7017 BG II	21.5	21.3	20.6	22.8	22.7	21.8
MRC 7031 BG II	24.4	25.0	24.3	23.8	25.4	24.6
<b>RCH 134 Bt (Bt. C)</b>	24.1	24.3	23.0	23.5	22.9	23.6
<b>LHH 144 (Hy.C)</b>	21.9	24.2	22.9	23.9	26.0	23.8
<b>SHRESTH (Hy. C)</b>	21.2	24.2	22.1	22.9	23.5	22.8
<b>Variety Check</b>	20.7	21.5	19.4	21.6	23.1	21.3

## C. ENTOMOLOGICAL EVALUATION

The entomological evaluations were primarily targeted against testing the entries against the bollworms and sap sucking pests.

### 1. EVALUATION UNDER ETL BASED PLANT PROTECTION

#### Jassids and whitefly damage

Jassids and whitefly were the predominant sucking pests encountered during the season. Jassid population was the maximum at Ludhiana, while whitefly was maximum at Sriganganagar (Table 12 and 13). Jassid population was the least and remained below ETL level at most of the times. However, chemical intervention was required at least once during critical period to control the jassids. The overall mean population showed that the entry MRC 7017 BG II recorded the lowest incidence of 1.7 jassids/plant and was on par with LHH 144 (Hy. C) Whitefly population above ETL level was noticed in Sriganganagar and needed chemical intervention twice. MRC 7017 BG II while showing least no of jassids/plant had maximum number of white fly/plant (4.9).

**Table 12. Sucking pest-Jassid/ plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	1.0	3.5	1.6	0.7	1.9	1.7
MRC 7031 BG II	1.0	3.9	1.7	0.9	2.2	2.0
<b>RCH 134 Bt (Bt. C)</b>	1.2	4.3	1.6	0.7	2.2	2.0
<b>LHH 144 (Hy.C)</b>	0.9	3.4	1.6	0.7	1.9	1.7
<b>SHRESTH (Hy. C)</b>	1.1	3.6	1.5	1.1	2.1	1.9
<b>Variety Check</b>	1.2	3.7	1.8	0.9	2.1	1.9

**Table 13. Sucking pest-White Fly / plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	2.0	2.2	1.6	1.1	17.8	4.9
MRC 7031 BG II	2.1	2.5	1.7	1.2	15.9	4.7
<b>RCH 134 Bt (Bt. C)</b>	2.7	2.6	1.5	1.5	11.4	3.9
<b>LHH 144 (Hy.C)</b>	2.4	2.4	1.7	1.2	12.4	4.0
<b>SHRESTH (Hy. C)</b>	2.8	2.4	1.6	1.3	15.1	4.6
<b>Variety Check</b>	2.4	2.6	1.7	1.2	9.7	3.5

Heavy incidence of thrips (12.9 to 26.0/Plant) was noticed at Sriganganagar in all the entries.

### Spotted bollworm

Among the bollworms, spotted bollworm (*Earias sp.*) was the predominant species particularly on non-Bt checks. The Bt hybrid entries recorded very low spotted boll worm incidence of 0.4% at Sriganaganagar, while it was absent at Faridkot and Ludhiana (Table 14).

**Table 14. Spotted boll worm (Number of larvae/ 5 plants)**

Entries	Faridkot	Ludhiana	Sriganga-nagar
MRC 7017 BG II	0.0	0.0	0.4
MRC 7031 BG II	0.0	0.0	0.4
<b>RCH 134 Bt (Bt. C)</b>	0.0	0.0	0.4
<b>LHH 144 (Hy.C)</b>	0.2	3.6	2.4
<b>SHRESTH (Hy. C)</b>	0.1	3.2	2.2
<b>Variety Check</b>	0.4	3.6	3.2

### American boll worm

The incidence of American boll worm (*Helicoverpa armigera*) was in general low in all the centres

### Pink bollworm

The Pink bollworm (*Pectinophora gossypiella*) either did not appear or their population was below the ETL values. Both the test entries MRC 7017 BG II and MRC 7031 BG II recorded very low larval infestation and was on par with the Bt check hybrid RCH 134 Bt (Table 15 a).

**Table 15 a. Pink bollworm larval population**

Entries	Number of larvae / 20 green bolls				
	Faridkot	Ludhiana	Sirsa	Sriganga-nagar	Mean
MRC 7017 BG II	0.0	0.0	0.0	0.9	0.2
MRC 7031 BG II	0.0	0.0	0.5	0.8	0.3
<b>RCH 134 Bt (Bt. C)</b>	0.0	0.0	0.3	0.9	0.3
<b>LHH 144 (Hy.C)</b>	0.4	0.0	0.9	3.4	1.2
<b>SHRESTH (Hy. C)</b>	0.7	0.0	1.7	2.7	1.3
<b>Variety Check</b>	0.3	0.0	0.4	2.5	0.8

At Sriganaganagar, the Green boll damage varied from 12.66 to 35.00 % at different periods on non-Bt hybrids and was minimum on Bt hybrids. At Sirsa, however, locule damage was up to 9.8 per cent in Bt cotton hybrids and was on par with the non-Bt hybrid (Table 15 b).

**Table 15 b. Pink bollworm (locule damage)**

Entries	Locule Damage %				Green Boll Damage %
	Faridkot	Ludhiana	Sirsa	Mean	Sriganganagar
MRC 7017 BG II	0.9	0.0	9.2	3.1	2.9
MRC 7031 BG II	0.9	0.0	9.8	3.3	2.0
<b>RCH 134 Bt (Bt. C)</b>	1.3	0.0	8.2	3.2	3.4
<b>LHH 144 (Hy.C)</b>	7.1	0.0	7.7	4.9	15.4
<b>SHRESTH (Hy. C)</b>	6.2	0.0	9.6	5.3	31.6
<b>Variety Check</b>	5.8	0.0	12.3	6.0	27.6

**Square damage**

Square damage due to bollworms was also minimum in the Bt hybrids. It ranged from 0 to 0.9 % in Bt hybrids and 1.0 to 6.5 in non-Bt checks (Table 16).

**Table 16. Square damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Mean
MRC 7017 BG II	0.0	0.5	0.6	0.3
MRC 7031 BG II	0.0	0.4	0.6	0.3
<b>RCH 134 Bt (Bt. C)</b>	0.0	0.6	0.9	0.5
<b>LHH 144 (Hy.C)</b>	1.3	5.8	2.1	3.1
<b>SHRESTH (Hy. C)</b>	1.0	6.5	1.4	2.9
<b>Variety Check</b>	2.7	5.7	2.4	3.6

**Open boll and locule damage**

Open boll and locule damage were also observed at harvest. BG II entries recorded significantly low level of open boll and locule damage as compared to non-Bt check hybrids and varieties. MRC 7017 BG II recorded the lowest open boll damage and locule damage (Table 17 a and b).

**Table 17 a. Open boll damage**

Entries	Open boll damage (%)				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	0.0	3.0	6.0	2.3	2.8
MRC 7031 BG II	0.0	3.7	9.0	1.3	3.5
<b>RCH 134 Bt (Bt. C)</b>	0.0	8.7	5.0	3.8	4.4
<b>LHH 144 (Hy.C)</b>	15.1	39.0	9.0	11.9	18.7
<b>SHRESTH (Hy. C)</b>	16.0	38.2	19.0	13.2	21.6
<b>Variety Check</b>	13.1	40.0	22.0	21.2	24.1

**Table 17 b. Locule damage**

Entries	Locule damage (%)				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	0.0	1.0	2.3	0.9	1.1
MRC 7031 BG II	0.1	1.2	3.4	0.7	1.3
<b>RCH 134 Bt (Bt. C)</b>	0.0	3.7	1.9	1.1	1.7
<b>LHH 144 (Hy.C)</b>	5.3	17.1	3.4	4.4	7.6
<b>SHRESTH (Hy. C)</b>	4.9	15.8	7.0	5.1	8.2
<b>Variety Check</b>	5.2	16.1	5.6	8.9	8.9

**Natural enemies**

Natural enemy population was also recorded at periodic intervals. There was no significant difference in natural enemy population between Bt and non-Bt entries in the trial (Table 18).

**Table 18. Natural Enemy population / 10 plants**

Entries	Faridkot	Ludhiana	Sirsa
MRC 7017 BG II	18.7	2.2	0.2
MRC 7031 BG II	16.9	2.5	0.2
<b>RCH 134 Bt (Bt. C)</b>	20.9	2.6	0.1
<b>LHH 144 (Hy.C)</b>	17.4	2.4	0.1
<b>SHRESTH (Hy. C)</b>	19.4	2.4	0.1
<b>Variety Check</b>	18.6	2.6	0.1

**Insecticide application**

Except at Faridkot, Bt cotton test entries MRC 7017 BG II and MRC 7031 BG II and the Bt check hybrid RCH 134 Bt did not warrant any insecticidal intervention for the control of boll worms. On the other hand, non-Bt check hybrids and check variety required one to three rounds of insecticidal application (Table 19). At Faridkot, the Bt cotton hybrids required 1 to 3 rounds of insecticides and the non-Bt entries 4 to 6 rounds to control boll worms.

**Table 19. Insecticides spray details in ETL based plant protection trial**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga nagar
<b>For Sucking Pests Control</b>					
MRC 7017 BG II	1	3	1	1	1
MRC 7031 BG II	1	3	1	0	1
<b>RCH 134 Bt (Bt. C)</b>	1	4	1	0	0
<b>LHH 144 (Hy.C)</b>	1	3	1	0	1
<b>SHRESTH (Hy. C)</b>	1	3	1	0	1
<b>Variety Check</b>	1	3	1	1	0
<b>For Boll Worm control</b>					
MRC 7017 BG II	3	0	0	0	0
MRC 7031 BG II	1	0	0	0	0
<b>RCH 134 Bt (Bt. C)</b>	2	0	0	0	0
<b>LHH 144 (Hy.C)</b>	6	3	0	2	2
<b>SHRESTH (Hy. C)</b>	4	3	0	0	2
<b>Variety Check</b>	6	3	0	1	3

## 2. EVALUATION UNDER UNPROTECTED CONDITIONS

All the six entries in the trial were also evaluated under unsprayed conditions for bollworms. However, they were protected for sucking pests based on their ETL values. The protocol for the trial was the same as that of the protected trial. The trial was conducted at four locations *viz.*, Faridkot, Ludhiana, Hisar and Sirsa.

### Germination and Final plant stand

The seed germination and crop stand was very good in the trial (Table 20 and 21).

**Table 20. Germination (%)**

Entries	Faridkot	Ludhiana	Sirsa	Mean
MRC 7017 BG II	98.8	95	90.6	95
MRC 7031 BG II	97.6	98	81	92
<b>RCH 134 Bt (Bt. C)</b>	98	98	97.2	98
<b>LHH 144 (Hy.C)</b>	94.9	97	73.2	88
<b>SHRESTH (Hy. C)</b>	93.9	94	76.2	88
<b>Variety Check</b>	98.1	96	76.4	90

**Table 21. Final Plant Stand (Number of plants)**

Entries	Faridkot	Ludhiana	Sirsa	Mean
MRC 7017 BG II	27	30	24	27
MRC 7031 BG II	26	30	22	26
<b>RCH 134 Bt (Bt. C)</b>	27	31	22	27
<b>LHH 144 (Hy.C)</b>	27	29	22	26
<b>SHRESTH (Hy. C)</b>	26	30	20	25
<b>Variety Check</b>	26	34	12	24

### Jassids and Whitefly damage

Except at Ludhiana, jassid infestation was very low at other places and could be easily controlled with one round of pesticide intervention. Whitefly population did not cross ETL values (Table 22 and 23).

**Table 22. Sucking pest-Jassids/ plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	1.1	3.3	1.6	1.2	1.8
MRC 7031 BG II	1.0	3.3	1.7	1.0	1.8
<b>RCH 134 Bt (Bt. C)</b>	1.0	3.4	1.6	1.0	1.7
<b>LHH 144 (Hy.C)</b>	1.1	3.7	1.6	0.8	1.8
<b>SHRESTH (Hy. C)</b>	1.3	3.5	1.5	1.0	1.8
<b>Variety Check</b>	1.3	3.6	1.8	0.8	1.9

**Table 23. Sucking pest-White fly/ plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	2.7	2.4	1.6	1.7	2.1
MRC 7031 BG II	3.1	2.6	1.7	1.4	2.2
<b>RCH 134 Bt (Bt. C)</b>	3.3	2.7	1.5	1.7	2.3
<b>LHH 144 (Hy.C)</b>	2.9	2.7	1.7	1.6	2.2
<b>SHRESTH (Hy. C)</b>	3.4	2.6	1.6	1.7	2.3
<b>Variety Check</b>	2.5	2.7	1.7	1.6	2.2

### Square damage

Square damage was least in the Bt hybrids at all the locations. However, on non-Bt entries, it varied from 3 to 8 per cent. The square damage on non-Bt entries was also the least in Sirsa (Table 24). The same trend was noticed under ETL based plant protection trial also.

**Table 24. Square damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Mean
MRC 7017 BG II	0.3	0.5	0.2	0.3
MRC 7031 BG II	0.0	0.5	0.2	0.2
<b>RCH 134 Bt (Bt. C)</b>	0.3	0.1	0.1	0.2
<b>LHH 144 (Hy.C)</b>	5.4	8.0	1.0	4.8
<b>SHRESTH (Hy. C)</b>	3.5	7.5	0.1	3.7
<b>Variety Check</b>	6.7	7.0	0.9	4.8



### Open boll and locule damage

The Bt cotton entries at harvest recorded very low open boll (0 to 7 %) and locule (0 to 2.5 %) damage. On the other hand, the non-Bt check entries recorded fairly high incidence of open boll (4.5 to 51.6 per cent) and locule (2.9 to 23.8 per cent) damage (Table 25 and 26).

**Table 25. Open boll damage (%)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	0.0	2.6	1.9	6.0	2.6
MRC 7031 BG II	0.3	3.7	1.6	7.0	3.2
<b>RCH 134 Bt (Bt. C)</b>	0.2	4.3	1.5	6.0	3.0
<b>LHH 144 (Hy.C)</b>	27.2	49.9	5.3	15.0	24.3
<b>SHRESTH (Hy. C)</b>	22.7	51.6	4.5	24.0	25.7
<b>Variety Check</b>	20.8	43.1	4.7	12.0	20.1

**Table 26. Locule damage (%)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	0.0	0.9	1.4	2.5	1.2
MRC 7031 BG II	0.1	1.5	1.2	2.4	1.3
<b>RCH 134 Bt (Bt. C)</b>	0.1	1.6	1.2	1.6	1.1
<b>LHH 144 (Hy.C)</b>	8.8	23.8	3.4	4.0	10.0
<b>SHRESTH (Hy. C)</b>	6.8	23.2	3.0	8.0	10.2
<b>Variety Check</b>	8.0	17.5	2.9	5.9	8.6

### Seed cotton yield

Due to low incidence of bollworm and better protection offered by Bt gene, the Bt entries recorded significantly higher yield over the non-Bt check entries. However, the test entries MRC 7017 BG II and MRC 7031 BG II were found to be the lower yielding than the Bt check hybrid RCH 134 Bt (Table 27).

**Table 27. Seed Cotton Yield (kg/ha)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
MRC 7017 BG II	2000	2740	1588	3333	2415
MRC 7031 BG II	1881	2814	1498	3190	2346
<b>RCH 134 Bt (Bt. C)</b>	1611	3811	1704	4463	2897
<b>LHH 144 (Hy.C)</b>	927	2130	1802	1229	1522
<b>SHRESTH (Hy. C)</b>	902	2812	1819	1779	1828
<b>Variety Check</b>	867	2375	1399	1243	1471
<b>C.D @ 5%</b>	114	387	199	2894	

A combined analysis of seed cotton yield under protected and unprotected conditions also revealed the superiority of the Bt check hybrid RCH 134 Bt. The test entries were found to yield as much as 19 to 22 per cent lower than the best check hybrid (Table 28).

**Table 28. Mean Seed Cotton Yield (kg/ha)**

Entries	Protected	Unprotected	Mean	% Decrease over RCH 134 Bt (Bt. C)
MRC 7017 BG II	2269	2415	2342	19
MRC 7031 BG II	2182	2346	2264	22
<b>RCH 134 Bt (Bt. C)</b>	2893	2897	2895	-
<b>LHH 144 (Hy.C)</b>	1350	1522	1436	-
<b>SHRESTH (Hy. C)</b>	1426	1828	1627	-
<b>Variety Check</b>	1413	1471	1442	-

#### D. PATHOLOGICAL EVALUATION

Two BG II Bt hybrids (MRC 7017 and MRC 7031) were compared with RCH 134 (Bt check), LHH 144 and Shresth (hybrid check) and a local check variety for their reaction to Cotton Leaf Curl virus Disease and other foliar diseases *viz.*, *Myrothecium* leaf spot, *Alternaria* leaf spot and bacterial leaf blight.

##### Cotton Leaf Curl Virus Disease (CLCuV)

The Bt hybrid MRC 7017 BG II has shown resistance to CLCuV disease at all locations and the viral disease was not noticed on this hybrid during this year. Whereas all check hybrids including the Bt check RCH 134 Bt and the test hybrid MRC 7031 BG II was found to have the disease ranging from 0.82 to 12.7 per cent disease index. The local checks H 1117 at Sirsa had the highest disease having a disease index of 131.6 and F 1861 at Faridkot had 8.3 PDI (Table 29).

**Table 29. CLCuV Disease index**

Entries	Sirsa		Hisar		Sriganganagar	Ludhiana		Faridkot	
	P	UP	P	UP	P	P/UP	Screen house	P	UP
MRC 7017 BG II	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MRC 7031 BG II	0.0	0.0	0.0	0.0	3.40	0.0	0.0	8.6	4.1
<b>RCH 134 Bt (Bt. C)</b>	1.4	0.0	0.03	0.0	10.31	0.0	0.0	12.7	3.4
<b>LHH 144 (Hy. C)</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0
<b>SHRESTH (Hy. C)</b>	0.0	0.0	0.0	0.0	0.82	0.0	0.0	23.7	0.0
<b>Variety Check</b>	63.3	131.6	0.02	0.0	0.0	0.0	0.0	8.3	0.0

### Fungal Foliar Diseases

*Myrothecium* leaf spot and bacterial blight were noticed on these hybrids at Ludhiana and Faridkot only. However, due to low incidence of these diseases no conclusion can be drawn (Table 30).

**Table 30. Fungal foliar Diseases (Grades)**

Entries	Myrothecium Leaf Spot (Grades)		Bacterial Leaf Blight (Grades)		Alternaria Leaf Spot (Grades)
	Ludhiana	Faridkot	Ludhiana	Faridkot	Faridkot
MRC 7017 BG II	1.0	2.0	1.0	2.0	2.0
MRC 7031 BG II	1.0	2.0	1.0	2.0	2.0
<b>RCH 134 Bt (Bt. C)</b>	0.0	2.0	1.0	2.0	2.0
<b>LHH 144 (Hy. C)</b>	1.0	1.0	1.0	1.0	2.0
<b>SHRESTH (Hy. C)</b>	1.0	2.0	1.0	2.0	2.0
<b>Variety Check</b>	0.0	1.0	0.0	1.0	1.0

### E. OVERALL ASSESSMENT

Two Bt cotton hybrids MRC 7017 BG II and MRC 7031 BG II were evaluated for the first time in the North Zone along with RCH 134 Bt as the Bt hybrid check, LHH 144 and Shresth as the non-Bt hybrid checks and a local variety. They were evaluated at five locations, under protected and at four locations under unprotected conditions.

The overall boll worm infestation was low during the year. Among the boll worm *Earias* sp. was more predominant than *Helicoverpa armigera*. Pink boll worm was absent or negligible at Faridkot, Ludhiana and Hisar. Even under moderate pest pressure, the non-Bt entries were found to have considerable square and boll damage. The Bt cotton entries on the other hand recorded very low boll damage, thereby indicating the effectiveness of Bt gene in reducing pest damage. Consequently all the Bt hybrids recorded significantly higher seed cotton yield than the non-Bt hybrids. The test entry MRC 7017 BG II showed resistance to CLCuV disease at all locations. All the other entries including checks showed CLCuV disease in varying intensities.

The Bt cotton test entries MRC 7017 BG II and MRC 7031 BG II recorded 19 to 22 per cent less seed cotton than the Bt check hybrid RCH 134 Bt both under protected and unprotected conditions. In ginning out turn also, the check hybrid RCH 134 Bt was the best.

The test entry MRC 7031 BG II recorded the highest fibre strength of 24.6 g/tex.

**Table 31. Overall performance**

<b>Entries</b>	<b>Mean Seed Cotton Yield (kg/ha)</b>	<b>Ginning Percent</b>	<b>Boll Wt (g)</b>	<b>2.5 Span length (mm)</b>	<b>Micro naire</b>	<b>Strength (g/tex)</b>
MRC 7017 BG II	2342	33.8	3.7	28.3	4.3	21.8
MRC 7031 BG II	2264	32.8	3.8	29.7	3.8	24.6
<b>RCH 134 Bt (Bt. C)</b>	2895	35.3	3.7	27.3	4.4	23.6

**CONCLUSION**

Eventhough the Bt hybrid test entries had very low boll damage, they could not establish significant yield superiority over the Bt check hybrid RCH 134 Bt. The test entries yielded 19 to 22 per cent less seed cotton compared to RCH 134 Bt.

## SECOND YEAR EVALUATION

Twelve Bt cotton hybrids were evaluated for the second time for confirmatory results. The hybrids evaluated were NCS 138 Bt, NCS 570 Bt and NCS 913 Bt from Nuziveedu seeds, MRC 6025 Bt and MRC 6029 Bt from MAHYCO seeds, JKCH 226, JKCH 1050 and JKCH 1947 from JK seeds, RCH 308 Bt and RCH 314 Bt from RASI seeds and NECH 3R Bt and NECH 6R Bt from Nath seeds. There were three checks in the trial. RCH 134 Bt was the Bt check hybrid. Shresth was the non-Bt hybrid check. A local check variety was also used. The local check varieties were the same as in the first year trial.

### A. BIOMETRICAL EVALUATION

Biometrical evaluation of 12 Bt cotton hybrids were done along with three checks in the ETL based plant protection trial. All the fifteen entries were tested at five locations viz., Faridkot, Ludhiana, Hisar, Sirsa and Sriganganagar. The sowings were completed during the second fortnight of May, 2005.

#### Germination and Final plant stand

Germination in general was very good in all the entries, ranging from 69 to 100 per cent. Only at Sirsa, the check variety (41 %) and NECH 6R Bt (35%) recorded low germination (Table 1). Consequently, the final stand of these entries was also low. The final plant stand in all the other entries was good (Table 2).

**Table 1. Germination (%)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
NCS 913 Bt	100	97	98	93	97
NCS 570 Bt	100	100	99	93	98
NCS 138 Bt	100	100	94	97	98
MRC 6029 Bt	100	100	98	91	97
JKCH 1947 Bt	90	85	91	69	84
RCH 308 Bt	100	100	100	86	96
JKCH 1050 Bt	98	100	96	86	95
MRC 6025 Bt	100	100	97	96	98
NECH 6R Bt	85	93	67	35	70
RCH 314 Bt	100	99	93	93	96
JKCH 226 Bt	100	100	97	90	97
NECH 3R Bt	100	99	97	88	96
<b>Check Variety</b>	98	99	78	41	79
<b>RCH 134 Bt (Bt.C.Hy)</b>	100	100	97	96	98
<b>SHRESTH (LC.Hy)</b>	97	99	91	85	93

**Table 2. Final Plant Stand (Number of plants)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Srigangana- nagar	Mean
NCS 913 Bt	24	21	29	31	25	26
NCS 570 Bt	24	21	30	32	24	27
NCS 138 Bt	24	21	28	33	27	27
MRC 6029 Bt	23	21	29	32	28	28
JKCH 1947 Bt	22	21	27	26	23	24
RCH 308 Bt	23	21	30	30	26	27
JKCH 1050 Bt	23	21	29	30	26	27
MRC 6025 Bt	23	21	29	33	27	28
NECH 6R Bt	21	21	20	13	19	18
RCH 314 Bt	24	20	28	30	28	27
JKCH 226 Bt	24	21	29	30	26	26
NECH 3R Bt	23	21	29	29	22	25
<b>Check Variety</b>	24	30	47	29	24	33
<b>RCH 134 Bt (Bt.C.Hy)</b>	24	21	29	33	24	27
<b>SHRESTH (LC.Hy)</b>	23	21	27	27	22	24

**First and 50 % Flowering**

The observations on first flowering and 50 % flowering were recorded (Table 3 and 4). Under Ludhiana conditions, all the entries came to flowering early. JKCH 1947 and JKCH 1050 were earlier than RCH 134 Bt check hybrid by ten days.

**Table 3. Days for first flowering**

Entries	Faridkot	Ludhiana	Hisar	Srigangana- nagar	Mean
NCS 913 Bt	59	51	62	51	56
NCS 570 Bt	62	52	65	50	57
NCS 138 Bt	60	49	69	54	58
MRC 6029 Bt	57	49	65	53	56
JKCH 1947 Bt	58	50	62	46	54
RCH 308 Bt	63	55	69	51	60
JKCH 1050 Bt	59	49	62	47	54
MRC 6025 Bt	58	49	61	52	55
NECH 6R Bt	75	54	85	47	65
RCH 314 Bt	61	49	67	49	57
JKCH 226 Bt	60	51	61	51	56
NECH 3R Bt	74	52	89	51	67
<b>Check Variety</b>	65	52	64	63	61
<b>RCH 134 Bt (Bt.C.Hy)</b>	74	66	71	55	67
<b>SHRESTH (LC.Hy)</b>	63	57	68	54	61

**Table 4. Days for 50% flowering**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	66	62	72	60	51	61
NCS 570 Bt	73	63	74	65	50	63
NCS 138 Bt	70	60	79	68	54	65
MRC 6029 Bt	65	59	75	61	53	62
JKCH 1947 Bt	64	60	70	62	46	60
RCH 308 Bt	83	65	78	64	51	64
JKCH 1050 Bt	70	59	71	63	47	60
MRC 6025 Bt	68	59	71	60	52	61
NECH 6R Bt	86	64	100	87	47	74
RCH 314 Bt	67	60	76	78	49	66
JKCH 226 Bt	72	61	71	62	51	61
NECH 3R Bt	87	63	104	88	51	76
<b>Check Variety</b>	77	61	74	80	63	69
<b>RCH 134 Bt (Bt.C.Hy)</b>	85	78	80	91	55	76
<b>SHRESTH (LC.Hy)</b>	76	68	80	69	54	68

**Bolls per Plant**

All entries in the trial including the check variety had sufficient boll load to register fairly high yield. JKCH 226 Bt recorded the highest mean boll number of 44/Plant (Table 5).

**Table 5. Number of bolls/plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	52	34	36	45	29	36
NCS 570 Bt	47	37	32	62	31	40
NCS 138 Bt	48	40	36	53	28	39
MRC 6029 Bt	42	38	32	42	23	34
JKCH 1947 Bt	50	36	26	48	26	34
RCH 308 Bt	54	36	32	50	32	38
JKCH 1050 Bt	51	36	46	56	25	41
MRC 6025 Bt	36	35	34	45	24	35
NECH 6R Bt	54	37	37	50	35	40
RCH 314 Bt	43	44	40	58	28	43
JKCH 226 Bt	59	48	43	62	23	44
NECH 3R Bt	53	28	27	53	29	34
<b>Check Variety</b>	44	29	28	40	33	32
<b>RCH 134 Bt (Bt.C.Hy)</b>	46	31	31	47	34	36
<b>SHRESTH (LC.Hy)</b>	35	28	23	59	18	32
CD at 5%	9	7	6	10	13	
CV %	11	11		12	16	

### Boll Weight (g)

NCS 138 Bt and MRC 6029 Bt with a mean boll weight of 4.2 g was marginally superior to the check hybrids RCH 134 Bt and Shresth. However, the differences were not significant (Table 6).

**Table 6. Boll Weight (g)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	2.7	3.8	3.2	3.6	3.3	3.5
NCS 570 Bt	3.5	3.8	3.3	3.9	3.9	3.7
NCS 138 Bt	3.6	4.3	3.8	4.5	4.3	4.2
MRC 6029 Bt	3.8	4.1	4.4	4.4	4.0	4.2
JKCH 1947 Bt	3.3	3.7	3.2	3.6	3.7	3.6
RCH 308 Bt	3.3	3.9	3.5	3.9	2.8	3.5
JKCH 1050 Bt	2.9	4.1	3.2	3.6	3.7	3.6
MRC 6025 Bt	4.1	4.1	4.5	4.5	4.5	4.4
NECH 6R Bt	3.2	3.5	3.3	3.2	3.2	3.3
RCH 314 Bt	3.7	3.9	3.7	3.5	4.0	3.8
JKCH 226 Bt	2.8	3.7	3.3	3.2	3.3	3.4
NECH 3R Bt	4.0	3.6	3.8	4.0	3.5	3.7
<b>Check Variety</b>	3.4	3.8	3.2	3.4	2.6	3.3
<b>RCH 134 Bt (Bt.C.Hy)</b>	3.7	4.1	4.0	4.2	3.8	4.0
<b>SHRESTH (LC.Hy)</b>	4.1	3.7	4.3	4.0	4.0	4.0
CD at 5%	0.5	0.2	0.4	0.5	0.9	
CV %	9.3	2.7		8.5	8.2	

### Ginning Percentage

JKCH 1050 Bt recorded the highest ginning out turn of 38.3 per cent and was significantly superior to all the check entries (Table 7).

**Table 7. Ginning Percentage**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	39.4	35.1	37.2	35.4	36.5	36.0
NCS 570 Bt	32.9	33.2	33.2	31.3	33.3	32.7
NCS 138 Bt	33.4	32.5	34.0	32.8	33.2	33.1
MRC 6029 Bt	33.8	32.2	32.2	33.6	34.5	33.1
JKCH 1947 Bt	36.6	32.4	34.7	35.1	36.3	34.6
RCH 308 Bt	36.3	34.3	36.7	33.5	36.4	35.2
JKCH 1050 Bt	39.8	35.5	39.5	39.1	39.1	38.3
MRC 6025 Bt	35.5	33.1	33.8	34.2	33.9	33.7
NECH 6R Bt	38.1	34.2	36.0	35.5	37.0	35.7



RCH 314 Bt	35.3	33.2	33.0	36.5	39.2	35.5
JKCH 226 Bt	38.6	35.1	36.9	36.4	34.2	35.7
NECH 3R Bt	34.2	33.1	35.1	32.5	37.4	34.5
<b>Check Variety</b>	34.6	32.2	35.4	34.1	32.8	33.6
<b>RCH 134 Bt (Bt.C.Hy)</b>	36.2	33.2	36.2	35.2	34.4	34.8
<b>SHRESTH (LC.Hy)</b>	35.5	32.3	31.9	32.7	32.6	32.4
CD at 5%	0.9	0.9	0.9	0.8	3.5	
CV %	1.4	1.6		1.4	3.4	

### Lint Index

The lint index varied from 4.1 to 4.9 g in various entries (Table 8).

**Table 8. Lint Index (g)**

Entries	Faridkot	Ludhiana	Hisar	Mean
NCS 913 Bt	5.4	4.2	5.2	4.7
NCS 570 Bt	4.8	4.9	4.9	4.9
NCS 138 Bt	4.9	4.6	4.6	4.6
MRC 6029 Bt	4.8	4.5	4.5	4.5
JKCH 1947 Bt	4.6	3.9	4.4	4.1
RCH 308 Bt	4.8	4.9	4.6	4.8
JKCH 1050 Bt	4.7	3.6	5.2	4.4
MRC 6025 Bt	5.1	5.1	5.3	5.2
NECH 6R Bt	5.1	4.9	4.2	4.5
RCH 314 Bt	5.6	4.7	4.2	4.4
JKCH 226 Bt	4.3	3.7	4.9	4.3
NECH 3R Bt	4.6	4.7	4.5	4.6
<b>Check Variety</b>	4.0	4.2	4.3	4.2
<b>RCH 134 Bt (Bt.C.Hy)</b>	5.6	4.4	5.3	4.9
<b>SHRESTH (LC.Hy)</b>	5.0	4.8	4.2	4.5
CD at 5%	0.2	0.4		
CV %	2.7	5.6		

### Seed Index

The seed index showed wide variation from 7.1 to 10.3 g (Table 9).

**Table 9. Seed Index (g)**

Entries	Faridkot	Ludhiana	Hisar	Sriganganagar	Mean
NCS 913 Bt	8.2	7.8	8.8	7.2	7.9
NCS 570 Bt	9.9	9.9	9.9	7.4	9.1
NCS 138 Bt	9.8	9.5	9.0	10.7	9.7
MRC 6029 Bt	9.4	9.5	9.5	10.2	9.7
JKCH 1947 Bt	8.0	8.1	8.2	8.2	8.2

RCH 308 Bt	8.4	9.4	8.0	7.7	8.3
JKCH 1050 Bt	7.1	6.6	8.0	7.3	7.3
MRC 6025 Bt	9.2	10.3	10.3	10.4	10.3
NECH 6R Bt	8.4	9.4	7.5	7.3	8.1
RCH 314 Bt	10.3	9.4	8.6	10.5	9.5
JKCH 226 Bt	6.9	6.9	8.3	6.2	7.1
NECH 3R Bt	8.9	9.5	8.3	10.0	9.3
<b>Check Variety</b>	7.5	8.8	7.9	7.4	8.0
<b>RCH 134 Bt (Bt.C.Hy)</b>	9.8	8.9	9.4	9.7	9.3
<b>SHRESTH (LC.Hy)</b>	9.1	10.0	9.0	8.1	
CD at 5%	0.2	0.6		1.4	
CV %	1.4	3.9		5.6	

### Seed Cotton Yield

RCH 314 Bt recorded the highest seed cotton yield of 3217 Kg/ha and was superior to the best check hybrid RCH 134 Bt at four out of five locations. MRC 6029 Bt recorded the second highest yield (2974 kg/ha) among the entries. However it was lower yielding than RCH 134 Bt, the Bt check hybrid (Table 10).

**Table 10. Seed Cotton Yield (Kg/ha)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	2462	2659	1591	3562	1556	2366
NCS 570 Bt	3383	3787	1564	3750	1815	2860
NCS 138 Bt	3075	3319	1756	3754	2000	2781
<b>MRC 6029 Bt</b>	<b>3336</b>	<b>3497</b>	<b>1728</b>	<b>4210</b>	<b>2099</b>	<b>2974</b>
JKCH 1947 Bt	2537	2645	933	2292	1630	2007
RCH 308 Bt	3590	2967	1591	3901	1704	2751
JKCH 1050 Bt	2659	2164	2277	3469	1778	2469
MRC 6025 Bt	2620	1484	2222	4520	2605	2690
NECH 6R Bt	2720	2137	823	1690	1519	1778
<b>RCH 314 Bt</b>	<b>3599</b>	<b>3620</b>	<b>2222</b>	<b>4100</b>	<b>2543</b>	<b>3217</b>
JKCH 226 Bt	3362	3429	2222	3910	2296	3044
NECH 3R Bt	3022	2289	1180	1908	1469	1974
<b>Check Variety</b>	3307	2536	1454	1512	1407	2043
<b>RCH 134 Bt (Bt.C.Hy)</b>	<b>3743</b>	<b>3429</b>	<b>1756</b>	<b>4017</b>	<b>2494</b>	<b>3088</b>
<b>SHRESTH (LC.Hy)</b>	3112	2477	933	2593	1272	2077
CD at 5%	711	465	356	702	831	
CV %	13.71	9.83	9.59	12.81	15.29	

## B. FIBRE QUALITY EVALUATION

Most of the test entries recorded a superior fibre length as compared to the check hybrids. NCS 570 Bt recorded the highest mean fibre length of 31.9 mm. The uniformity ratio (UR) ranged from 47.8 to 52.8 per cent. Similarly all the entries recorded values ranging from 4.2 to 5.0 for micronaire. Hybrids NCS 570 Bt, MRC 6029 Bt, MRC 6025 Bt and NECH 3R Bt were found to be superior to the Bt check hybrid RCH 134 in fibre strength RCH 308 Bt, JKCH 1050 Bt, NECH 6R Bt, RCH 314 Bt and JKCH 226 Bt recorded lower fibre strength as compared to the check hybrids (Table 11).

**Table 11. Fibre Quality of Bt cotton**

<b>2.5 % Span Length (mm)</b>						
<b>Hybrid</b>	<b>Ludhiana</b>	<b>Faridkot</b>	<b>Hisar</b>	<b>Sirsa</b>	<b>Sriganga-nagar</b>	<b>Mean</b>
NCS 913 Bt	28.4	28.7	27.5	27.7	29.4	28.3
NCS 570 Bt	32.1	32.0	31.0	33.1	31.1	31.9
NCS 138 Bt	27.9	29.2	27.2	29.0	27.6	28.2
MRC 6029 Bt	29.2	28.8	28.6	29.3	29.5	29.1
JKCH 1947 Bt	28.1	28.6	27.9	28.9	28.2	28.3
RCH 308 Bt	28.4	30.4	28.1	28.3	28.7	28.8
JKCH 1050 Bt	27.8	28.2	27.1	29.2	27.9	28.0
MRC 6025 Bt	28.8	30.4	29.0	27.8	29.0	29.0
NECH 6R Bt	27.2	30.5	27.1	27.6	26.9	27.9
RCH 314 Bt	29.1	30.4	27.6	27.4	29.5	28.8
JKCH 226 Bt	25.6	29.0	26.2	27.3	30.3	27.7
NECH 3R Bt	31.1	30.7	30.0	30.6	25.7	29.6
<b>Check Variety</b>	26.2	28.0	23.1	27.3	24.9	25.9
<b>RCH 134 Bt (Bt.C.Hy)</b>	27.6	29.4	26.1	28.2	26.9	27.6
<b>SHRESTH (LC.Hy)</b>	28.4	27.7	26.8	27.8	30.0	28.1
<b>Uniformity Ratio</b>						
NCS 913 Bt	44	52	45	51	50	48
NCS 570 Bt	47	54	44	49	50	49
NCS 138 Bt	54	54	51	53	52	53
MRC 6029 Bt	50	47	44	48	50	48
JKCH 1947 Bt	49	46	46	54	50	49
RCH 308 Bt	50	54	43	51	49	49
JKCH 1050 Bt	49	52	48	50	52	50
MRC 6025 Bt	48	54	46	49	48	49
NECH 6R Bt	50	53	47	49	51	50
RCH 314 Bt	52	54	45	49	49	50
JKCH 226 Bt	52	54	47	53	49	51

NECH 3R Bt	48	47	44	46	54	48
<b>Check Variety</b>	53	54	50	50	54	52
<b>RCH 134 Bt (Bt.C.Hy)</b>	52	54	48	52	53	52
<b>SHRESTH (LC.Hy)</b>	52	49	46	51	52	50

<b>Micronaire</b>						
<b>Hybrid</b>	<b>Ludhiana</b>	<b>Faridkot</b>	<b>Hisar</b>	<b>Sirsa</b>	<b>Sriganga-nagar</b>	<b>Mean</b>
NCS 913 Bt	3.8	5.0	5.4	4.7	4.6	4.7
NCS 570 Bt	4.9	4.8	4.8	4.6	4.4	4.7
NCS 138 Bt	5.2	5.2	5.3	4.2	5.0	5.0
MRC 6029 Bt	4.0	4.4	4.2	4.2	4.3	4.2
JKCH 1947 Bt	4.6	4.8	4.7	4.4	4.6	4.6
RCH 308 Bt	4.9	5.3	4.8	3.8	5.0	4.8
JKCH 1050 Bt	4.6	5.3	5.0	5.0	5.0	5.0
MRC 6025 Bt	4.0	4.7	4.8	4.6	4.6	4.5
NECH 6R Bt	4.2	4.5	4.2	4.2	3.9	4.2
RCH 314 Bt	3.7	4.2	3.9	5.0	4.1	4.2
JKCH 226 Bt	4.5	5.0	4.8	4.8	4.5	4.7
NECH 3R Bt	4.0	4.5	4.1	3.7	4.7	4.2
<b>Check Variety</b>	4.9	5.1	5.1	4.5	3.9	4.7
<b>RCH 134 Bt (Bt.C.Hy)</b>	4.7	4.9	4.8	4.9	4.6	4.8
<b>SHRESTH (LC.Hy)</b>	4.8	4.8	4.8	4.7	4.0	4.6
<b>Fibre Strength (g/tex)</b>						
NCS 913 Bt	25.3	23.3	22.3	22.4	23.8	23.4
NCS 570 Bt	25.4	23.6	24.9	24.5	25.0	24.7
NCS 138 Bt	22.0	22.6	23.5	24.2	22.8	23.0
MRC 6029 Bt	22.9	25.2	23.1	24.5	24.4	24.0
JKCH 1947 Bt	23.4	24.1	23.0	22.6	22.5	23.1
RCH 308 Bt	23.0	22.8	20.6	22.3	20.8	21.9
JKCH 1050 Bt	21.7	20.0	21.4	21.9	23.2	21.6
MRC 6025 Bt	23.9	23.4	24.0	23.0	23.7	23.6
NECH 6R Bt	22.7	22.5	21.6	23.9	22.5	22.6
RCH 314 Bt	24.2	22.3	21.0	21.8	22.8	22.4
JKCH 226 Bt	21.5	21.3	21.0	21.7	22.9	21.7
NECH 3R Bt	24.9	24.9	22.1	25.4	23.0	24.1
<b>Check Variety</b>	20.5	21.6	18.8	20.3	21.9	20.6
<b>RCH 134 Bt (Bt.C.Hy)</b>	24.5	23.9	23.6	23.3	22.3	23.5
<b>SHRESTH (LC.Hy)</b>	24.5	25.1	22.2	22.4	24.7	23.8

## C. ENTOMOLOGICAL EVALUATION

The entomological evaluations were primarily targeted to study the sucking pest and boll worm reaction of the Bt hybrid entries as against the non-Bt checks.

### 1. EVALUATION UNDER ETL BASED PLANT PROTECTION TRIAL

#### Sucking Pest

Jassids and whitefly were the predominant sucking pests noticed during the crop season in North Zone. Jassids needed chemical intervention at the initial phase in most of the test centres to avoid population build up. Mean jassid population was more in JKCH 1947 Bt (2.3) and RCH 308 Bt (2.3) hybrids as against 1.5 to 1.8 in the check entries (Table 12).

**Table 12. Sucking pest-Jassids/ plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	0.9	3.3	1.6	1.3	1.1	1.6
NCS 570 Bt	1.5	3.1	1.6	0.8	1.1	1.6
NCS 138 Bt	3.4	3.1	1.7	0.9	1.3	2.1
MRC 6029 Bt	1.2	3.1	1.6	0.9	1.1	1.6
JKCH 1947 Bt	4.4	3.2	1.9	1.1	1.0	2.3
RCH 308 Bt	3.9	3.3	1.9	1.0	1.3	2.3
JKCH 1050 Bt	1.2	3.2	2.0	0.9	1.4	1.8
MRC 6025 Bt	1.6	3.0	2.0	1.0	1.3	1.8
NECH 6R Bt	0.5	2.9	1.6	0.8	1.4	1.5
RCH 314 Bt	0.6	3.0	1.7	1.0	1.6	1.6
JKCH 226 Bt	3.1	3.0	1.9	1.0	1.0	2.0
NECH 3R Bt	1.1	3.3	1.7	1.2	1.8	1.8
<b>Check Variety</b>	0.6	3.0	1.7	0.9	1.2	1.5
<b>RCH 134 Bt (Bt.C.Hy)</b>	1.3	3.0	1.6	1.1	1.4	1.7
<b>SHRESTH (LC.Hy)</b>	2.4	2.7	1.7	0.9	1.3	1.8

Whitefly population was higher at Sriganganagar and warranted chemical intervention in several entries during the crop phase. Mean whitefly population varied from 3.3 to 4.5 per plant. NCS 913 Bt recorded the highest population of 4.5 per plant (Table 13).

**Table 13. Sucking pest-White Fly/ plant**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar	Mean
NCS 913 Bt	2.1	2.7	1.6	1.4	14.6	4.5
NCS 570 Bt	2.2	2.4	1.7	1.4	12.6	4.0
NCS 138 Bt	2.6	2.6	1.6	1.3	13.8	4.4
MRC 6029 Bt	3.0	2.3	1.5	1.4	11.1	3.9
JKCH 1947 Bt	2.2	2.5	1.5	1.3	9.2	3.4
RCH 308 Bt	3.2	2.6	1.8	1.3	10.3	3.8
JKCH 1050 Bt	2.5	2.6	1.6	1.2	14.3	4.4
MRC 6025 Bt	2.8	2.7	1.7	1.4	13.3	4.4
NECH 6R Bt	2.6	2.4	1.8	1.4	10.8	3.8
RCH 314 Bt	2.8	2.5	1.7	1.5	8.8	3.5
JKCH 226 Bt	2.4	2.6	1.7	1.4	9.8	3.5
NECH 3R Bt	3.0	2.4	1.6	1.6	11.1	3.9
<b>Check Variety</b>	2.0	2.6	1.8	1.2	9.2	3.3
<b>RCH 134 Bt (Bt.C.Hy)</b>	2.6	2.7	1.6	1.4	10.7	3.8
<b>SHRESTH (LC.Hy)</b>	2.7	2.4	1.7	1.4	12.3	4.1

Thrips and Aphids were absent at Hisar and Sirsa and were very minimal at Ludhiana and Faridkot. The population of Thrips ranged from 13.4 to 22.7 per plant in various entries at Sriganganagar.

#### **Boll worm infestation**

Among the boll worms, spotted boll worm was the predominant species. However, the incidence was very minimum at Faridkot. At Ludhiana, a maximum of 2.33 larvae/5 plants was seen on 110 DAS in Bt cotton. However, in non-Bt checks up to 5.66 larvae/5 plants were noticed even at 54 DAS and remained high up to 145 days (Table 14).

**Table 14. Spotted bollworm at Ludhiana (Number of Larvae / 5 plants)**

Entry	54 DAS	67 DAS	82 DAS	96 DAS	110 DAS
NCS 913 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.33 (1.11)	0.67 (1.27)
NCS 570 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.00 (1.00)	0.00 (1.00)
NCS 138 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.33 (1.14)	0.33 (1.13)
MRC 6029 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.00 (1.00)	0.00 (1.00)
JKCH 1947 Bt	0.0 (1.00)	0.0 (1.00)	0.3 (1.00)	1.33 (1.52)	<b>2.33</b> (1.82)
RCH 308 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.33 (1.13)	0.33 (1.13)
JKCH 1050 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.00 (1.00)	0.00 (1.00)
MRC 6025 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.67 (1.24)	1.00 (1.38)
NECH 6R Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.67 (1.24)	1.00 (1.38)
RCH 314 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.00 (1.00)	0.00 (1.00)

JKCH 226 Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.33 (1.13)	0.67 (1.27)
NECH 3R Bt	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	0.33 (1.13)	0.33 (1.13)
<b>Check Variety</b>	<b>3.3 (2.07)</b>	<b>1.3 (1.52)</b>	<b>2.3 (1.82)</b>	<b>1.33 (1.52)</b>	<b>2.33 (1.82)</b>
<b>RCH 134 Bt (Bt.C.Hy)</b>	<b>0.0 (1.00)</b>	<b>0.0 (1.00)</b>	<b>0.0 (1.00)</b>	<b>0.00 (1.00)</b>	<b>0.00 (1.00)</b>
<b>SHRESHT(C.Hy)</b>	<b>5.7 (2.54)</b>	<b>4.0 (2.22)</b>	<b>3.7 (2.15)</b>	<b>2.00 (1.72)</b>	<b>3.00 (1.98)</b>
CD at 5 %	(0.22)	(0.13)	(0.16)	(0.39)	(0.35)
CV %	11.38	6.70	8.62	19.33	16.15

Figures in Parenthesis indicate transformed values

At Sriganganagar, eventhough the larval population was maximum at 90 DAS, it remained within the ETL

### American boll worm

American boll worm (*Helicoverpa armigera*) was noticed only in traces at all locations.

### Pink boll worm

Larval population of pink boll worm (*Pectinophora gossypiella*) was either very low or absent at all the places (Table 15).

**Table 15. Pink bollworm larval population**

Entries	Number of larvae / 20 green bolls				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	0.3	0.0	0.0	1.4	0.4
NCS 570 Bt	0.0	0.0	0.3	1.4	0.4
NCS 138 Bt	0.3	0.0	0.0	2.0	0.6
MRC 6029 Bt	0.0	0.0	0.0	1.6	0.4
JKCH 1947 Bt	0.1	0.0	0.2	1.4	0.4
RCH 308 Bt	0.0	0.0	0.0	1.9	0.5
JKCH 1050 Bt	0.0	0.0	0.0	2.7	0.7
MRC 6025 Bt	0.1	0.0	0.0	2.7	0.7
NECH 6R Bt	0.0	0.0	0.0	1.6	0.4
RCH 314 Bt	0.0	0.0	0.2	2.0	0.5
JKCH 226 Bt	0.0	0.0	0.0	1.4	0.4
NECH 3R Bt	0.0	0.0	0.0	1.7	0.4
<b>Check Variety</b>	<b>0.3</b>	<b>0.0</b>	<b>0.8</b>	<b>2.6</b>	<b>0.9</b>
<b>RCH 134 Bt (Bt.C.Hy)</b>	<b>0.0</b>	<b>0.0</b>	<b>0.2</b>	<b>1.6</b>	<b>0.4</b>
<b>SHRESTH (LC.Hy)</b>	<b>0.6</b>	<b>0.0</b>	<b>0.7</b>	<b>2.2</b>	<b>0.9</b>

However, locule damage up to 8.7 per cent was noticed at Sirsa and 7.1 per cent at Sriganganagar on Bt hybrids. The non-Bt check variety had the highest locule damage of 21.7 per cent (Table 16).

**Table 16. Pink bollworm (Locule damage)**

Entries	Locule Damage %				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	1.5	0.0	8.7	3.3	3.4
NCS 570 Bt	0.0	0.0	4.7	3.4	2.0
NCS 138 Bt	0.0	0.0	2.4	5.4	2.0
MRC 6029 Bt	1.5	0.0	6.1	3.7	2.8
JKCH 1947 Bt	0.9	0.0	7.3	7.1	3.8
RCH 308 Bt	0.0	0.0	3.3	3.9	1.8
JKCH 1050 Bt	0.0	0.0	7.4	4.5	3.0
MRC 6025 Bt	1.5	0.0	6.3	5.7	3.4
NECH 6R Bt	0.0	0.0	3.9	1.9	1.4
RCH 314 Bt	0.0	0.0	2.9	2.4	1.3
JKCH 226 Bt	0.0	0.0	4.9	4.2	2.3
NECH 3R Bt	3.7	0.0	6.8	4.0	3.6
<b>Check Variety</b>	2.2	0.0	7.1	21.7	7.7
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.0	0.0	7.2	2.9	2.5
<b>SHRESTH (LC.Hy)</b>	9.7	0.0	16.8	6.5	8.3

**Square damage**

The mean square damage was very low in both Bt and non-Bt entries, indicating low boll worm incidence (Table 17).

**Table 17. Square damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	0.7	1.4	0.3	2.8	1.3
NCS 570 Bt	0.6	1.0	1.4	2.0	1.3
NCS 138 Bt	0.0	1.0	1.3	2.1	1.1
MRC 6029 Bt	0.0	0.8	1.2	2.9	1.2
JKCH 1947 Bt	1.1	1.2	0.5	2.4	1.3
RCH 308 Bt	0.0	1.2	0.7	1.0	0.7
JKCH 1050 Bt	0.7	1.2	0.4	1.7	1.0
MRC 6025 Bt	0.5	0.9	0.4	1.4	0.7
NECH 6R Bt	0.0	1.0	0.9	1.3	0.8
RCH 314 Bt	0.0	0.9	1.5	1.3	0.9
JKCH 226 Bt	0.9	1.4	0.2	1.3	1.0
NECH 3R Bt	0.9	1.0	0.5	1.1	0.9
<b>Check Variety</b>	3.6	4.6	1.4	5.5	3.8
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.0	1.5	0.5	0.9	0.7
<b>SHRESTH (LC.Hy)</b>	1.4	2.4	1.0	3.1	2.0



However, weekly observations indicated that at certain periods the square damage in check entries had crossed the threshold levels at Faridkot, Ludhiana, Sirsa and Sriganganagar warranting chemical intervention.

### Open boll and locule damage

Open boll damage and loculi damage observations were recorded at harvest (Table 18). Open boll damage and locule damage was high in non-Bt check variety and hybrid.

**Table 18. Open boll damage**

Entries	Open boll damage (%)				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	0.0	3.0	3.3	11.1	4.4
NCS 570 Bt	0.5	2.7	0.0	5.3	2.1
NCS 138 Bt	1.5	5.4	6.7	7.4	5.2
MRC 6029 Bt	0.3	4.8	0.0	8.4	3.4
JKCH 1947 Bt	0.2	10.8	5.0	9.2	6.3
RCH 308 Bt	0.0	2.8	3.3	10.2	4.1
JKCH 1050 Bt	0.0	1.9	0.0	10.9	3.2
MRC 6025 Bt	0.2	4.9	1.7	2.1	2.2
NECH 6R Bt	1.0	1.8	3.3	14.3	5.1
RCH 314 Bt	0.8	4.8	1.7	2.4	2.4
JKCH 226 Bt	0.2	1.3	0.0	3.2	1.1
NECH 3R Bt	1.9	8.8	3.3	13.9	7.0
<b>Check Variety</b>	12.1	21.3	6.7	34.3	18.6
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.6	4.1	5.0	3.6	3.3
<b>SHRESTH (LC.Hy)</b>	18.6	28.5	13.3	16.8	19.3

Locule damage was less than two per cent in most of the Bt cotton entries across different locations. JKCH 1947 Bt and NECH 3R Bt showed a mean locule damage of 2.8 to 3.1 per cent (Table 19)

**Table 19. Locule damage**

Entries	Locule damage (%)				
	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	0.0	1.1	1.6	4.1	1.7
NCS 570 Bt	0.1	0.9	0.0	2.7	0.9
NCS 138 Bt	0.6	1.8	2.2	2.2	1.7
MRC 6029 Bt	0.1	2.0	0.0	3.6	1.4
JKCH 1947 Bt	0.1	5.5	3.7	3.3	3.1
RCH 308 Bt	0.0	1.3	1.1	4.2	1.7
JKCH 1050 Bt	0.0	0.6	0.0	3.1	0.9

MRC 6025 Bt	0.1	1.8	0.7	0.8	0.9
NECH 6R Bt	0.3	0.6	1.5	4.2	1.6
RCH 314 Bt	0.5	1.7	0.8	1.3	1.1
JKCH 226 Bt	0.0	0.4	0.0	1.2	0.4
NECH 3R Bt	0.6	3.6	1.5	5.4	2.8
<b>Check Variety</b>	4.0	9.2	1.8	11.9	6.7
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.2	1.5	0.0	1.2	0.7
<b>SHRESTH (LC.Hy)</b>	5.0	8.6	3.1	7.6	6.1

### Natural Enemies

The population of natural enemies was high at Faridkot. However, there was not much difference between the Bt and non-Bt entries in terms of natural enemy population (Table 20).

**Table 20. Natural enemy population / 10 plants**

Entries	Faridkot	Ludhiana	Sirsa	Sriganga-nagar	Mean
NCS 913 Bt	14.3	1.4	2.6	3.1	5.3
NCS 570 Bt	17.8	1.9	1.3	3.2	6.0
NCS 138 Bt	20.2	1.8	2.6	3.3	7.0
MRC 6029 Bt	17.4	1.6	4.6	3.2	6.7
JKCH 1947 Bt	16.7	2.0	1.5	4.5	6.2
RCH 308 Bt	20.3	2.2	7.5	4.1	8.5
JKCH 1050 Bt	16.4	2.9	2.6	3.5	6.4
MRC 6025 Bt	16.0	2.3	2.6	2.7	5.9
NECH 6R Bt	23.1	1.7	2.6	5.0	8.1
RCH 314 Bt	21.6	1.8	1.3	4.7	7.3
JKCH 226 Bt	19.6	2.7	0.0	4.4	6.7
NECH 3R Bt	22.6	1.6	0.0	4.5	7.2
<b>Check Variety</b>	16.0	1.1	2.3	4.5	6.0
<b>RCH 134 Bt (Bt.C.Hy)</b>	23.1	1.6	0.0	3.2	7.0
<b>SHRESTH (LC.Hy)</b>	20.5	2.5	0.0	4.6	6.9

### Insecticide application

Based on the ETL values insecticide application was undertaken. There was not much difference between Bt cotton hybrids and non-Bt checks in sucking pest population. At Faridkot and Hisar, the plant could be adequately protected against sucking pests by resorting to single insecticidal application. At Ludhiana, however, the sucking pest incidence was more and required as much as four rounds of insecticide application. At Sriganganagar, some genotypes required one to two rounds of insecticides. There was no chemical intervention at Sirsa.

As regards boll worm damage, most of the Bt cotton genotypes showed fairly high levels of resistance and could record high yields with just one round of insecticidal application. NECH 3R Bt alone at Faridkot required three rounds of application. Non-Bt entries required 3 to 6 rounds of insecticide application at Faridkot, Ludhiana and Sriganganagar (Table 21).

**Table 21. Insecticide spray details in ETL based Plant Protection trial**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganganagar
<b>For Sucking Pests Control</b>					
NCS 913 Bt	1	4	1	0	2
NCS 570 Bt	1	4	1	0	2
NCS 138 Bt	1	4	1	0	2
MRC 6029 Bt	1	4	1	0	1
JKCH 1947 Bt	1	4	1	0	0
RCH 308 Bt	1	4	1	0	0
JKCH 1050 Bt	1	4	1	0	1
MRC 6025 Bt	1	4	1	0	2
NECH 6R Bt	1	4	1	0	0
RCH 314 Bt	1	4	1	0	0
JKCH 226 Bt	1	4	1	0	0
NECH 3R Bt	1	4	1	0	0
<b>Check Variety</b>	1	4	1	0	0
<b>RCH 134 Bt (Bt.C.Hy)</b>	1	4	1	0	0
<b>SHRESTH (LC.Hy)</b>	1	4	1	0	0
<b>For Boll Worm Control</b>					
NCS 913 Bt	1	0	0	0	1
NCS 570 Bt	1	0	0	1	0
NCS 138 Bt	1	0	0	1	1
MRC 6029 Bt	2	0	0	1	1
JKCH 1947 Bt	2	0	0	0	1
RCH 308 Bt	1	0	0	0	0
JKCH 1050 Bt	1	0	0	0	0
MRC 6025 Bt	1	0	0	1	0
NECH 6R Bt	1	0	0	0	0
RCH 314 Bt	1	0	0	1	0
JKCH 226 Bt	1	0	0	0	0
NECH 3R Bt	3	0	0	0	0
<b>Check Variety</b>	6	4	0	1	3
<b>RCH 134 Bt (Bt.C.Hy)</b>	2	0	0	0	0
<b>SHRESTH (LC.Hy)</b>	6	4	0	1	1

## 2. EVALUATION UNDER UNPROTECTED CONDITIONS

All the fifteen entries in the trial were also evaluated under unprotected conditions for boll worm damage assessment. The trial was conducted at five locations viz., Faridkot, Ludhiana, Hisar, Sirsa and Sriganganagar.

### Germination and Final plant stand

The germination at Faridkot, Ludhiana and Hisar was good. At Sirsa average germination was around 70 per cent. JKCH 1947 Bt, NECH 6R Bt and the local variety had less germination. (Table 22).

**Table 22. Germination (%)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Mean
NCS 913 Bt	100.0	100.0	85.6	75.1	90.2
NCS 570 Bt	97.8	99.0	92.2	74.6	90.9
NCS 138 Bt	100.0	99.0	95.6	77.1	92.9
MRC 6029 Bt	98.8	99.0	87.8	84.1	92.4
JKCH 1947 Bt	84.0	97.0	80.0	64.0	81.2
RCH 308 Bt	97.8	100.0	96.7	73.1	91.9
JKCH 1050 Bt	96.9	99.0	92.2	74.0	90.5
MRC 6025 Bt	97.5	99.0	94.4	75.0	91.5
NECH 6R Bt	79.6	91.0	87.8	47.7	76.5
RCH 314 Bt	100.0	100.0	91.1	78.5	92.4
JKCH 226 Bt	100.0	100.0	93.3	83.3	94.1
NECH 3R Bt	98.8	94.0	87.8	72.8	88.3
<b>Check Variety</b>	99.2	100.0	88.9	47.0	83.8
<b>RCH 134 Bt (Bt.C.Hy)</b>	100.0	99.0	90.0	83.3	93.1
<b>SHRESTH (LC.Hy)</b>	97.2	98.0	88.9	73.5	89.4

Final Plant stand was adequate at Faridkot, Ludhiana and Sirsa. At Sriganganagar, NECH 6R Bt and the local variety had less stand. At Sirsa also the local variety had low stand (Table 23).

**Table 23. Final Plant Stand (Number of plants)**

Entries	Faridkot	Ludhiana	Sirsa	Sriganganagar	Mean
NCS 913 Bt	24	21	32	27	26
NCS 570 Bt	24	21	26	21	23
NCS 138 Bt	24	21	31	24	25
MRC 6029 Bt	23	21	31	20	24
JKCH 1947 Bt	22	20	28	21	23
RCH 308 Bt	23	21	29	30	26
JKCH 1050 Bt	23	21	31	24	25

MRC 6025 Bt	23	21	32	28	26
NECH 6R Bt	21	21	25	13	20
RCH 314 Bt	24	20	26	23	23
JKCH 226 Bt	24	21	28	21	23
NECH 3R Bt	23	19	28	26	24
<b>Check Variety</b>	24	30	22	18	24
<b>RCH 134 Bt (Bt.C.Hy)</b>	24	20	29	25	25
<b>SHRESTH (LC.Hy)</b>	23	21	31	21	24

### Square damage

The square damage was less than ten per cent in both Bt and non-Bt entries indicating low boll worm incidence. While the mean square damage varied from 3 to 9 per cent in non-Bt entries, it was only 0 to 5 per cent in the Bt hybrids (Table 24).

**Table 24. Square damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Hisar	Mean
NCS 913 Bt	0.00	1.00	0.50	2.4	0.97
NCS 570 Bt	0.15	1.07	0.61	2.7	1.13
NCS 138 Bt	0.62	0.98	0.80	1.7	1.02
MRC 6029 Bt	0.17	1.11	0.64	3.2	1.28
JKCH 1947 Bt	3.90	1.30	2.60	3.6	2.84
RCH 308 Bt	0.31	0.85	0.58	2.3	1.02
JKCH 1050 Bt	0.37	1.05	0.71	3.3	1.37
MRC 6025 Bt	0.00	1.29	0.64	5.0	1.74
NECH 6R Bt	0.00	1.17	0.58	1.9	0.92
RCH 314 Bt	0.19	0.95	0.57	3.2	1.24
JKCH 226 Bt	0.53	1.03	0.78	3.2	1.40
NECH 3R Bt	0.70	1.02	0.86	1.2	0.95
<b>Check Variety</b>	6.37	2.91	4.64	9.2	5.79
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.00	1.08	0.54	2.2	0.95
<b>SHRESTH (LC.Hy)</b>	4.09	3.46	3.77	3.2	3.64

### Open boll and locule damage

The open boll damage and locule damage were the least in Bt cotton hybrids. The Non-Bt checks recorded 18 to 37 per cent open boll damage (Table 25 and 26).

**Table 25. Open boll damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Sriganga-nagar	Mean
NCS 913 Bt	0.45	2.65	5.00	13.05	5.29
NCS 570 Bt	0.00	7.20	3.33	7.82	4.59
NCS 138 Bt	1.36	2.02	0.00	10.26	3.41
MRC 6029 Bt	0.16	2.47	1.67	9.64	3.49

JKCH 1947 Bt	1.03	15.75	3.33	10.94	7.76
RCH 308 Bt	0.15	3.45	0.00	13.15	4.19
JKCH 1050 Bt	0.00	1.41	1.67	11.80	3.72
MRC 6025 Bt	0.31	3.55	3.33	4.33	2.88
NECH 6R Bt	0.00	3.92	5.00	16.66	6.40
RCH 314 Bt	1.07	2.78	5.00	4.16	3.25
JKCH 226 Bt	0.15	1.87	4.00	5.58	2.90
NECH 3R Bt	3.23	6.59	3.33	14.70	6.96
<b>Check Variety</b>	25.51	18.81	5.00	37.36	21.67
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.00	3.18	1.67	4.88	2.43
<b>SHRESTH (LC.Hy)</b>	27.28	27.98	8.33	17.76	20.34

**Table 26. Locule damage (%)**

Entries	Faridkot	Ludhiana	Sirsa	Sriganga-nagar	Mean
NCS 913 Bt	0.1	1.1	1.6	4.2	1.7
NCS 570 Bt	0.0	2.3	1.6	2.3	1.5
NCS 138 Bt	0.6	1.0	0.0	4.4	1.5
MRC 6029 Bt	0.1	1.0	0.7	3.6	1.3
JKCH 1947 Bt	0.3	6.3	2.3	3.4	3.1
RCH 308 Bt	0.0	1.3	0.0	4.8	1.5
JKCH 1050 Bt	0.0	0.5	0.4	3.3	1.0
MRC 6025 Bt	0.2	1.2	1.5	1.9	1.2
NECH 6R Bt	0.0	1.2	0.4	5.8	1.9
RCH 314 Bt	3.1	0.8	2.0	1.1	1.7
JKCH 226 Bt	0.1	0.8	3.2	1.3	1.4
NECH 3R Bt	0.7	2.7	1.1	3.7	2.0
<b>Check Variety</b>	7.1	7.0	1.6	14.6	7.6
<b>RCH 134 Bt (Bt.C.Hy)</b>	0.0	1.3	0.8	1.2	0.8
<b>SHRESTH (LC.Hy)</b>	8.2	10.9	2.4	5.5	6.8

### Seed cotton yield

Under unsprayed conditions also, the Bt hybrids have recorded high yields. The Bt check hybrid RCH 134 Bt (3160 Kg/ha) was found to be the highest yielder. The Bt test entry RCH 314 Bt was the next best with 2902 Kg/ha (Table 27).

**Table 27. Seed Cotton Yield (kg/ha)**

Entries	Faridkot	Ludhiana	Hisar	Sirsa	Sriganga-nagar	Mean
NCS 913 Bt	2437	1858	1243	3241	1681	2092
NCS 570 Bt	3288	3552	1202	3575	1407	2604
NCS 138 Bt	3012	3109	1391	3484	1037	2406

MRC 6029 Bt	3197	3168	1366	3931	1444	2621
JKCH 1947 Bt	2388	1767	1144	2152	1207	1731
RCH 308 Bt	3474	2827	1432	3435	2089	2651
JKCH 1050 Bt	2644	2230	1333	3460	1333	2200
MRC 6025 Bt	2457	1599	1309	3309	2637	2262
NECH 6R Bt	2731	2278	1053	2283	815	1832
<b>RCH 314 Bt</b>	<b>3450</b>	<b>3233</b>	<b>1539</b>	<b>4365</b>	<b>1926</b>	<b>2902</b>
JKCH 226 Bt	3286	3205	1473	3674	1629	2653
NECH 3R Bt	2826	1872	839	2593	941	1814
<b>Check Variety</b>	2643	2053	856	1273	641	1493
<b>RCH 134 Bt (Bt.C.Hy)</b>	<b>3689</b>	<b>3484</b>	<b>1300</b>	<b>4960</b>	<b>2370</b>	<b>3160</b>
<b>SHRESTH (LC.Hy)</b>	2726	2233	889	2837	629	1862
<b>C.D. @ 5%</b>	613	602	182	598	773	
<b>CV %</b>	12.4	14.0	7.4		14.5	

A combined analysis of protected and unprotected trial yields indicates that RCH 314 Bt (3060 Kg/ha) was on par with the check RCH 134 Bt (3124 Kg/ha) in seed cotton yield (Table 28).

**Table 28. Mean Seed Cotton Yield (kg/ha)**

<b>Entries</b>	<b>Protected</b>	<b>Unprotected</b>	<b>Mean</b>
NCS 913 Bt	2366	2092	2229
NCS 570 Bt	2860	2604	2732
NCS 138 Bt	2781	2406	2593
<b>MRC 6029 Bt</b>	<b>2974</b>	<b>2621</b>	<b>2798</b>
JKCH 1947 Bt	2007	1731	1869
RCH 308 Bt	2751	2651	2701
JKCH 1050 Bt	2469	2200	2366
MRC 6025 Bt	2690	2262	2476
NECH 6R Bt	1778	1832	1805
<b>RCH 314 Bt</b>	<b>3217</b>	<b>2902</b>	<b>3060</b>
<b>JKCH 226 Bt</b>	<b>3044</b>	<b>2653</b>	<b>2848</b>
NECH 3R Bt	1974	1814	1894
<b>Check Variety</b>	2043	1493	1768
<b>RCH 134 Bt (Bt.C.Hy)</b>	<b>3088</b>	<b>3160</b>	<b>3124</b>
<b>SHRESTH (LC.Hy)</b>	2077	1862	1970

## D. PATHOLOGICAL EVALUATION

The Bt hybrids (12 nos.) with three checks (RCH 134 Bt, Shresth and local check) were evaluated for diseases both under protected and unprotected conditions.

### Cotton Leaf Curl Virus Disease (CLCuV)

Cotton leaf curl virus disease was noticed in the field of all centres except in Ludhiana where it was noticed only under screen house condition.

MRC 6029 Bt and JKCH 1050 Bt hybrids were free from CLCuV disease at all locations. The rest of the entries had the disease in varying intensities at different locations. NECH 3R Bt was found highly susceptible to CLCuV with disease ranging from 16.7 to 81.5 per cent disease index (PDI). NCS 913 Bt had an incidence ranging from 1.0 to 40.3 at different centres (Table 29).

**Table 29. CLCuV Disease Index**

Entries	Sirsa		Hisar		Srigangaganagar		Ludhiana		Faridkot	
	P	UP	P	UP	P	UP	P/UP	Screen house	P	UP
NCS 913 Bt	40.3	1.0	0.26	0.0	18.91	-	0.0	11.5	3.70	10.7
NCS 570 Bt	0.0	0.0	0.0	0.0	2.77	-	0.0	0.0	12.90	0.0
NCS 138 Bt	1.0	1.3	0.0	0.0	2.38	-	0.0	0.0	16.60	0.0
MRC 6029 Bt	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
JKCH 1947 Bt	0.0	1.3	0.06	0.0	1.61	-	0.0	5.0	0.0	0.0
RCH 308 Bt	6.3	6.8	0.0	0.0	4.41	-	0.0	0.0	0.0	0.0
JKCH 1050 Bt	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
MRC 6025 Bt	0.0	0.0	0.0	0.0	1.21	-	0.0	0.0	0.0	0.0
NECH 6R Bt	0.0	0.0	0.01	0.0	1.85	-	0.0	0.0	0.0	0.0
RCH 314 Bt	0.0	0.0	0.11	0.0	18.91	-	0.0	3.6	2.8	2.8
JKCH 226 Bt	9.3	5.2	0.09	1.11	6.66	-	0.0	2.9	0.0	0.0
NECH 3R Bt	49.0	81.5	46.42	27.75	57.14	-	0.0	16.7	25.9	18.5
<b>Local check</b>	57.8	55.2	0.03	0.01	1.75	-	0.0	0.0	0.0	0.0
<b>RCH 134 Bt (Bt Check)</b>	0.0	0.0	0.01	0.0	2.73	-	0.0	4.8	0.0	2.7
<b>SHRESTH</b>	0.0	0.0	0.0	0.0	4.83	-	0.0	0.0	0.0	0.0

### Fungal Foliar Diseases

Only at Faridkot and Ludhiana centres, bacterial leaf blight and *Myrothecium* leaf spot were noticed and the *Alternaria* leaf spot was noticed at Faridkot centre. The hybrids NCS 913 Bt, NCS 138 Bt, RCH 308 Bt, JKCH 1050 Bt, MRC 6025 Bt and RCH 314 Bt were found susceptible to bacterial leaf blight under protected conditions at Ludhiana. Otherwise, these three diseases were at low level at Faridkot (Table 30).



**Table 30. Fungal foliar diseases (Grades)**

Entries	Myrothecium Leaf Spot (Grades)		Bacterial Blight (Grades)		Alternaria Leaf Spot (Grades)
	Ludhiana	Faridkot	Ludhiana	Faridkot	Faridkot
NCS 913 Bt	0.0	2.0	3.0	0.0	2.0
NCS 570 Bt	1.0	2.0	2.0	1.0	2.0
NCS 138 Bt	0.0	2.0	3.0	0.0	2.0
MRC 6029 Bt	1.0	1.0	2.0	1.0	1.0
JKCH 1947 Bt	0.0	2.0	1.0	0.0	2.0
RCH 308 Bt	1.0	1.0	3.0	1.0	1.0
JKCH 1050 Bt	0.0	1.0	3.0	0.0	1.0
MRC 6025 Bt	0.0	1.0	3.0	0.0	2.0
NECH 6R Bt	0.0	1.0	2.0	0.0	2.0
RCH 314 Bt	0.0	2.0	3.0	0.0	2.0
JKCH 226 Bt	0.0	2.0	2.0	0.0	1.0
NECH 3R Bt	0.0	1.0	1.0	0.0	1.0
<b>Local check</b>	0.0	1.0	1.0	0.0	1.0
<b>RCH 134 Bt (Bt Check)</b>	0.0	1.0	1.0	0.0	1.0
<b>SHRESTH</b>	0.0	1.0	1.0	0.0	1.0

**E. OVERALL ASSESSMENT**

Twelve Bt cotton hybrids were evaluated under ETL and under unprotected conditions along with RCH 134 Bt (Bt check hybrid), Shresth (non-Bt check hybrid) and a local variety. The trial was conducted at five locations.

The overall incidence of boll worm was low in this trial as indicated by the low square damage and low boll worm larval population on both Bt and non-Bt entries. Even under low boll worm incidence level, considerable differences could be seen in the boll and locule damage at harvest. Most of the Bt cotton hybrids recorded considerably low boll and locule damage as compared to the local variety or Shresth.

Bt test entries MRC 6029 Bt and JKCH 1050 Bt were free from CLCuV disease at all locations. Rest of the entries, including check, showed varying intensity of disease at different locations. RCH 314 Bt did not show symptoms of CLCuV disease at Ludhiana, Hisar and Sirsa. However, at Sriganganagar (18.9 PDI) and Faridkot (2.8 PDI) it was found susceptible.

The test hybrid RCH 314 Bt recorded the highest mean seed cotton yield of 3217 Kg/ha as against 3088 Kg/ha recorded by the Bt check hybrid RCH 134 under protected conditions. Both the hybrids were on par in ginning out turn with around 35 per cent

ginning out turn under protected conditions. However, the Bt check hybrid (3160 Kg/ha) was better than RCH 314 Bt (2902 Kg/ha) under unprotected conditions. But over all, RCH 314 Bt and RCH 134 Bt check hybrids were on par with each other.

Quality wise NCS 570 Bt recorded the highest fibre length of 31.9 mm with a high fibre Strength of 24.7 g/tex. RCH 314 Bt, recorded a lower fibre strength than that of RCH 134 Bt check.

**Table 31. Overall performance**

Entries	Mean Seed Cotton Yield (kg/ha)			2..5 % Span Length (mm)	Micro naire	Strength (g/tex)
	Protected	Unprotected	Mean			
RCH 314 Bt	3217	2902	3060	28.8	4.2	22.4
JKCH 226 Bt	3044	2653	2848	27.7	4.7	21.7
MRC 6029 Bt	2974	2621	2798	29.1	4.2	24.0
<b>RCH 134 (Bt.C.Hy)</b>	<b>3088</b>	<b>3160</b>	<b>3124</b>	<b>27.6</b>	<b>4.8</b>	<b>23.5</b>

## CONCLUSION

Bt hybrids recorded low square, boll and locule damage as compared to the non-Bt entries, indicating the effectiveness of Bt gene in boll worm management.

Among the hybrids tested, RCH 314 Bt was the best with a mean seed cotton yield of 3060 Kg/ha and was on par with the Bt check hybrid RCH 134 Bt (3124 Kg/ha). RCH 314 Bt, recorded a lower fibre strength than that of RCH 134 Bt check.

## COMBINED REPORT OF TWO YEARS (2004-05 AND 2005-06)

Sixteen Bt cotton hybrids were evaluated during 2004-05 season in North Zone. However, seeds of only twelve entries were received from the respective seed companies for repeating the trial during 2005-06 season. Seeds of 02-26 VIP, 02-42 VIP, 02-50 VIP and MRC 6021 Bt were not received. Hence, in the combined report results of the following twelve hybrids alone are discussed.

1. NCS 138 Bt, NCS 570 Bt and NCS 913 Bt from Nuziveedu seeds
2. MRC 6025 Bt and MRC 6029 Bt from MAHYCO seeds
3. JKCH Bt 226, JKCH 1050 Bt and JKCH 1947 Bt from JK seeds
4. RCH 308 Bt and RCH 314 Bt from RASI seeds and
5. NECH 3R Bt and NECH 6R Bt from NATH seeds

### A. BIOMETRICAL EVALUATION

Most of the biometrical characters studied showed consistency over the years. There was no difference between the mean boll weights of entries tested during the two years. However, MRC 6029 Bt showed an increase in boll weight during the second year. On the other hand NECH 6R Bt showed a decline in boll weight (Table 1)

Similarly, the mean ginning out turn of entries during the first year was 35.5 per cent and showed a marginal decline to 34.8 per cent during second year. Barring NCS 570 Bt which showed a decline of 4 per cent ginning out turn during 2005-06 season, all other entries showed consistency in ginning out turn (Table 1)

**Table 1. Boll weight and ginning percentage**

Entries	Boll Weight(g)			Ginning Percent		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
JKCH226 Bt	3.6	3.4	3.5	36.8	35.7	36.2
JKCH.1050 Bt	3.4	3.6	3.5	39.0	38.3	38.7
JKCH.1947 Bt	3.2	3.6	3.4	36.3	34.6	35.5
MRC.6025 Bt	4.5	4.4	4.4	34.0	33.7	33.9
MRC.6029 Bt	3.5	4.2	3.9	34.2	33.1	33.7
NCS.138 Bt	4.2	4.2	4.2	34.2	33.1	33.7
NCS.570 Bt	3.3	3.7	3.5	36.2	32.7	34.5
NCS.913 Bt	3.6	3.5	3.5	35.1	36.0	35.6
NECH.3R Bt	3.6	3.7	3.7	34.7	34.5	34.6
NECH.6R Bt	4.1	3.3	3.7	36.8	35.7	36.2

RCH.308 Bt	3.8	3.5	3.7	35.2	35.2	35.2
RCH.314 Bt	4.0	3.8	3.9	35.0	35.5	35.2
Bt check Hybrid	3.5	4.0	3.8	34.9	34.8	34.8
Variety Check	3.1	3.3	3.2	34.4	33.6	34.0
Mean	3.7	3.7	3.7	35.5	34.8	35.1

Mean seed cotton yield during the second year of testing was marginally lower at 2574 Kg/ha as against 2896 Kg/ha during the first year under ETL based plant protection trials. The same trend was noticed under unprotected conditions also. MECH 162 Bt was used as the Bt check hybrid during 2004-05 and RCH 134 Bt was used as the Bt check hybrid during 2005-06. The yield performance of MECH 162 Bt was very poor during 2004-05 and was even below the check variety. Performance of RCH 134 Bt was, however, found to be very good during the second year.

The test Hybrids JKCH 226 Bt, MRC 6029 Bt and RCH 314 Bt were consistent in their yield performance during both the years. Overall, **RCH 314 Bt** recorded the highest seed cotton yield of 3356 Kg/ha with an increased seed cotton yield of 36 per cent over the Bt check hybrid (2476 Kg/ha). RCH 308 Bt (3105 Kg/ha) and MRC 6029 Bt (2963 Kg/ha) were the second and third best hybrids with an yield increase of 25 and 20 per cent respectively (Table 2).

**Table 2. Seed cotton yield (Kg/ha)**

Hybrid	Sprayed			Un sprayed			Overall Mean	± Over Bt check (%)
	2004-05	2005-06	Mean	2004-05	2005-06	Mean		
JKCH226 Bt	3127	3044	3085	2746	2653	2700	2892	17
JKCH.1050 Bt	2818	2469	2644	2672	2200	2436	2540	3
JKCH.1947 Bt	2995	2007	2501	2714	1731	2223	2362	-5
MRC.6025 Bt	3330	2690	3010	2990	2262	2626	2818	14
<b>MRC.6029 Bt</b>	<b>3294</b>	<b>2974</b>	<b>3134</b>	<b>2962</b>	<b>2621</b>	<b>2792</b>	<b>2963</b>	<b>20</b>
NCS.138 Bt	3063	2781	2922	2706	2406	2556	2739	11
NCS.570 Bt	2571	2860	2715	2067	2604	2336	2525	2
NCS.913 Bt	3238	2366	2802	3133	2092	2613	2707	9
NECH.3R Bt	1762	1974	1868	1693	1814	1754	1811	-27
NECH.6R Bt	2854	1778	2316	2548	1832	2190	2253	-9
<b>RCH.308 Bt</b>	<b>3541</b>	<b>2751</b>	<b>3146</b>	<b>3477</b>	<b>2651</b>	<b>3064</b>	<b>3105</b>	<b>25</b>
<b>RCH.314 Bt</b>	<b>3642</b>	<b>3217</b>	<b>3429</b>	<b>3663</b>	<b>2902</b>	<b>3283</b>	<b>3356</b>	<b>36</b>
Bt check Hybrid	1956	3088	2522	1699	3160	2430	<b>2476</b>	0
Variety Check	2357	2043	2200	1832	1493	1663	1931	
Mean	2896	2574	2735	2636	2316	2476	2606	

## B. FIBRE QUALITY EVALUATION

Fibre quality parameters, except in the case of NCS 570 Bt, showed remarkable consistency. The fibre quality in respect of NCS 570 Bt in the second year was superior to the first year values, which can not be attributed to environmental effect. Hybrids MRC 6029 Bt, MRC 6025 Bt and NECH 3 R Bt were on par with RCH 134 Bt (Bt.C.Hy.) in fibre strength and other acceptable fibre parameters (Table 3).

**Table 3. Fibre quality parameters**

Name of entry	2.5 Span Length (mm)			Micronaire			Strength (g/tex)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean	2004-05	2005-06	Mean
NCS 913 Bt	28.1	28.3	28.2	4.7	4.7	4.7	21.8	23.4	22.6
NCS 570 Bt	25.9	31.9	28.9	5.1	4.7	4.9	20.6	24.7	22.7
NCS 138 Bt	27.4	28.2	27.8	4.7	5.0	4.9	22.8	23.0	22.9
MRC 6029 Bt	27.5	29.1	28.3	4.1	4.2	4.2	22.6	24.0	23.3
JKCH 1947 Bt	27.6	28.3	28.0	4.7	4.6	4.7	21.6	23.1	22.4
RCH 308 Bt	28.0	28.8	28.4	4.4	4.8	4.6	21.7	21.9	21.8
JKCH 1050 Bt	27.0	28.0	27.5	5.0	5.0	5.0	21.0	21.6	21.3
MRC 6025 Bt	29.4	29.0	29.2	4.5	4.5	4.5	22.6	23.6	23.1
NECH 6R Bt	28.8	27.9	28.4	4.7	4.2	4.5	22.4	22.6	22.5
RCH 314 Bt	27.5	28.8	28.2	4.0	4.2	4.1	22.5	22.4	22.5
JKCH 226 Bt	28.6	27.7	28.2	4.5	4.7	4.6	23.1	21.7	22.4
NECH 3R Bt	30.2	29.6	29.9	4.5	4.2	4.4	23.1	24.1	23.6
Check Variety	25.0	25.9	25.5	4.8	4.7	4.8	20.5	20.6	20.6
RCH 134 Bt (Bt.C.Hy)	-	27.6	27.6	-	4.8	4.8	-	23.5	23.5
SHRESTH (LC.Hy)	-	28.1	28.1	-	4.6	4.6	-	23.8	23.8
MECH 162 Bt Check	25.9	-	25.9	5.0	-	5.0	20.1	-	20.1

## C. ENTOMOLOGICAL EVALUATION

### Jassid Damage

Jassid and whitefly were the major sucking pests affecting cotton in North Zone. Jassid population was recorded upto fairly last stage of crop growth making it necessary to take up plant protection measures to control the population. Jassid population was maximum at Ludhiana and the least at Sirsa. MRC 6029 Bt and RCH 314 Bt recorded low mean jassid population of 1.3/plant. Jassid population was comparatively more on JKCH 1947 Bt, JKCH 1050 Bt, RCH 308 Bt and JKCH 226 Bt (Table 4).

**Table 4. Jassid population/plant**

Entries	Faridkot		Ludhiana		Sriganganagar	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
NCS.913 Bt	1.4	0.9	3.0	3.3	1.5	1.1
NCS.570 Bt	1.0	1.5	2.4	3.1	1.1	1.1
NCS.138 Bt	1.0	3.4	2.1	3.1	0.9	1.3
MRC.6029 Bt	0.8	1.2	1.8	3.1	1.0	1.1
JKCH.1947 Bt	1.1	4.4	2.1	3.2	0.7	1.0
RCH.308 Bt	1.0	3.9	1.9	3.3	1.2	1.3
JKCH.1050 Bt	1.6	1.2	3.1	3.2	1.8	1.4
MRC.6025 Bt	1.0	1.6	2.1	3.0	0.9	1.3
NECH.6R Bt	1.6	0.5	2.2	2.9	1.1	1.4
RCH.314 Bt	0.8	0.6	1.8	3.0	0.9	1.6
JKCH226 Bt	1.3	3.1	2.1	3.0	2.1	1.0
NECH.3R Bt	0.8	1.1	1.9	3.3	1.5	1.8
<b>Variety Check</b>	0.8	0.6	2.1	3.0	0.8	1.2
<b>Bt Check</b>	0.8	1.3	2.0	3.0	0.9	1.4

Entries	Hisar		Sirsa		Mean
	2004-05	2005-06	2004-05	2005-06	
NCS.913 Bt	1.6	1.6	0.9	1.3	1.6
NCS.570 Bt	1.2	1.6	0.8	0.8	1.4
NCS.138 Bt	1.1	1.7	0.8	0.9	1.6
MRC.6029 Bt	0.9	1.6	0.7	0.9	1.3
JKCH.1947 Bt	1.2	1.9	0.7	1.1	1.7
RCH.308 Bt	2.2	1.9	0.9	1.0	1.8
JKCH.1050 Bt	1.4	2.0	1.3	0.9	1.8
MRC.6025 Bt	1.3	2.0	0.8	1.0	1.5
NECH.6R Bt	1.4	1.6	1.0	0.8	1.5
RCH.314 Bt	1.0	1.7	0.8	1.0	1.3
JKCH226 Bt	1.5	1.9	1.0	1.0	1.8
NECH.3R Bt	1.4	1.7	0.9	1.2	1.6
<b>Variety Check</b>	1.4	1.7	0.8	0.9	1.3
<b>Bt Check</b>	1.4	1.6	1.0	1.1	1.4

### Whitefly damage

Whitefly population was maximum at Sriganganagar during both the years warranting chemical intervention more than once. At other centres the population built up was only moderate. Mean of two years data over locations does not indicate much variation between entries (Table 5).

**Table 5. Whitefly population/plant**

Entries	Faridkot		Ludhiana		Sriganganagar		Hisar	Sirsa		Mean
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2005-06	2004-05	2005-06	
NCS.913 Bt	1.1	2.1	2.4	2.7	16.2	14.6	1.6	1.9	1.4	4.9
NCS.570 Bt	1.2	2.2	2.8	2.4	11.1	12.6	1.7	2.0	1.4	4.1
NCS.138 Bt	1.2	2.6	2.6	2.6	14.6	13.8	1.6	1.9	1.3	4.7
MRC.6029 Bt	1.6	3.0	2.7	2.3	10.7	11.1	1.5	1.8	1.4	4.0
JKCH.1947 Bt	1.9	2.2	2.8	2.5	10.0	9.2	1.5	1.8	1.3	3.7
RCH.308 Bt	1.0	3.2	2.6	2.6	12.7	10.3	1.8	2.1	1.3	4.2
JKCH.1050 Bt	1.4	2.5	2.7	2.6	17.1	14.3	1.6	2.3	1.2	5.1
MRC.6025 Bt	1.3	2.8	2.4	2.7	14.2	13.3	1.7	1.6	1.4	4.6
NECH.6R Bt	1.7	2.6	2.8	2.4	14.3	10.8	1.8	2.2	1.4	4.4
RCH.314 Bt	1.2	2.8	2.6	2.5	15.5	8.8	1.7	1.9	1.5	4.3
JKCH226 Bt	1.0	2.4	2.5	2.6	13.8	9.8	1.7	2.0	1.4	4.1
NECH.3R Bt	1.5	3.0	2.7	2.4	15.5	11.1	1.6	2.1	1.6	4.6
<b>Variety Check</b>	1.4	2.0	2.8	2.6	10.5	9.2	1.8	1.9	1.2	3.7
<b>Bt Check</b>	1.7	2.6	2.9	2.7	12.6	10.7	1.6	2.0	1.4	4.2

**Square damage**

The square damage under ETL based protected trial was low indicating the low incidence of boll worm during both the years. The non-Bt varietal check had comparatively more square damage than the Bt hybrids. Barring Faridkot during 2004-05, most of the Bt hybrids recorded less than two per cent square damage, amply demonstrating the effectiveness of Bt gene in controlling the boll worm damage (Table 6).

**Table 6. Square damage (%)**

Entries	Faridkot		Ludhiana		Sriganganagar		Sirsa		Mean
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	
NCS.913 Bt	4.4	0.7	0.0	1.4	2.1	2.8	0.5	0.3	1.5
NCS.570 Bt	15.0	0.6	0.6	1.0	2.0	2.0	1.4	1.4	3.0
NCS.138 Bt	9.6	0.0	0.0	1.0	2.5	2.1	0.7	1.3	2.2
MRC.6029 Bt	7.2	0.0	0.0	0.8	1.4	2.9	1.0	1.2	1.8
JKCH.1947 Bt	6.1	1.1	0.3	1.2	2.1	2.4	1.1	0.5	1.8
RCH.308 Bt	5.4	0.0	0.8	1.2	1.3	1.0	0.9	0.7	1.4
JKCH.1050 Bt	6.8	0.7	0.2	1.2	2.0	1.7	1.5	0.4	1.8
MRC.6025 Bt	1.9	0.5	0.0	0.9	1.3	1.4	0.7	0.4	0.9
NECH.6R Bt	8.7	0.0	0.8	1.0	1.3	1.3	1.2	0.9	1.9

RCH.314 Bt	6.1	0.0	0.1	0.9	1.6	1.3	1.0	1.5	1.6
JKCH226 Bt	2.4	0.9	0.5	1.4	3.0	1.3	0.6	0.2	1.3
NECH.3R Bt	2.6	0.9	1.3	1.0	1.0	1.1	1.3	0.5	1.2
<b>Variety Check</b>	20.7	3.6	1.9	4.6	5.4	5.5	2.6	1.4	5.7
<b>Bt Check</b>	15.1	0.0	1.6	1.5	2.6	0.9	1.7	0.5	3.0

### Open boll damage

The open boll damage was maximum at Ludhiana and Sriganaganagar. All the Bt cotton entries recorded less mean open boll damage than non-Bt varietal check. NCS 913 Bt, MRC 6029 Bt, RCH 308 Bt, JKCH 1050 Bt, RCH 314 Bt and JKCH 226 Bt recorded less than 6 per cent open boll damage as against 8.6 per cent in Bt check hybrid and 20 per cent in check variety (Table 7).

**Table 7. Open boll damage (%)**

Entries	Faridkot		Ludhiana		Sriganaganagar		Hisar	Sirsa		Mean
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2004-05	2005-06	
NCS.913 Bt	1.7	0.0	21.8	3.0	1.8	11.1	6.9	0.5	3.3	5.6
NCS.570 Bt	7.4	0.5	36.5	2.7	30.0	5.3	7.1	0.5	0.0	10.0
NCS.138 Bt	1.9	1.5	15.3	5.4	25.0	7.4	7.4	0.5	6.7	7.9
MRC.6029 Bt	0.6	0.3	12.4	4.8	15.0	8.4	7.2	0.5	0.0	5.5
JKCH.1947 Bt	0.3	0.2	32.3	10.8	18.3	9.2	7.7	0.5	5.0	9.4
RCH.308 Bt	3.2	0.0	22.1	2.8	6.7	10.2	4.2	0.5	3.3	5.9
JKCH.1050 Bt	2.0	0.0	31.5	1.9	1.7	10.9	3.6	0.5	0.0	5.8
MRC.6025 Bt	0.6	0.2	22.6	4.9	23.3	2.1	4.9	0.5	1.7	6.8
NECH.6R Bt	2.4	1.0	30.2	1.8	21.7	14.3	5.6	0.5	3.3	9.0
RCH.314 Bt	1.2	0.8	29.6	4.8	8.3	2.4	3.7	0.5	1.7	5.9
JKCH226 Bt	0.3	0.2	24.3	1.3	13.3	3.2	4.2	0.5	0.0	5.2
NECH.3R Bt	4.8	1.9	42.4	8.8	31.7	13.9	3.9	0.5	3.3	12.4
<b>Variety Check</b>	16.7	12.1	53.5	21.3	21.7	34.3	15.8	0.5	6.7	20.3
<b>Bt Check</b>	5.7	0.6	21.3	4.1	26.7	3.6	9.5	0.5	5.0	8.6

### Locule damage

Per cent locule damage was also more in Ludhiana and Sriganaganagar. Most of the Bt test hybrids recorded mean locule damage of 2 to 3 per cent only. Only NCS 570 Bt (4.6 %) and NECH 3R Bt (6.1 %) recorded more locule damage than Bt check hybrid (3.8 %). Variety check recorded the highest locule damage of 9.4 per cent (Table 8).



**Table 8. Locule damage (%)**

Entries	Faridkot		Ludhiana		Sriganganagar		Hisar	Sirsa		Mean
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2004-05	2005-06	
NCS.913 Bt	0.7	0.0	7.9	1.1	1.0	4.1	2.7	0.5	1.6	2.2
NCS.570 Bt	3.1	0.1	15.8	0.9	10.4	2.7	3.0	5.5	0.0	4.6
NCS.138 Bt	0.8	0.6	5.3	1.8	10.6	2.2	3.2	2.9	2.2	3.3
MRC.6029 Bt	0.2	0.1	4.5	2.0	4.3	3.6	2.7	0.5	0.0	2.0
JKCH.1947 Bt	0.1	0.1	13.4	5.5	2.3	3.3	3.3	1.3	3.7	3.6
RCH.308 Bt	1.0	0.0	8.1	1.3	2.4	4.2	1.6	1.3	1.1	2.3
JKCH.1050 Bt	1.0	0.0	11.6	0.6	1.0	3.1	1.4	1.3	0.0	2.2
MRC.6025 Bt	0.2	0.1	8.4	1.8	9.2	0.8	1.9	0.5	0.7	2.6
NECH.6R Bt	0.9	0.3	8.8	0.6	9.5	4.2	1.1	1.3	1.5	3.1
RCH.314 Bt	0.4	0.5	9.9	1.7	4.4	1.3	1.1	1.2	0.8	2.4
JKCH226 Bt	0.1	0.0	7.6	0.4	10.6	1.2	1.4	0.5	0.0	2.4
NECH.3R Bt	2.1	0.6	15.8	3.6	23.0	5.4	1.4	1.9	1.5	6.1
<b>Variety Check</b>	7.7	4.0	27.6	9.2	8.8	11.9	7.4	6.1	1.8	9.4
<b>Bt Check</b>	2.1	0.2	11.1	1.5	11.1	1.2	3.3	4.0	0.0	3.8

### **Insecticidal Application**

Jassids and whitefly were the main sucking pest during both years at Faridkot, Hisar and Sriganganagar. The incidence was more severe during 2004-05, warranting more number of sprays than during 2005-06. At Sirsa, sucking pests were very much with in the ETL level during both years. Bollworm incidence was minimum during the two years of test. Except at Faridkot, the check varieties did not require more than three rounds of pesticide application to control bollworms. NECH 3R Bt required 3 applications whereas JKCH 1947 Bt required 2 applications of pesticides during the two years at Faridkot. NCS 570 Bt had three rounds of pesticide application at Faridkot during 2004-05. MRC 6029 Bt required two rounds during 2005-06. At Hisar, two rounds of pesticides were given to RCH 314 Bt. Rest of the entries had either no application or one round of pesticide for bollworm control (Table 9).

Table 9. Insecticide spray details in ETL based Plant Protection trial

Entries	Faridkot		Ludhiana	Hisar		Sirsa		Sriganganagar	
	2004-05	2005-06	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
<b>For Sucking Pests Control</b>									
NCS 913 Bt	3	1	4	3	1	0	0	1	2
NCS 570 Bt	2	1	4	1	1	0	0	0	2
NCS 138 Bt	2	1	4	1	1	0	0	0	2
MRC 6029 Bt	2	1	4	1	1	0	0	1	1
JKCH 1947 Bt	1	1	4	0	1	0	0	0	0
RCH 308 Bt	1	1	4	1	1	0	0	2	0
JKCH 1050 Bt	3	1	4	2	1	0	0	1	1
MRC 6025 Bt	1	1	4	1	1	0	0	0	2
NECH 6R Bt	3	1	4	2	1	0	0	2	0
RCH 314 Bt	1	1	4	3	1	0	0	1	0
JKCH 226 Bt	3	1	4	1	1	0	0	2	0
NECH 3R Bt	1	1	4	1	1	0	0	0	0
<b>Check Variety</b>	2	1	4	1	1	0	0	0	0
<b>Bt Check Hybrid</b>	3	1	4	2	1	0	0	1	0
<b>SHRESTH (LC.Hy)</b>	-	1	4	-	1	-	0	-	0
<b>For Boll Worm Control</b>									
NCS 913 Bt	1	1	0	0	0	0	0	0	1
NCS 570 Bt	3	1	0	0	0	0	1	0	0
NCS 138 Bt	1	1	0	1	0	0	1	0	1
MRC 6029 Bt	1	2	0	1	0	0	1	0	1
JKCH 1947 Bt	2	2	0	1	0	0	0	0	1
RCH 308 Bt	0	1	0	1	0	0	0	0	0
JKCH 1050 Bt	1	1	0	1	0	0	0	0	0
MRC 6025 Bt	1	1	0	1	0	0	1	0	0
NECH 6R Bt	1	1	0	0	0	1	0	0	0
RCH 314 Bt	1	1	0	2	0	0	1	0	0
JKCH 226 Bt	1	1	0	1	0	0	0	0	0
NECH 3R Bt	3	3	0	0	0	0	0	0	0
<b>Check Variety</b>	5	6	4	3	0	1	1	1	3
<b>Bt Check Hybrid</b>	1	2	0	3	0	0	0	0	0
<b>SHRESTH (LC.Hy)</b>	-	6	4	-	0	-	1		1

## D. PATHOLOGICAL EVALUATION

Among the Bt hybrids MRC 6025 Bt had the least disease incidence of 1.21 followed by NECH 6R Bt (1.85) during 2005-06 only at Sriganaganagar and had shown a maximum grades of 1 and 3 respectively at the same place during 2004-05.

Over two years the Bt hybrid NECH 3R Bt showed highest susceptibility to the Cotton leaf curl disease with 16.7 to 81.5 per cent disease index during 2005-06 and 1.30 to 18.20 per cent plant infection with a maximum grade of 4 during 2004-05. NCS 913 Bt also showed high susceptibility with maximum PDI of 40.3 at Sirsa during 2005-06 and a grade of 3 at Sriganaganagar during 2004-05 (Table 10).

**Table 10. Reaction of Bt hybrids to CLCuV (2004-2006)**

Entries	Maximum Grade	2004-05 Percentage of Infected Plants (range)	2005-06 Percent Disease Index
NCS.913 Bt	3	7.88	1.00 to 40.30
NCS.570 Bt	4	5.26 to 9.68	2.77 to 12.90
NCS.138 Bt	4	2.50 to 5.66	1.00 to 16.60
MRC.6029 Bt	4	9.20 to 15.40	0.00
JKCH.1947 Bt	4	5.71	1.30 to 5.00
RCH.308 Bt	3	4.43	4.41 to 6.80
JKCH.1050 Bt	4	6.33 to 10.90	0.00
MRC.6025 Bt	1	1.81 to 3.45	1.21*
NECH.6R Bt	3	5.66	1.85*
RCH.314 Bt	4	4.17 to 5.98	0.11 to 18.91
JKCH226 Bt	4	5.56 to 7.55	0.09 to 9.30
NECH.3R Bt	4	1.30 to 18.20	16.90 to 81.5
<b>Local check</b>	3	2.67 to 11.45	1.75 to 57.80
<b>RCH 134 Bt (Bt Check)</b>	4	1.30 to 11.91	2.70 to 4.80

\* Noticed only at Sriganaganagar

### Other diseases

Eventhough parawilt was observed at Ludhiana during 2004-05 with MRC 6025 showing maximum wilting (55.4 to 71.4 %) and the least in NECH 3R Bt (3.2 to 4.6 %), this phenomenon was absent during 2005-06.

Among the foliar diseases, bacterial leaf blight was noticed in high intensity during 2005-06 only at Ludhiana against which the Bt hybrids NCS 913 Bt, NCS 138 Bt, RCH 308 Bt, JKCH 1050 Bt, MRC 6025 Bt and RCH 314 Bt were found susceptible. *Myrothecium* and *Alternaria* leaf spots were noticed in Punjab at low intensities.

## E. OVERALL ASSESSMENT AND CONCLUSION

Of the twelve Bt hybrids evaluated for two years at five locations, RCH 314 was the most promising with mean seed cotton yield of 3356 Kg/ha, as against 2468 Kg/ha of the Bt check hybrid (mean of MECH 162 Bt and RCH 134 Bt). RCH 308 Bt and MRC 6029 Bt were the second and third best hybrids. However, compared to the best Bt check hybrid RCH 134 Bt, only RCH 314 Bt showed marginal superiority. However, the fibre quality of RCH 314 Bt was shade inferior to the check hybrids RCH 134 Bt (Table 11).

**Table 11. Overall Performance**

<b>Entries</b>	<b>Mean Seed Cotton Yield (Kg/ha)</b>	<b>% Inc. over RCH 134 Bt</b>	<b>% Inc. over MECH 162 Bt</b>	<b>Ginning Percent</b>	<b>2.5 % Span Length (mm)</b>	<b>Micro naire</b>	<b>Strength (g/tex)</b>
RCH 314 Bt	3356	8	84	35.2	28.2	4.1	22.5
RCH 308 Bt	3105	0	70	35.2	28.4	4.6	21.8
MRC 6029 Bt	2963	- 5	62	33.7	28.0	4.2	23.3
RCH 134 Bt (Bt. C)	3107	-	-	34.8	27.6	4.8	23.5
MECH 162 Bt (Bt. C)	1828	-	-	34.9	25.9	5.0	20.1