

NORTH ZONE

Evaluation of Bt Cotton Hybrids

The All India Coordinated Cotton Improvement Project (AICCIP) was assigned the task of evaluating the Bt Cotton hybrids in the North Zone vide ICAR letterNo.F2(5)/2006-CCI Dt.24th April 2006.

FIRST YEAR TRIALS (2006-07)

Trial entries

In the first year trial, 19 Bt cotton hybrids were evaluated, of which 11 were BG I entries and eight were BG II entries. There were three checks. The BG I entries were Namcot 402 Bt (Namdhari Seeds), ACH 155-1 Bt (Ajeet Seeds), IT 905 Bt (Pro Agro Seeds), BCHH 6317 Bt (Bio seeds), Sigma Bt (Vibha seeds), Ankur 2226 Bt (Ankur seeds), NCEH 9 Bt (Nath Seeds), NCS 918 Bt (Nuziveedu seeds), GK 206 Bt (Ganga Kaveri Seeds), PCH 917 Bt (Prabhat seeds) and JKCH 1945 Bt (JK Seeds). The BG II entries were RCH 134 BG II (Rasi seeds), NCS145 BG II (Nuziveedu seeds), KDCHH 441 BG II (Krishidhan seeds), Ankur Jassi BG II (Ankur seeds), Tulasi 9 BG II (Tulasi seeds) and BCHH 6488-2 BG II (Bio Seeds). RCH 134 Bt was the Bt check hybrid. The Non Bt check hybrids were CSHH 198 (Shresth) and LHH 144.

Trial Locations :

The trial was conducted at six locations. They are

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

Trial details:

No.of entries	: 19 + 3 checks
No.of Rows	: Yield Trial 1 : 6 Rows Test Screening Trial 2 & 3 : 3 Rows
Row length	: 6m
Spacing	: 75 x 60 cm
No. of Replications	: Three
Design	: Randomized Block Design
Fertilizers	: As per recommendation

Trials:

I. 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.

II. EVALUATION UNDER UNPROTECTED CONDITIONS FOR BOLL WORMS

All the Bt cotton hybrids and the controls were evaluated against key pests of cotton under unprotected conditions.

III. PATHOLOGICAL EVALUATION OF BT COTTON HYBRIDS

All the entries in the trial were screened against CLCuV disease (CLCuD) and other fungal diseases.

Observations recorded

The biometrical observations recorded were Germination percentage, Final Plant Stand, Ginning Percentage, Lint Index, Seed Index, Seed Cotton Yield (Kg/ha) and Lint Yield (Kg/ha). The entomological observations on sap sucking pests, boll worm damage and natural enemies were recorded under ETL based plant protection trial. The pathological observations on incidences of cotton leaf curl virus disease and other foliar diseases were recorded.

A. BIOMETRICAL EVALUATION

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

Germination and Final Plant Stand

The Germination in general was good and consequently the final stand was also satisfactory in all the entries (Table 1 & 2). BCHH 6488-2 BG II recorded the lowest germination percentage (74.7 %) and plant stand (41.7)

Table 1. Germination (%)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Mean
Namcot.402 Bt	98.7	96.5	87.4	96.0	94.6
ACH 155-1 Bt	96.7	99.3	79.8	76.0	87.9
IT 905 Bt	99.3	98.6	84.8	92.0	93.7
BCHH 6317 Bt	97.3	97.9	77.3	75.0	86.9
Sigma Bt	98.0	96.5	91.9	83.0	92.4
Ankur 2226 Bt	98.0	96.5	84.8	87.0	91.6
NCEH 9 Bt	98.0	100.0	88.2	93.0	94.8
NCS 918 Bt	98.7	99.3	89.4	81.0	92.1
GK 206 Bt	97.7	96.5	78.3	92.0	91.1
PCH 917 Bt	97.3	96.5	90.4	96.0	95.1
JKCH 1945 Bt	98.0	97.9	90.4	91.0	94.3
MLCH 315 BG II	97.0	97.2	87.9	82.0	91.0
RCH 134 BG II	98.7	97.2	90.4	77.0	90.8
NCS 145 BG II	99.3	97.2	88.4	88.0	93.2

Table 1. Contd.

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Mean
KDCHH 441 BG II	100.0	97.9	87.9	88.0	93.4
Ankur Jassi BG II	99.3	98.6	79.8	84.0	90.4
Tulasi 9 BG II	95.0	97.9	91.8	96.0	95.2
BCHH 6488-2 BG II	84.3	95.8	60.6	58.0	74.7
ACH 33.2 BG II	98.0	95.8	82.3	87.0	90.8
RCH 134 Bt (Bt c)	96.3	99.3	85.9	95.0	94.1
CSHH 198 (c)	98.0	98.6	82.8	93.0	93.1
LHH 144 (c)	98.7	95.1	84.3	86.0	91.0

Table 2. Number of plants at harvest

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean
Namcot.402 Bt	47.0	46.7	53.7	61.7	56.3	54.3	53.3
ACH 155-1 Bt	49.3	48.0	49.7	54.7	45.3	46.7	48.9
IT 905 Bt	50.3	47.7	55.3	57.7	55.0	56.0	53.7
BCHH 6317 Bt	41.7	47.0	50.0	51.7	45.0	45.7	46.8
Sigma Bt	46.0	47.0	60.3	61.0	49.7	55.0	53.2
Ankur 2226 Bt	39.7	46.7	63.0	60.7	52.3	55.0	52.9
NCEH 9 Bt	50.7	48.0	65.0	62.3	55.3	54.3	55.9
NCS 918 Bt	46.7	47.7	60.0	61.0	47.3	44.3	51.2
GK 206 Bt	42.7	47.0	57.0	59.7	54.3	54.7	52.6
PCH 917 Bt	47.0	47.3	57.0	60.3	56.7	48.0	52.7
JKCH 1945 Bt	48.7	47.7	60.0	63.3	54.7	52.7	54.5
MLCH 315 BG II	42.3	46.7	52.3	58.0	49.0	55.3	50.6
RCH 134 BG II	53.0	47.0	60.7	62.0	46.0	57.7	54.4
NCS 145 BG II	43.7	47.3	60.0	61.0	52.3	57.3	53.6
KDCHH 441 BG II	47.0	47.0	59.7	57.3	52.0	55.0	53.0
Ankur Jassi BG II	50.7	47.3	57.7	56.3	50.3	54.3	52.8
Tulasi 9 BG II	49.3	47.7	63.0	63.0	55.7	56.3	55.8
BCHH 6488-2 BG II	33.7	46.0	51.7	35.7	35.0	48.0	41.7
ACH 33.2 BG II	43.0	46.3	53.7	57.0	52.0	49.3	50.2
RCH 134 Bt (Bt c)	51.3	47.7	59.3	59.7	56.0	57.7	55.3
CSHH 198 (c)	50.3	48.0	61.0	58.3	54.0	51.3	53.8
LHH 144 (c)	52.7	46.3	63.7	55.3	50.0	51.7	53.3

Boll Weight

Mean boll weight varied from 3.2 (Namcot 402 Bt and ACH 33-2 BG II) to 4.2 g (NCS 918 Bt). Among the check hybrids, LHH 144 (Non Bt check) recorded the highest boll weight of 4.0g (Table 3).

Table 3. Boll weight (g)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Srigang anagar	Mean
Namcot.402 Bt	3.5	3.0	3.6	2.7	2.6	3.6	3.2
ACH 155-1 Bt	4.1	3.9	4.3	3.6	3.2	4.3	3.9
IT 905 Bt	3.7	3.6	4.2	3.3	3.1	3.5	3.6
BCHH 6317 Bt	3.7	3.5	4.1	3.6	3.1	3.6	3.6
Sigma Bt	4.0	3.9	4.2	3.6	3.2	2.9	3.6
Ankur 2226 Bt	3.5	3.9	4.3	4.0	3.5	3.2	3.7
NCEH 9 Bt	3.9	4.0	4.2	3.5	3.7	3.4	3.8
NCS 918 Bt	4.4	4.0	4.2	4.2	4.2	4.1	4.2
GK 206 Bt	4.2	4.5	4.5	3.7	3.3	3.1	3.9
PCH 917 Bt	3.9	3.5	3.9	3.3	3.3	3.4	3.5
JKCH 1945 Bt	4.0	3.6	3.8	3.3	3.7	2.7	3.5
MLCH 315 BG II	4.6	4.6	3.9	3.5	3.7	3.4	3.9
RCH 134 BG II	4.5	4.0	3.9	3.2	3.2	3.5	3.7
NCS 145 BG II	4.3	4.1	4.0	3.3	3.5	3.6	3.8
KDCHH 441 BG II	4.0	3.9	4.0	3.3	3.9	3.9	3.8
Ankur Jassi BG II	4.0	3.7	3.9	3.6	3.5	3.1	3.6
Tulasi 9 BG II	4.6	3.8	4.0	3.6	3.7	2.4	3.7
BCHH 6488-2 BG II	3.9	3.3	3.8	3.5	3.3	2.9	3.4
ACH 33.2 BG II	3.6	3.3	3.7	2.8	2.8	3.1	3.2
RCH 134 Bt (Bt c)	4.3	3.7	4.1	3.3	3.4	3.2	3.7
CSHH 198 (c)	3.9	3.9	4.0	3.7	3.7	2.4	3.6
LHH 144 (c)	4.5	4.3	4.5	3.5	3.4	3.6	4.0
CD @ 5%	0.3	0.5	0.2	0.6		0.4	
CV(%)	4.1	8.2	3.5	9.9		7.9	

Ginning Out turn (%)

Ginning out turn varied from 33.4 (Ankur Jassi BG II) to 36.5 percent (NCEH 9 Bt, JKCH 1945 Bt). The Bt check hybrid RCH 134 Bt recorded a ginning out turn of 34.6 per cent (Table 4).

Table 4. Ginning Outturn (%)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Srigang anagar	Mean
Namcot.402 Bt	34.0	32.4	33.6	34.9	37.0	33.2	34.2
ACH 155-1 Bt	34.8	32.1	33.9	37.6	38.9	34.6	35.3
IT 905 Bt	34.0	33.4	34.2	36.7	35.8	34.1	34.7
BCHH 6317 Bt	35.2	35.8	34.7	38.1	37.7	35.4	36.1
Sigma Bt	34.8	34.2	34.8	36.5	36.6	31.2	34.7
Ankur 2226 Bt	35.2	34.8	34.1	36.0	34.4	32.9	34.6
NCEH 9 Bt	35.3	36.6	35.5	39.2	38.2	34.4	36.5
NCS 918 Bt	34.5	37.9	34.5	37.2	36.5	32.3	35.5
GK 206 Bt	34.0	34.3	33.4	35.7	37.4	33.4	34.7
PCH 917 Bt	34.8	36.5	33.8	38.8	38.2	35.5	36.3

Table 4. Contd.

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean
JKCH 1945 Bt	35.6	36.3	34.8	38.9	37.9	35.8	36.5
MLCH 315 BG II	33.8	33.9	33.3	35.6	34.8	33.0	34.1
RCH 134 BG II	34.4	33.9	33.7	37.4	34.8	29.7	34.0
NCS 145 BG II	34.8	26.9	34.3	36.4	37.8	34.4	34.1
KDCHH 441 BG II	34.3	32.1	34.2	33.8	38.3	30.5	33.9
Ankur Jassi BG II	34.3	32.7	33.3	34.5	34.2	31.4	33.4
Tulasi 9 BG II	33.4	33.7	33.4	35.6	35.3	32.6	34.0
BCHH 6488-2 BG II	34.8	35.7	34.8	39.4	36.7	35.1	36.1
ACH 33.2 BG II	35.1	32.9	33.7	37.3	40.0	32.1	35.2
RCH 134 Bt (Bt c)	34.4	33.4	34.5	37.2	37.8	30.5	34.6
CSHH 198 (c)	32.9	32.8	32.7	34.9	37.1	34.9	34.2
LHH 144 (c)	32.9	30.6	32.8	34.8	35.6	29.6	32.7
CD @ 5%	0.4	1.0	0.5	1.0		1.8	
CV(%)	0.8	1.9	0.9	1.6		3.4	

Lint Index and Seed Index

The variation among the entries for lint and seed index was minimum. Lint index varied from 4.0 to 5.4 g (Table 5) and the seed index from 7.4 to 9.8 g (Table 6). NCS 918 Bt recorded the highest lint and seed index.

Table 5. Lint Index (g)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean
Namcot.402 Bt	3.4	4.5	4.8	4.1	4.3	4.2	4.2
ACH 155-1 Bt	5.3	5.3	5.4	5.1	5.1	4.9	5.2
IT 905 Bt	3.8	4.2	4.5	4.2	3.9	4.2	4.1
BCHH 6317 Bt	4.2	5.0	4.3	5.0	4.2	5.4	4.7
Sigma Bt	4.6	5.3	5.4	4.9	5.0	4.0	4.9
Ankur 2226 Bt	3.8	4.9	4.8	4.6	3.8	4.2	4.3
NCEH 9 Bt	4.2	5.6	4.8	5.2	4.6	4.8	4.9
NCS 918 Bt	5.1	6.2	5.4	5.7	5.1	5.0	5.4
GK 206 Bt	4.6	5.5	5.4	5.3	5.0	4.8	5.1
PCH 917 Bt	4.4	5.1	4.7	5.2	4.6	4.5	4.8
JKCH 1945 Bt	4.4	4.6	4.6	4.5	4.2	4.4	4.4
MLCH 315 BG II	5.1	5.4	5.2	5.1	4.7	4.7	5.0
RCH 134 BG II	4.5	5.2	4.6	4.9	4.2	3.8	4.5
NCS 145 BG II	4.0	3.8	5.9	4.9	4.4	4.5	4.6
KDCHH 441 BG II	4.1	4.9	4.8	4.1	4.4	4.1	4.4
Ankur Jassi BG II	4.5	5.0	5.6	4.6	3.9	4.7	4.7
Tulasi 9 BG II	4.6	5.3	5.1	4.8	4.2	4.7	4.8
BCHH 6488-2 BG II	3.8	4.6	4.8	5.2	4.1	4.8	4.5
ACH 33.2 BG II	3.5	4.0	4.3	4.3	4.6	3.4	4.0
RCH 134 Bt (Bt c)	4.4	5.3	4.9	5.6	4.2	3.6	4.7
CSHH 198 (c)	5.0	5.2	5.2	4.9	4.4	4.8	4.9
LHH 144 (c)	5.1	4.7	5.0	4.1	4.7	3.9	4.6
CD @ 5%	0.6	0.2	0.5	0.3		0.5	
CV(%)	8.4	3.0	5.7	3.7		7.0	

Table 6. Seed Index (g)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean
Namcot.402 Bt	6.6	9.4	9.5	7.7	7.4	8.5	8.2
ACH 155-1 Bt	9.9	11.1	10.6	8.5	8.1	9.3	9.6
IT 905 Bt	7.4	8.3	8.6	7.2	7.0	8.1	7.8
BCHH 6317 Bt	7.8	9.0	8.1	8.1	7.0	9.9	8.3
Sigma Bt	8.5	10.2	10.2	8.5	8.7	8.8	9.2
Ankur 2226 Bt	7.0	9.3	9.2	8.1	7.3	8.6	8.2
NCEH 9 Bt	7.7	9.7	8.7	8.1	7.4	9.1	8.5
NCS 918 Bt	9.7	10.2	10.2	9.6	8.8	10.5	9.8
GK 206 Bt	8.9	10.4	10.7	9.5	8.3	9.5	9.5
PCH 917 Bt	8.3	8.9	9.2	8.2	7.4	8.2	8.4
JKCH 1945 Bt	7.9	8.0	8.6	7.1	6.9	7.8	7.7
MLCH 315 BG II	9.9	10.5	10.5	9.2	8.7	9.5	9.7
RCH 134 BG II	8.6	10.1	9.1	8.2	7.8	9.0	8.8
NCS 145 BG II	7.4	10.3	11.3	8.5	7.3	8.6	8.9
KDCHH 441 BG II	7.9	10.3	9.2	7.9	7.1	9.2	8.6
Ankur Jassi BG II	8.6	10.2	11.2	8.7	7.4	10.2	9.4
Tulasi 9 BG II	9.2	10.4	10.2	8.7	7.7	9.6	9.3
BCHH 6488-2 BG II	7.1	8.3	9.0	8.0	7.0	8.8	8.0
ACH 33.2 BG II	6.5	8.1	8.5	7.2	7.0	7.1	7.4
RCH 134 Bt (Bt c)	8.4	10.6	9.3	9.4	6.9	8.3	8.8
CSHH 198 (c)	10.3	10.8	10.6	9.2	7.4	8.9	9.5
LHH 144 (c)	10.4	10.6	10.3	7.8	8.5	9.3	9.5
CD @ 5%	1.1	0.2	0.9	0.3		0.6	
CV(%)	8.3	1.2	5.4	2.5		4.4	

Seed Cotton Yield

The Bt check hybrid RCH 134 Bt recorded a mean seed cotton yield of 2783 kg/ha. Among the Bt entries tested, only RCH 134 BG II with a mean seed cotton yield of 2918 kg/ha was superior to it. The yield increase was of the order of 5 per cent. IT 905 Bt (2717 kg/ha) and Sigma Bt (2663 kg/ha) were the second and third ranking hybrids, even though the yield potential was 2 to 4 per cent less than the Bt check hybrid. All the Bt cotton entries recorded higher seed cotton yield than the best non Bt check Hybrid LHH 144 (Table 7). The yield increase ranged from 3 to 52 percent.

Table 7. Seed cotton yield (kg/ha)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144
Namcot.402 Bt	2148	2181	2700	2634	1578	2550	2299	-17	20
ACH 155-1 Bt	1775	2906	2000	2723	1193	1776	2062	-26	7
IT 905 Bt	1576	2927	3590	3203	2387	2617	2717	-2	41
BCHH 6317 Bt	1392	2933	2800	2918	1728	2584	2392	-14	25

Table 7. Contd.

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144
Sigma Bt	1732	3380	2840	3388	1811	2826	2663	-4	39
Ankur 2226 Bt	712	2564	3130	2620	1303	2620	2158	-22	12
NCEH 9 Bt	1026	2812	2750	3148	1687	2663	2348	-16	22
NCS 918 Bt	1013	2764	3200	2938	1481	2354	2292	-18	19
GK 206 Bt	866	3213	3490	2867	1962	2299	2450	-12	28
PCH 917 Bt	1670	3652	3270	2421	1770	1766	2425	-13	26
JKCH 1945 Bt	1269	2343	2660	2435	1536	1529	1962	-30	2
MLCH 315 BG II	1694	2940	3010	2833	1646	2776	2483	-11	29
RCH 134 BG II	2730	3458	3540	3141	1907	2730	2918	5	52
NCS 145 BG II	1106	2841	2670	2353	1728	1133	1972	-29	3
KDCHH 441 BG II	1059	2899	2370	2647	1619	1963	2093	-25	9
Ankur Jassi BG II	2058	2503	3010	2167	1824	2085	2275	-18	18
Tulasi 9 BG II	1988	3102	3020	2833	1550	2154	2441	-12	27
BCHH 6488-2 BG II	1389	3051	2620	2798	1289	2610	2293	-18	19
ACH 33.2 BG II	1530	2620	2720	2812	1852	2750	2381	-14	24
RCH 134 Bt (Bt c)	2571	3382	2900	3210	1975	2661	2783		
CSHH 198 (c)	1013	2577	2000	1927	809	1545	1645		
LHH 144 (c)	1677	2188	2590	2195	1180	1698	1921		
CD @ 5%	426	547	843	561	342	386			
CV(%)	16.8	11.6	17.9	12.5	12.7	10.7			

Lint Yield

The same trend was noticed in the case of lint yield also. RCH 134 BG II with a mean lint yield 991 kg/ha was the only test hybrid superior to Bt check hybrid RCH 134 Bt (960 kg/ha). IT 905 Bt (943 kg/ha) and Sigma Bt (919 kg/ha), recorded 2 to 4 per cent less lint yield than the Bt check hybrid. The Bt hybrid entries recorded an increased lint yield ranging from 6 to 59 percent over the best Non Bt check hybrid LHH 144 (Table 8).

Table 8. Lint yield (kg/ha)

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144
Namcot.402 Bt	731	705	907	920	584	842	781	-19	25
ACH 155-1 Bt	618	931	678	1024	464	611	721	-25	15
IT 905 Bt	536	978	1227	1175	854	886	943	-2	51
BCHH 6317 Bt	491	1051	971	1111	652	905	863	-10	38
Sigma Bt	603	1157	987	1236	663	870	919	-4	47

Table 8. Contd.

Entry	Ludhiana	Faridkot	Bathinda	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144
Ankur 2226 Bt	251	893	1066	944	448	853	743	-23	19
NCEH 9 Bt	362	1029	975	1230	645	908	858	-11	37
NCS 918 Bt	349	1046	1104	1094	541	744	813	-15	30
GK 206 Bt	294	1101	1166	1023	734	760	846	-12	35
PCH 917 Bt	581	1334	1103	939	677	621	876	-9	40
JKCH 1945 Bt	451	850	924	947	583	542	716	-25	15
MLCH 315 BG II	575	997	1004	1008	572	906	844	-12	35
RCH 134 BG II	939	1171	1192	1174	663	805	991	3	59
NCS 145 BG II	385	762	917	856	653	385	660	-31	6
KDCHH 441 BG II	362	931	810	897	620	594	702	-27	12
Ankur Jassi BG II	707	821	1001	749	624	649	758	-21	21
Tulasi 9 BG II	664	1047	1009	1008	547	694	828	-14	33
BCHH 6488-2 BG II	483	1089	913	1103	473	909	828	-14	33
ACH 33.2 BG II	537	862	917	1049	741	872	830	-14	33
RCH 134 Bt (Bt c)	885	1127	1001	1195	747	803	960		
CSHH 198 (c)	334	843	654	672	300	534	556		
LHH 144 (c)	552	669	848	763	420	499	625		
CD @ 5%	148	188	286	207		133			
CV(%)	16.9	11.7	17.9	12.5		11.3			

B. FIBRE QUALITY EVALUATION

In general, there was not much variation among the test entries and the check hybrid in respect of 2.5% Span length, Micronaire and Uniformity ratio (Tables 9-11). In respect of Bundle Strength, both RCH 134 Bt (Bt check) and LHH 144 (Non Bt check) recorded 23 g/tex (Table 12). Among the test entries also, as many as 14 hybrids recorded fibre strength ranging from 22 to 23 g/tex.

Table 9. 2.5 % Span Length (mm)

Entry	Ludhiana	Faridkot	Sirsa	Sriganganagar	Mean
Namcot.402 Bt	29.3	27.8	29.2	29.8	29.0
ACH 155-1 Bt	25.7	26.7	26.5	27.2	26.5
IT 905 Bt	27.1	28.1	27.0	27.2	27.4
BCHH 6317 Bt	28.6	27.5	27.4	28.1	27.9
Sigma Bt	30.1	29.6	30.9	30.4	30.3
Ankur 2226 Bt	26.5	25.8	27.8	27.2	26.8
NCEH 9 Bt	28.2	26.1	26.0	27.2	26.9
NCS 918 Bt	29.1	27.3	30.1	30.4	29.2
GK 206 Bt	27.9	28.3	29.7	29.5	28.9

Table 9. Contd.

Entry	Ludhiana	Faridkot	Sirsa	Srigangana gar	Mean
PCH 917 Bt	28.5	28.5	27.9	28.8	28.4
JKCH 1945 Bt	27.3	26.1	25.9	25.9	26.3
MLCH 315 BG II	30.9	28.6	29.9	29.6	29.8
RCH 134 BG II	26.9	26.9	26.9	27.6	27.1
NCS 145 BG II	27.6	27.6	29.3	29.7	28.6
KDCHH 441 BG II	26.2	26.3	26.7	28.6	27.0
Ankur Jassi BG II	30.3	30.0	31.1	31.9	30.8
Tulasi 9 BG II	29.8	29.0	29.9	28.5	29.3
BCHH 6488-2 BG II	26.2	27.3	27.6	26.5	26.9
ACH 33.2 BG II	27.2	27.6	27.9	27.7	27.6
RCH 134 Bt (Bt c)	27.4	27.2	27.1	28.2	27.5
CSHH 198 (c)	28.1	26.7	25.0	26.1	26.5
LHH 144 (c)	28.1	27.2	27.4	28.5	27.8

Table 10. Uniformity Ratio

Entry	Ludhiana	Faridkot	Sirsa	Srigangana gar	Mean
Namcot.402 Bt	51.0	52.0	47.0	54.0	51.0
ACH 155-1 Bt	52.0	52.0	50.0	53.0	51.8
IT 905 Bt	51.0	51.0	48.0	54.0	51.0
BCHH 6317 Bt	52.0	51.0	47.0	54.0	51.0
Sigma Bt	51.0	52.0	46.0	54.0	50.8
Ankur 2226 Bt	47.0	50.0	48.0	50.0	48.8
NCEH 9 Bt	53.0	52.0	50.0	52.0	51.8
NCS 918 Bt	50.0	52.0	48.0	51.0	50.3
GK 206 Bt	51.0	51.0	46.0	50.0	49.5
PCH 917 Bt	51.0	50.0	47.0	51.0	49.8
JKCH 1945 Bt	52.0	53.0	50.0	51.0	51.5
MLCH 315 BG II	52.0	51.0	49.0	51.0	50.8
RCH 134 BG II	50.0	52.0	51.0	52.0	51.3
NCS 145 BG II	50.0	52.0	45.0	49.0	49.0
KDCHH 441 BG II	45.0	52.0	47.0	51.0	48.8
Ankur Jassi BG II	46.0	51.0	46.0	48.0	47.8
Tulasi 9 BG II	48.0	50.0	46.0	52.0	49.0
BCHH 6488-2 BG II	46.0	52.0	49.0	50.0	49.3
ACH 33.2 BG II	52.0	51.0	47.0	52.0	50.5
RCH 134 Bt (Bt c)	53.0	52.0	48.0	52.0	51.3
CSHH 198 (c)	52.0	52.0	50.0	48.0	50.5
LHH 144 (c)	52.0	51.0	47.0	51.0	50.3

Table 11. Micronaire

Entry	Ludhiana	Faridkot	Sirsa	Srigangana gar	Mean
Namcot.402 Bt	4.5	4.9	4.6	4.4	4.6
ACH 155-1 Bt	5.0	5.1	4.6	4.5	4.8
IT 905 Bt	4.1	4.8	4.6	4.4	4.5
BCHH 6317 Bt	4.2	5.2	5.0	4.7	4.8
Sigma Bt	4.9	5.4	5.1	4.6	5.0
Ankur 2226 Bt	3.9	5.4	4.9	4.6	4.7
NCEH 9 Bt	4.1	5.4	5.4	4.7	4.9
NCS 918 Bt	3.8	5.4	5.0	4.6	4.7
GK 206 Bt	4.0	5.4	4.9	4.5	4.7
PCH 917 Bt	4.9	5.5	5.5	4.1	5.0
JKCH 1945 Bt	4.9	5.2	5.4	5.2	5.2
MLCH 315 BG II	3.9	5.2	4.9	4.7	4.7
RCH 134 BG II	4.6	5.4	4.9	4.9	5.0
NCS 145 BG II	4.2	5.6	4.4	4.4	4.7
KDCHH 441 BG II	3.8	5.2	4.4	5.1	4.6
Ankur Jassi BG II	3.8	4.8	4.1	4.2	4.2
Tulasi 9 BG II	4.4	5.5	4.7	4.4	4.8
BCHH 6488-2 BG II	3.6	5.1	5.1	4.4	4.6
ACH 33.2 BG II	4.5	5.0	4.7	4.2	4.6
RCH 134 Bt (Bt c)	4.5	5.5	5.3	4.6	5.0
CSHH 198 (c)	4.6	5.0	5.1	3.7	4.6
LHH 144 (c)	4.6	5.0	4.8	3.8	4.6

Table 12. Bundle Strength (g/tex)

Entry	Ludhiana	Faridkot	Sirsa	Srigangana gar	Mean
Namcot.402 Bt	21.9	23.2	23.6	24.3	23.3
ACH 155-1 Bt	20.1	23.1	22.5	22.6	22.1
IT 905 Bt	21.5	22.6	21.8	22.5	22.1
BCHH 6317 Bt	20.2	22.9	21.5	21.0	21.4
Sigma Bt	20.3	24.6	23.4	24.4	23.2
Ankur 2226 Bt	19.6	21.2	20.0	22.1	20.7
NCEH 9 Bt	20.6	21.8	21.2	24.4	22.0
NCS 918 Bt	22.6	22.5	23.5	23.9	23.1
GK 206 Bt	21.1	23.5	23.6	23.7	23.0
PCH 917 Bt	22.4	23.3	21.8	24.2	22.9
JKCH 1945 Bt	20.9	21.6	21.1	20.9	21.1
MLCH 315 BG II	23.4	22.6	22.5	23.0	22.9
RCH 134 BG II	21.8	23.0	22.2	23.5	22.6
NCS 145 BG II	20.6	22.6	23.0	22.6	22.2
KDCHH 441 BG II	20.3	21.2	18.8	21.0	20.3
Ankur Jassi BG II	23.3	23.6	20.0	23.5	22.6
Tulasi 9 BG II	21.0	22.4	22.6	24.0	22.5
BCHH 6488-2 BG II	21.8	20.8	22.3	22.5	21.9
ACH 33.2 BG II	20.9	22.0	22.5	22.8	22.1
RCH 134 Bt (Bt c)	21.5	23.4	22.6	24.6	23.0
CSHH 198 (c)	21.9	22.5	22.2	21.2	22.0
LHH 144 (c)	21.0	23.7	22.5	24.7	23.0

C. ENTOMOLOGICAL EVALUATION

I. EVALUATION UNDER ETL BASED PLANT PROTECTION

Jassids and Whitefly were the predominant sucking pests encountered during the season. Thrips was noticed at Sriganganagar and Sirsa. Aphid was absent at all the locations. *Helicoverpa armigera* population was nil or appeared only in traces. Spotted boll worm (*Earias vitella*) was observed at all the centres. *Spodoptera litura* was observed at Bhatinda and Faridkot. Pink boll worm (*Pectinophora gossypiella*) appeared at the late stage of the crop growth at Sriganganagar & Faridkot.

Jassids and Whitefly

Jassid population remained high at Ludhiana and Sriganganagar (Table 13). Whitefly population remained high at Ludhiana and Sriganganagar (Table 14). Chemical intervention was required at most of the places to control the sucking pests. However, the overall mean population of jassids and whitefly remained almost the same on all the entries, including the check hybrids.

Table 13. Mean number of Jassid nymphs/3 leaves/plant

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganga nagar	Mean
Namcot.402 Bt	3.6	1.1	1.0	1.0	1.0	1.6
ACH 155-1 Bt	3.5	0.9	0.8	1.0	1.3	1.5
IT 905 Bt	3.8	0.9	0.7	1.0	1.5	1.6
BCHH 6317 Bt	3.9	1.4	0.9	0.9	1.4	1.7
Sigma Bt	3.9	1.1	0.8	0.9	1.3	1.6
Ankur 2226 Bt	2.6	1.0	0.7	1.1	1.5	1.4
NCEH 9 Bt	3.7	1.1	0.7	1.0	1.8	1.7
NCS 918 Bt	5.4	1.1	0.9	1.0	1.4	2.0
GK 206 Bt	3.3	1.1	0.9	1.0	1.3	1.5
PCH 917 Bt	6.8	1.2	1.1	1.1	1.5	2.3
JKCH 1945 Bt	4.6	1.1	1.0	1.3	1.4	1.9
MLCH 315 BG II	4.2	0.8	1.0	1.0	1.4	1.7
RCH 134 BG II	4.5	1.3	0.5	1.0	1.3	1.7
NCS 145 BG II	4.0	0.9	1.0	1.3	1.1	1.6
KDCHH 441 BG II	3.1	1.0	0.7	0.9	1.3	1.4
Ankur Jassi BG II	3.5	0.9	1.1	0.9	1.3	1.5
Tulasi 9 BG II	3.7	1.1	1.0	1.1	1.3	1.6
BCHH 6488-2 BG II	4.0	0.9	0.8	0.9	1.2	1.6
ACH 33.2 BG II	3.7	1.2	0.8	0.9	1.3	1.6
RCH 134 Bt (Bt c)	3.9	1.0	0.6	1.1	1.4	1.6
CSHH 198 (c)	4.0	0.9	0.8	1.2	1.2	1.6
LHH 144 (c)	3.9	1.1	1.2	1.0	1.2	1.7

Table 14. Mean number of Whitefly adults/3leaves/plant

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganga nagar	Mean
Namcot.402 Bt	7.3	2.2	1.1	1.5	11.9	4.8
ACH 155-1 Bt	7.8	2.4	2.0	1.5	14.7	5.7
IT 905 Bt	7.2	2.1	0.9	1.5	15.0	5.3
BCHH 6317 Bt	6.1	2.6	1.3	1.3	13.5	5.0
Sigma Bt	6.5	2.6	2.0	1.3	14.9	5.5
Ankur 2226 Bt	5.2	2.0	1.7	1.3	13.2	4.7
NCEH 9 Bt	6.3	2.2	1.3	1.3	11.3	4.5
NCS 918 Bt	6.4	2.4	1.8	1.2	12.4	4.8
GK 206 Bt	4.8	2.4	2.0	1.4	13.8	4.9
PCH 917 Bt	6.6	2.3	1.6	1.5	14.2	5.3
JKCH 1945 Bt	5.1	2.1	1.3	1.4	12.5	4.5
MLCH 315 BG II	6.3	2.0	1.8	1.5	12.3	4.8
RCH 134 BG II	7.6	2.8	2.5	1.6	14.1	5.7
NCS 145 BG II	7.3	2.7	1.7	1.5	11.8	5.0
KDCHH 441 BG II	6.3	2.0	1.4	1.4	13.8	5.0
Ankur Jassi BG II	7.0	2.2	1.5	1.3	11.9	4.8
Tulasi 9 BG II	5.6	2.3	1.4	1.5	12.0	4.5
BCHH 6488-2 BG II	6.1	2.1	1.2	1.4	13.6	4.9
ACH 33.2 BG II	7.9	2.6	1.5	1.5	14.0	5.5
RCH 134 Bt (Bt c)	8.1	2.8	1.9	1.5	15.0	5.8
CSHH 198 (c)	6.6	2.5	1.4	1.6	13.6	5.2
LHH 144 (c)	5.6	2.5	2.4	1.5	11.0	4.6

Square Damage

Square damage due to boll worms was minimum on most of the Bt hybrids. Percent square damage was nil on almost all the Bt hybrids tested at Ludhiana and Faridkot. At other centres also, it ranged between 0 to 0.7 per cent on most of the Bt hybrids (Table 15). Only ACH 155-1 Bt at Sriganganagar, JKCH 1945 Bt at Hisar and Ankur Jassi BG II at Sriganganagar recorded more than 1 per cent square damage. The Bt check hybrid showed a square damage of 0 to 0.5 per cent only. On the other hand, the non Bt check hybrids showed a mean square damage of 1.1 to 11.7 per cent.

Table 15. Per cent square damage

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganga nagar	Mean
Namcot.402 Bt	0.0	0.0	0.0	0.0	0.5	0.1
ACH 155-1 Bt	0.0	0.2	0.0	0.0	1.0	0.2
IT 905 Bt	0.0	0.0	0.7	0.0	0.5	0.2
BCHH 6317 Bt	0.0	0.0	0.0	0.0	0.5	0.1
Sigma Bt	0.0	0.0	0.6	0.0	0.5	0.2
Ankur 2226 Bt	0.0	0.0	0.0	0.0	0.5	0.1
NCEH 9 Bt	0.0	0.0	0.0	0.0	0.5	0.1
NCS 918 Bt	0.0	0.0	0.4	0.0	0.5	0.2

Table 15. Contd.

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganga nagar	Mean
GK 206 Bt	0.0	0.0	0.0	0.0	0.6	0.1
PCH 917 Bt	0.0	0.0	0.0	0.0	0.5	0.1
JKCH 1945 Bt	0.0	0.0	1.7	0.0	0.5	0.4
MLCH 315 BG II	0.0	0.0	0.0	0.0	0.5	0.1
RCH 134 BG II	0.0	0.0	0.5	0.0	0.5	0.2
NCS 145 BG II	0.0	0.0	0.8	0.0	0.5	0.3
KDCHH 441 BG II	0.0	0.0	0.0	0.0	0.5	0.1
Ankur Jassi BG II	0.0	0.0	0.8	0.0	1.5	0.5
Tulasi 9 BG II	0.0	0.0	0.4	0.0	0.6	0.2
BCHH 6488-2 BG II	0.0	0.0	0.0	0.0	0.5	0.1
ACH 33.2 BG II	0.0	0.0	0.2	0.0	0.5	0.1
RCH 134 Bt (Bt c)	0.0	0.0	0.2	0.0	0.5	0.2
CSHH 198 (c)	8.1	1.4	1.9	1.3	3.1	3.2
LHH 144 (c)	11.7	1.1	1.3	1.6	3.6	3.9

Pink Boll worm (PBW) damage

The Pink boll worm (*Pectinophora gossypiella*) larval data is available from Ludhiana, Faridkot and Sriganganagar centres only (Table 16). The mean number of PBW larvae/20 green bolls ranged from 0.3 to 4.3 on non Bt check hybrids. At Ludhiana it was nil on Bt hybrids and at Faridkot, it ranged from 0.1 to 0.4 in five entries only. At Sriganganagar, it ranged from 0.5 to 1.5 larvae/20 bolls.

Table 16. Mean number of PBW larvae/20 green bolls

Entry	Ludhiana	Faridkot	Sriganganagar	Mean
Namcot.402 Bt	0.0	0.0	0.5	0.2
ACH 155-1 Bt	0.0	0.0	0.9	0.3
IT 905 Bt	0.0	0.4	0.5	0.3
BCHH 6317 Bt	0.0	0.0	0.5	0.2
Sigma Bt	0.0	0.0	0.5	0.2
Ankur 2226 Bt	0.0	0.1	0.5	0.2
NCEH 9 Bt	0.0	0.0	0.5	0.2
NCS 918 Bt	0.0	0.0	0.5	0.2
GK 206 Bt	0.0	0.2	0.5	0.2
PCH 917 Bt	0.0	0.0	0.5	0.2
JKCH 1945 Bt	0.0	0.2	0.5	0.2
MLCH 315 BG II	0.0	0.0	0.5	0.2
RCH 134 BG II	0.0	0.0	0.5	0.2
NCS 145 BG II	0.0	0.0	0.5	0.2
KDCHH 441 BG II	0.0	0.0	0.5	0.2
Ankur Jassi BG II	0.0	0.0	1.5	0.5
Tulasi 9 BG II	0.0	0.0	0.5	0.2
BCHH 6488-2 BG II	0.0	0.0	0.9	0.3
ACH 33.2 BG II	0.0	0.1	0.9	0.4
RCH 134 Bt (Bt c)	0.0	0.0	0.9	0.3
CSHH 198 (c)	1.7	1.1	4.3	2.4
LHH 144 (c)	1.7	0.3	2.6	1.5

Green boll damage (%) due to Pink bollworm in Bt cotton hybrids varied from 0 to 2.2 at Faridkot and 0.5 to 7.3 at Sriganaganagar (Table 17). The non Bt hybrids on the other hand showed up to 30.1% percent green boll damage.

Table 17. Mean PBW larvae damage in green bolls (%)

Entry	Faridkot	Sriganaganagar	Mean
Namcot.402 Bt	0.0	0.5	0.3
ACH 155-1 Bt	0.7	0.5	0.6
IT 905 Bt	3.7	0.5	2.1
BCHH 6317 Bt	0.0	3.9	2.0
Sigma Bt	0.0	0.5	0.3
Ankur 2226 Bt	2.2	0.5	1.4
NCEH 9 Bt	0.0	0.5	0.3
NCS 918 Bt	1.5	1.4	1.4
GK 206 Bt	2.2	0.5	1.4
PCH 917 Bt	0.7	0.5	0.6
JKCH 1945 Bt	2.2	0.5	1.4
MLCH 315 BG II	0.7	0.5	0.6
RCH 134 BG II	0.7	0.5	0.6
NCS 145 BG II	1.5	0.5	1.0
KDCHH 441 BG II	0.7	0.5	0.6
Ankur Jassi BG II	0.0	6.7	3.4
Tulasi 9 BG II	0.0	0.5	0.3
BCHH 6488-2 BG II	0.0	7.3	3.6
ACH 33.2 BG II	1.5	5.2	3.3
RCH 134 Bt (Bt c)	0.0	7.3	3.7
CSHH 198 (c)	11.9	30.1	21.0
LHH 144 (c)	3.0	29.2	16.1

Open boll and locule damage

Open boll and locule damage were observed at harvest (Table 18 & 19). Open boll damage and locule damage were very low in all the Bt cotton entries at all the locations except Hisar where it ranged from 0.9 to 6.1 per cent for open boll damage and 0.4 to 2.1 per cent for locule damage. The open boll damage at centres other than Faridkot was high in the non Bt check hybrids ranging from 4.7 to 22.1 percent. Similarly, the locule damage ranged from 0.2 to 12.0 percent in the non Bt check hybrids. Both open boll damage and locule damage was low in the non Bt hybrids at Faridkot.

Table 18. Open boll damage (%) - Boll basis

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Sirsa	Sriganganagar	Mean
Namcot.402 Bt	0.6	0.6	0.4	1.3	0.1	0.5	0.6
ACH 155-1 Bt	2.2	0.2	0.0	1.7	0.0	0.5	0.8
IT 905 Bt	0.4	0.0	1.8	1.5	0.0	0.5	0.7
BCHH 6317 Bt	1.1	0.0	1.6	1.2	0.0	0.5	0.7
Sigma Bt	2.6	0.0	0.0	0.9	0.0	0.5	0.7
Ankur 2226 Bt	0.0	0.0	0.3	2.5	0.0	0.5	0.6
NCEH 9 Bt	0.9	0.0	0.5	1.3	0.1	0.5	0.5
NCS 918 Bt	2.9	0.0	4.1	3.3	0.0	0.5	1.8
GK 206 Bt	0.2	0.0	0.0	4.8	0.0	0.5	0.9
PCH 917 Bt	0.7	0.0	0.3	2.5	0.0	0.5	0.7
JKCH 1945 Bt	1.2	0.0	1.8	1.2	0.0	0.5	0.8
MLCH 315 BG II	2.1	0.0	1.6	2.1	0.0	0.5	1.0
RCH 134 BG II	1.0	0.0	0.0	4.5	0.0	0.5	1.0
NCS 145 BG II	1.6	0.0	0.0	3.3	0.0	0.5	0.9
KDCHH 441 BG II	2.3	0.0	0.8	1.9	0.0	0.5	0.9
Ankur Jassi BG II	2.1	0.0	0.7	6.1	0.1	1.0	1.6
Tulasi 9 BG II	0.7	0.0	1.8	1.9	0.0	0.5	0.8
BCHH 6488-2 BG II	2.3	0.6	0.8	1.5	0.0	0.5	1.0
ACH 33.2 BG II	1.7	0.0	2.0	1.7	0.0	3.8	1.5
RCH 134 Bt (Bt c)	3.0	0.3	1.5	1.5	0.0	12.0	3.0
CSHH 198 (c)	17.3	2.3	18.5	22.1	4.7	18.9	14.0
LHH 144 (c)	15.6	0.3	13.2	11.1	5.3	17.6	10.5

Table 19. Open boll damage (%) - Locule basis

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Sriganganagar	Mean
Namcot.402 Bt	0.2	0.2	0.1	0.4	0.5	0.3
ACH 155-1 Bt	0.9	0.0	0.0	0.5	0.5	0.4
IT 905 Bt	0.3	0.0	0.6	0.5	0.5	0.4
BCHH 6317 Bt	0.6	0.0	0.4	0.5	0.6	0.4
Sigma Bt	1.5	0.0	0.0	0.3	1.1	0.6
Ankur 2226 Bt	0.0	0.0	0.2	1.2	1.3	0.5
NCEH 9 Bt	0.4	0.0	0.2	0.7	0.5	0.3
NCS 918 Bt	1.4	0.0	0.7	1.2	0.9	0.8
GK 206 Bt	0.1	0.0	0.0	1.5	0.5	0.4
PCH 917 Bt	0.4	0.0	0.1	0.7	0.5	0.3
JKCH 1945 Bt	0.3	0.0	1.0	0.6	0.5	0.5
MLCH 315 BG II	0.9	0.0	0.5	0.5	0.5	0.5
RCH 134 BG II	0.5	0.0	0.0	1.7	0.5	0.6
NCS 145 BG II	0.8	0.0	0.0	0.9	0.5	0.4
KDCHH 441 BG II	1.2	0.0	0.3	0.5	0.5	0.5
Ankur Jassi BG II	0.9	0.0	0.3	2.1	1.3	0.9
Tulasi 9 BG II	0.4	0.0	1.2	0.6	0.5	0.5
BCHH 6488-2 BG II	2.3	0.1	0.5	0.6	4.1	1.5
ACH 33.2 BG II	0.6	0.0	0.8	0.5	1.3	0.6
RCH 134 Bt (Bt c)	1.8	0.0	0.7	0.5	4.0	1.4
CSHH 198 (c)	8.0	0.9	12.0	6.1	6.1	6.6
LHH 144 (c)	7.6	0.2	6.4	5.2	6.4	5.1

Natural enemies

Predator population was recorded at periodic intervals. There was no significant difference in natural enemy population between Bt and non Bt hybrids

Table 20. - Mean number of Predators/5 plants

Entry	Ludhiana	Faridkot	Sirsa	Sriganga-nagar	Mean
Namcot.402 Bt	0.9	6.8	5.0	2.4	3.8
ACH 155-1 Bt	1.8	7.0	2.6	2.6	3.5
IT 905 Bt	1.0	7.3	3.4	2.5	3.6
BCHH 6317 Bt	0.6	7.2	2.3	2.9	3.2
Sigma Bt	0.8	8.1	3.0	3.1	3.7
Ankur 2226 Bt	0.6	6.0	2.3	3.8	3.1
NCEH 9 Bt	0.4	5.9	3.3	3.3	3.2
NCS 918 Bt	0.8	6.7	3.7	4.0	3.8
GK 206 Bt	0.7	6.8	3.3	3.1	3.5
PCH 917 Bt	0.9	7.2	3.6	3.2	3.7
JKCH 1945 Bt	0.7	6.3	1.6	3.9	3.1
MLCH 315 BG II	0.7	7.2	4.7	3.9	4.1
RCH 134 BG II	1.1	7.9	5.0	4.2	4.5
NCS 145 BG II	0.6	7.7	2.3	4.3	3.7
KDCHH 441 BG II	0.3	7.5	3.0	4.1	3.7
Ankur Jassi BG II	1.0	7.5	2.6	3.4	3.6
Tulasi 9 BG II	0.8	7.3	2.6	3.5	3.6
BCHH 6488-2 BG II	0.8	6.3	3.7	4.2	3.7
ACH 33.2 BG II	0.7	7.2	2.3	3.7	3.5
RCH 134 Bt (Bt c)	0.7	7.6	0.6	4.2	3.3
CSHH 198 (c)	0.7	7.2	3.3	4.4	3.9
LHH 144 (c)	1.2	6.7	2.4	3.3	3.4

Insecticide application

Jassid population was very low at Faridkot and only four Bt cotton entries required one round of application of insecticides to control Jassids. Similarly at Sirsa, 12 entries required one round of insecticide application to control jassids. At Hisar, 1 to 3 rounds of insecticide applications were required to control the sucking pests. At Sriganganagar, four rounds of insecticide applications were required to control white fly population (Table 21).

As regards boll worm damage, five Bt cotton genotypes showed fairly high levels of resistance and could record high yields without any insecticide applications. Thirteen hybrids required only one round of insecticide application. Only two hybrids required two rounds of application of insecticides at Hisar. The Non Bt check hybrids CSHH 198 and LHH 144 required two rounds of application of insecticides at all the locations, except CSHH 198 at Faridkot which required three rounds of insecticide application.

Table 21. Number of Sprays - For Sucking Pests Control

Entry	Faridkot	Hisar	Sirsa	Sriganganagar
Namcot.402 Bt	0	2	1	4
ACH 155-1 Bt	0	3	0	4
IT 905 Bt	0	1	1	4
BCHH 6317 Bt	0	1	0	4
Sigma Bt	0	1	0	4
Ankur 2226 Bt	0	2	1	4
NCEH 9 Bt	0	1	1	4
NCS 918 Bt	1	2	1	4
GK 206 Bt	0	1	1	4
PCH 917 Bt	1	1	1	4
JKCH 1945 Bt	1	1	1	4
MLCH 315 BG II	0	1	0	4
RCH 134 BG II	0	2	0	4
NCS 145 BG II	0	1	1	4
KDCHH 441 BG II	0	1	0	4
Ankur Jassi BG II	0	1	0	4
Tulasi 9 BG II	0	2	1	4
BCHH 6488-2 BG II	1	2	1	4
ACH 33.2 BG II	0	1	0	4
RCH 134 Bt (Bt c)	0	1	1	4
CSHH 198 (c)	0	2	0	4
LHH 144 (c)	0	2	0	4

Number of Sprays - For Boll Worm control

Entry	Faridkot	Hisar	Sirsa	Sriganganagar
Namcot.402 Bt	0	1	0	0
ACH 155-1 Bt	0	0	0	0
IT 905 Bt	0	1	0	0
BCHH 6317 Bt	1	0	0	0
Sigma Bt	0	1	0	0
Ankur 2226 Bt	0	0	0	0
NCEH 9 Bt	0	1	0	0
NCS 918 Bt	0	1	0	0
GK 206 Bt	1	0	0	0
PCH 917 Bt	0	0	0	0
JKCH 1945 Bt	0	1	0	0
MLCH 315 BG II	0	0	0	0
RCH 134 BG II	0	2	0	0
NCS 145 BG II	0	1	0	0
KDCHH 441 BG II	0	2	0	0
Ankur Jassi BG II	0	1	0	0
Tulasi 9 BG II	0	1	0	0
BCHH 6488-2 BG II	0	1	0	0
ACH 33.2 BG II	0	1	0	0
RCH 134 Bt (Bt c)	0	0	0	0
CSHH 198 (c)	3	2	2	2
LHH 144 (c)	2	2	2	2

II. EVALUATION UNDER UNPROTECTED CONDITIONS FOR BOLL WORMS

Germination and Plant Stand

Under unprotected conditions also, the Germination and Plant stand were satisfactory (Table 22 & 23). BCHH 6488-2 BG II recorded the lowest germination of 64.6 percent and a mean stand of 14.3.

Table 22. Germination Percentage

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
Namcot.402 Bt	98.7	95.8	86.0	73.3	88.5
ACH 155-1 Bt	96.7	94.4	71.0	68.9	82.8
IT 905 Bt	99.3	97.2	87.0	81.1	91.2
BCHH 6317 Bt	97.3	93.1	72.0	73.3	83.9
Sigma Bt	98.0	98.6	79.0	83.3	89.7
Ankur 2226 Bt	98.0	95.8	82.0	78.9	88.7
NCEH 9 Bt	98.0	95.8	87.0	85.6	91.6
NCS 918 Bt	98.7	95.8	74.0	80.0	87.1
GK 206 Bt	97.7	98.6	85.0	85.6	91.7
PCH 917 Bt	97.3	95.8	88.0	83.3	91.1
JKCH 1945 Bt	98.0	97.2	86.0	88.9	92.5
MLCH 315 BG II	97.0	68.1	78.0	75.6	79.7
RCH 134 BG II	98.7	93.1	73.0	82.2	86.7
NCS 145 BG II	99.3	94.4	82.0	83.3	89.8
KDCHH 441 BG II	100.0	98.6	82.0	76.7	89.3
Ankur Jassi BG II	99.3	90.3	81.0	58.9	82.4
Tulasi 9 BG II	95.0	95.8	88.0	76.7	88.9
BCHH 6488-2 BG II	84.3	68.1	55.0	51.1	64.6
ACH 33.2 BG II	98.0	93.1	83.0	78.9	88.2
RCH 134 Bt (Bt c)	96.3	94.4	91.0	74.4	89.1
CSHH 198 (c)	98.0	91.7	85.0	82.2	89.2
LHH 144 (c)	98.7	83.3	79.0	77.8	84.7

Table 23. Number of plants at harvest

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Sriganganagar	Mean
Namcot.402 Bt	21.7	23.0	17.9	26.0	21.0	21.9
ACH 155-1 Bt	20.0	21.0	16.6	25.0	20.7	20.6
IT 905 Bt	19.3	23.3	18.4	26.0	23.7	22.2
BCHH 6317 Bt	23.7	22.3	16.7	19.3	22.0	20.8
Sigma Bt	25.0	23.3	20.1	26.0	25.0	23.9
Ankur 2226 Bt	23.7	23.0	21.0	20.7	23.0	22.3
NCEH 9 Bt	23.0	22.7	21.7	26.7	25.7	23.9
NCS 918 Bt	22.7	23.0	20.0	25.7	24.0	23.1
GK 206 Bt	25.3	23.3	19.0	26.7	25.7	24.0
PCH 917 Bt	19.7	22.7	19.0	25.7	24.0	22.2
JKCH 1945 Bt	23.0	16.7	20.0	24.3	26.3	22.1
MLCH 315 BG II	22.7	16.3	17.4	23.3	22.7	20.5

Table 23. Contd.

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Srigangan agar	Mean
RCH 134 BG II	21.0	23.3	20.2	26.0	24.7	23.0
NCS 145 BG II	26.7	23.0	20.0	26.0	24.3	24.0
KDCHH 441 BG II	22.3	23.7	19.9	26.0	23.0	23.0
Ankur Jassi BG II	22.0	21.7	19.2	25.7	17.0	21.1
Tulasi 9 BG II	22.7	23.0	21.0	26.0	23.0	23.1
BCHH 6488-2 BG II	12.0	16.7	17.2	11.0	14.7	14.3
ACH 33.2 BG II	23.3	21.3	17.9	24.0	23.7	22.0
RCH 134 Bt (Bt c)	25.0	22.7	19.8	27.7	21.7	23.4
CSHH 198 (c)	25.0	22.3	20.3	23.3	24.7	23.1
LHH 144 (c)	25.0	20.3	21.2	26.0	23.3	23.2

Open boll damage

Under unprotected conditions, the non Bt check hybrids recorded a mean boll damage of 24.3 to 27.3 per cent (Table 24). The locule damage also ranged from 9.5 to 10.4 per cent (Table 25). On the other hand, in the Bt cotton hybrids, the mean boll damage varied from 0.6 to 5.1 per cent and mean locule damage from 0.3 to 2.2 per cent only.

Table 24. - Open boll damage (%) - Boll basis

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganga nagar	Mean
Namcot.402 Bt	0.8	0.2	1.3	0.0	0.5	0.6
ACH 155-1 Bt	1.2	1.9	1.9	0.0	0.5	1.1
IT 905 Bt	0.3	1.2	1.5	0.0	0.5	0.7
BCHH 6317 Bt	1.3	0.4	1.2	0.0	1.2	0.8
Sigma Bt	1.1	18.1	0.9	5.1	0.5	5.1
Ankur 2226 Bt	1.7	4.6	4.0	0.0	0.5	2.1
NCEH 9 Bt	1.2	0.0	1.3	0.0	0.5	0.6
NCS 918 Bt	3.0	0.4	5.2	0.0	1.5	2.0
GK 206 Bt	2.3	0.6	5.6	0.0	0.5	1.8
PCH 917 Bt	0.5	0.4	2.5	0.2	0.5	0.8
JKCH 1945 Bt	1.1	0.0	1.2	2.2	0.5	1.0
MLCH 315 BG II	1.1	3.6	2.1	0.0	0.5	1.5
RCH 134 BG II	3.1	6.2	6.0	0.0	0.5	3.1
NCS 145 BG II	0.7	2.0	3.3	0.0	0.5	1.3
KDCHH 441 BG II	1.6	5.1	1.9	0.0	0.5	1.8
Ankur Jassi BG II	2.4	0.9	7.7	1.7	6.4	3.8
Tulasi 9 BG II	2.4	1.0	1.9	0.0	0.5	1.2
BCHH 6488-2 BG II	2.9	1.2	2.2	1.6	8.1	3.2
ACH 33.2 BG II	0.4	0.5	1.7	0.2	9.8	2.5
RCH 134 Bt (Bt c)	0.8	1.0	1.5	0.0	15.0	3.6
CSHH 198 (c)	20.4	29.4	23.2	30.8	32.6	27.3
LHH 144 (c)	20.5	30.0	12.5	24.1	34.6	24.3

Table 25. Open boll damage (%) - Locule basis

Entry	Ludhiana	Faridkot	Hisar	Srigangan agar	Mean
Namcot.402 Bt	0.4	0.1	0.4	0.5	0.3
ACH 155-1 Bt	0.7	0.8	0.6	0.5	0.6
IT 905 Bt	0.2	0.5	0.5	0.5	0.4
BCHH 6317 Bt	0.8	0.2	0.5	1.6	0.7
Sigma Bt	0.5	6.9	0.3	1.1	2.2
Ankur 2226 Bt	0.8	1.7	1.2	1.3	1.2
NCEH 9 Bt	0.7	0.0	0.7	0.5	0.5
NCS 918 Bt	2.0	0.1	1.4	2.0	1.4
GK 206 Bt	1.3	0.3	1.7	0.5	0.9
PCH 917 Bt	0.5	0.1	0.7	0.5	0.5
JKCH 1945 Bt	0.6	0.0	0.6	0.5	0.4
MLCH 315 BG II	0.6	1.1	0.5	0.5	0.7
RCH 134 BG II	1.6	2.5	1.7	0.5	1.6
NCS 145 BG II	0.4	0.6	0.9	0.5	0.6
KDCHH 441 BG II	1.1	2.4	0.5	0.5	1.1
Ankur Jassi BG II	1.1	0.4	2.3	2.3	1.5
Tulasi 9 BG II	1.3	0.2	0.6	0.5	0.7
BCHH 6488-2 BG II	1.3	0.5	0.6	2.9	1.3
ACH 33.2 BG II	0.2	0.2	0.5	3.5	1.1
RCH 134 Bt (Bt c)	0.5	0.3	0.5	5.0	1.6
CSHH 198 (c)	10.7	11.3	8.1	11.4	10.4
LHH 144 (c)	10.6	10.9	5.5	11.1	9.5

Seed Cotton Yield

All the Bt cotton hybrids tested recorded higher yield than the non Bt check hybrids (Table 26). However, as compared to the Bt check hybrid RCH 134 Bt, which recorded a mean seed cotton yield of 2478 kg/ha, only RCH 134 BG II (2565 kg/ha) was marginally superior to it by 4 per cent. IT 905 Bt and GK 206 Bt were on par with the Bt check hybrid.

Table 26. Seed Cotton Yield (kg/ha)

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Sirsa	Mean	% Inc over RCH 134 Bt	% Inc over CSHH 198	% Inc over LHH 144
Namcot.402 Bt	1326	2044	2700	1481	2277	1966	-21	47	23
ACH 155-1 Bt	1660	1763	2000	1399	2497	1864	-25	39	17
IT 905 Bt	1402	2901	3590	1811	2771	2495	1	87	56
BCHH 6317 Bt	1237	2894	2800	1591	2798	2264	-9	69	42
Sigma Bt	1723	3366	2840	1262	3079	2454	-1	84	54
Ankur 2226 Bt	1108	2557	3130	1372	2306	2095	-15	57	31
NCEH 9 Bt	795	2738	2750	1152	2387	1964	-21	47	23
NCS 918 Bt	854	2694	3200	1289	2442	2096	-15	57	31

Table 26. Contd.

Entry	Ludhiana	Faridkot	Bathinda	Hisar	Sirsa	Mean	% Inc over RCH 134 Bt	% Inc over CSHH 198	% Inc over LHH 144
GK 206 Bt	1436	3160	3490	1756	2582	2485	0	86	56
PCH 917 Bt	875	2085	3270	1454	1975	1932	-22	44	21
JKCH 1945 Bt	1146	2318	2660	1207	2187	1904	-23	42	19
MLCH 315 BG II	1590	2167	3010	1427	2671	2173	-12	63	36
RCH 134 BG II	1733	2930	3540	1728	2894	2565	4	92	61
NCS 145 BG II	1437	2818	2670	1427	2149	2100	-15	57	31
KDCHH 441 BG II	1156	2099	2370	1372	2474	1894	-24	42	19
Ankur Jassi BG II	1833	2481	3010	1783	1674	2156	-13	61	35
Tulasi 9 BG II	1321	2551	3020	1372	2526	2158	-13	61	35
BCHH 6488-2 BG II	922	2269	2620	1070	2222	1821	-27	36	14
ACH 33.2 BG II	1195	2620	2720	1207	2608	2070	-16	55	30
RCH 134 Bt (Bt c)	2103	2475	2900	1975	2939	2478	0	85	55
CSHH 198 (c)	893	1461	2000	878	1450	1337	-46	0	-16
LHH 144 (c)	1125	1743	2590	988	1544	1598	-36	20	0
CD(0.05)	359	435	843	285	528				
CV(%)	17	11	18	12	13				

D. PATHOLOGICAL EVALUATION

Nineteen Bt test hybrids along with three check hybrids were evaluated for their reaction to various diseases at five centres *viz.* Faridkot, Ludhiana, Sriganganagar, Sirsa and Hisar. For comparative evaluation against Cotton Leaf curl Disease (CLCuD), F 1861 as resistant check and RS 921 as susceptible were also used. These test hybrids were also screened at Sirsa and Ludhiana centres for their reaction against CLCuD after artificial inoculation.

Cotton Leaf Curl Disease

Cotton leaf curl disease was observed on all test Bt hybrids at varying intensities with Faridkot having very high disease incidence and Hisar the least. JKCH 1945 Bt (mean Disease Index -DI: 202.09) and NCS 918 Bt (DI: 127.81) were found highly susceptible to CLCuD. The test hybrids Ankur 2226Bt (DI: 15.1) and BCHH 6317 Bt (DI: 16.39) had the disease either less than or on par with the standard resistant check F1861. Rest of the test Bt hybrids had higher disease indices ranging from 33.69 to 87.14 (Table 27). Under artificial screening also, JKCH 1945 Bt was found highly susceptible at both centres (DI: 155.45), where it was tested. The test hybrid BCHH 6488-2 BG II (DI: 117.13), PCS 917 Bt (DI: 90.00) and NCS 918 Bt (DI: 74.96) had very high mean leaf curl disease indices (Table 28).

Table 27. Reaction of Bt hybrids to Cotton Leaf Curl Disease under natural condition.

S.No.	Entry	Disease Index					
		Faridkot	Ludhiana	Sriganganagar	Sirsa	Hisar	Mean
1	Namcot.402 Bt	242.20	27.40	0.00	0.00	2.00	54.32
2	ACH 155-1 Bt	146.10	60.00	3.66	4.55	32.62	49.39
3	IT 905 Bt	101.20	71.40	0.00	0.00	0.00	34.52
4	BCHH 6317 Bt	28.60	13.50	22.77	5.00	12.10	16.39
5	Sigma Bt	179.50	26.50	0.00	0.00	8.68	42.94
6	Ankur 2226 Bt	62.50	3.40	3.48	6.10	0.00	15.10
7	NCEH 9 Bt	130.90	46.60	67.53	0.00	0.00	49.01
8	NCS 918 Bt	249.50	280.00	51.68	42.66	15.20	127.81
9	GK 206 Bt	110.30	32.40	8.58	0.00	6.36	31.53
10	PCH 917 Bt	199.70	155.10	0.00	0.00	0.00	70.96
11	JKCH 1945 Bt	394.20	249.90	3.50	232.07	130.76	202.09
12	MLCH 315 BG II	211.30	44.40	6.54	0.00	0.00	65.56
13	RCH 134 BG II	154.20	60.00	31.75	4.35	0.00	62.58
14	NCS 145 BG II	211.70	120.00	16.84	0.00	0.00	87.14
15	KDCHH 441 BG II	144.90	99.90	75.00	24.87	6.12	70.16
16	Ankur Jassi BG II	123.10	10.30	1.35	0.00	0.00	33.69
17	Tulasi 9 BG II	130.30	34.40	5.81	1.59	6.12	35.64
18	BCHH 6488-2 BG II	33.30	30.40	11.60	72.96	0.00	37.07
19	ACH 33.2 BG II	155.70	33.20	1.26	0.00	0.00	47.54
20	RCH 134 Bt (Bt c)	109.30	62.00	17.27	0.00	1.96	38.11
21	CSHH 198 (c)	135.20	15.00	14.64	0.00	0.00	41.21
22	LHH 144 (c)	27.30	15.80	0.00	0.00	0.00	10.78
23	F1861 (Standard Check)	27.30	35.00	12.15	7.03	0.00	16.30
24	RS921 (Susceptible Check)	400.00	400.00	307.11	167.92	350.00	325.01

Table 28. Reaction of the hybrids to CLCuD following inoculation (Disease Index)

S.No.	Entry	Sirsa	Ludhiana	Mean
1	Namcot.402 Bt	0.00	25.00	12.50
2	ACH 155-1 Bt	11.11	57.00	34.06
3	IT 905 Bt	0.00	33.30	16.65
4	BCHH 6317 Bt	11.11	14.20	12.66
5	Sigma Bt	0.00	25.00	12.50
6	Ankur 2226 Bt	22.22	10.00	16.11
7	NCEH 9 Bt	0.00	50.00	25.00
8	NCS 918 Bt	21.42	128.50	74.96
9	GK 206 Bt	0.00	33.40	16.70
10	PCH 917 Bt	0.00	180.00	90.00
11	JKCH 1945 Bt	190.89	120.00	155.45
12	MLCH 315 BG II	10.00	25.00	17.50
13	RCH 134 BG II	7.14	50.00	28.57
14	NCS 145 BG II	0.00	50.00	25.00
15	KDCHH 441 BG II	44.44	66.60	55.52
16	Ankur Jassi BG II	0.00	11.10	5.55
17	Tulasi 9 BG II	6.25	33.30	19.78
18	BCHH 6488-2 BG II	214.26	20.00	117.13
19	ACH 33.2 BG II	0.00	33.70	16.85
20	RCH 134 Bt (Bt c)	0.00	25.00	12.50
21	CSHH 198 (c)	0.00	12.50	6.25
22	LHH 144 (c)	0.00		0.00
23	F1861 (Standard Check)	10.00		10.00
24	RS921 (Susceptible Check)	81.82		81.82

Foliar Diseases

High rain fall (102.2mm), cloudy conditions, low temperature (21.5-26.5 C min. and 24.4 – 33.8 C max.) and a RH above 85% during the first fortnight of September caused severe outbreak of alternaria leaf spot disease leading to severe defoliation. Among the hybrids tested, NCEH 9 Bt, NCS 918 Bt, GK 206 Bt, MLCH 315 Bt, RCH 134 BG II, JKCH 1945 Bt, Sigma Bt, IT 905 Bt, NCS 145 BG II, KDCHH 441 BG II and Tulasi 9 BG II were found susceptible to alternaria leaf spot (Table 29). There was low incidence of bacterial leaf blight at Ludhiana and Faridkot. These diseases were not observed at the other three centres.

Para Wilt

Para wilt was noticed only at Ludhiana. The test hybrids IT 905 Bt, Ankur 2226 Bt and NCS 918 Bt had shown 38.4 to 42.0 percent wilting and the rest of the test hybrids had wilting in the range of 2.0 to 24.4 percent (Table 30).

Table 29. Reaction of Bt hybrids to alternaria leaf spot and bacterial blight (Grade)

S. No.	Entry	Alternaria Leaf Spot			Bacterial Blight		
		Faridkot	Ludhiana	Reaction	Faridkot	Ludhiana	Reaction*
1	Namcot.402 Bt	2.0	2.0	MR	2.0	0.0	MR
2	ACH 155-1 Bt	2.0	2.0	MR	1.0	0.0	R
3	IT 905 Bt	2.0	3.0	MS	2.0	1.0	MR
4	BCHH 6317 Bt	2.0	2.0	MR	2.0	1.0	MR
5	Sigma Bt	2.0	3.0	MS	2.0	0.0	MR
6	Ankur 2226 Bt	1.0	2.0	MR	2.0	0.0	MR
7	NCEH 9 Bt	2.0	4.0	S	2.0	0.0	MR
8	NCS 918 Bt	1.0	4.0	S	1.0	1.0	R
9	GK 206 Bt	2.0	4.0	S	2.0	0.0	MS
10	PCH 917 Bt	2.0	2.0	MR	1.0	0.0	R
11	JKCH 1945 Bt	2.0	3.0	MS	2.0	1.0	MR
12	MLCH 315 BG II	2.0	4.0	S	2.0	0.0	MR
13	RCH 134 BG II	2.0	4.0	S	2.0	0.0	MR
14	NCS 145 BG II	2.0	3.0	MS	1.0	0.0	R
15	KDCHH 441 BG II	2.0	3.0	MS	2.0	0.0	MR
16	Ankur Jassi BG II	2.0	2.0	MR	2.0	0.0	MR
17	Tulasi 9 BG II	2.0	3.0	MS	2.0	0.0	MR
18	BCHH 6488-2 BG II	2.0	2.0	MR	2.0	0.0	MR
19	ACH 33.2 BG II	2.0	0.0	MR	2.0	0.0	MR
20	RCH 134 Bt (Bt c)	2.0	1.0	MR	2.0	0.0	MR
21	CSHH 198 (c)	2.0	4.0	S	2.0	0.0	MR
22	LHH 144 (c)	2.0	1.0	MR	2.0	0.0	MR
23	F1861 (Standard Check)	2.0	1.0	MR	3.0	0.0	S
24	RS921 (Susceptible Check)	3.0	0.0	MS	2.0	0.0	MR

*R = Resistant; MR = Moderately Resistant; MS = Moderately Susceptible; S = Susceptible

Table 30. Incidence of para wilt on the test hybrids at Ludhiana

S. No.	Entry	Wilt (%)	S. No.	Entry	Wilt (%)
1.	Namcot.402 Bt	16.4	13.	RCH 134 BG II	9.2
2.	ACH 155-1 Bt	4.6	14.	NCS 145 BG II	7.8
3.	IT 905 Bt	38.4	15.	KDCHH 441 BG II	12.6
4.	BCHH 6317 Bt	17.4	16.	Ankur Jassi BG II	12.6
5.	Sigma Bt	7.4	17.	Tulasi 9 BG II	7.6
6.	Ankur 2226 Bt	41.5	18.	BCHH 6488-2 BG II	24.4
7.	NCEH 9 Bt	19.6	19.	ACH 33.2 BG II	20.1
8.	NCS 918 Bt	42.0	20.	RCH 134 Bt (Bt c)	2.0
9.	GK 206 Bt	20.4	21.	CSHH 198 (c)	0.0
10.	PCH 917 Bt	22.5	22.	LHH 144 (c)	3.0
11.	JKCH 1945 Bt	13.3	23.	F1861 (Standard Check)	0.0
12.	MLCH 315 BG II	17.1	24.	RS921 (Susceptible Check)	0.0

E. OVERALL ASSESSMENT

Nineteen Bt cotton hybrids were evaluated for the first time during 2006-07 in North Zone with RCH 134 Bt as the Bt check and CSHH 198 and LHH 144 as the non Bt check hybrids. They were evaluated at six locations under both protected and unprotected conditions.

The overall boll worm infestation was low during the year. Square damage was low on Bt cotton hybrids and varied from 0.1 to 0.5 per cent only. Square damage on Non Bt check hybrids ranged from 5.3 to 6.4 percent. Chemical intervention was required only for few entries at certain locations to control the bollworm damage. However, Jassids and Whitefly were noticed at all locations on all entries including check hybrids, warranting chemical intervention more than once to keep them under check. There was no significant variation in natural enemy population between Bt and non Bt hybrids.

Under ETL based plant protection, all the Bt cotton entries recorded higher seed cotton yield than the best Non Bt check Hybrid LHH 144. Among the Bt entries tested, only RCH 134 BG II with a mean seed cotton yield of 2918 kg/ha was superior to the Bt check hybrid RCH 134 Bt (2783 kg/ha) . The yield increase was of the order of 5 per cent. IT 905 Bt (2717 kg/ha) and Sigma Bt (2663 kg/ha) were the second and third ranking hybrids, even though the yield potential was 2 to 5 per cent less than the Bt check hybrid.

The same trend was noticed in the case of lint yield also. RCH 134 BG II with a mean lint yield 991 kg/ha was the only test hybrid superior to Bt check hybrid RCH 134 Bt (960 kg/ha). IT 905 Bt (943 kg/ha) and Sigma Bt (919 kg/ha), recorded 2 to 4 per cent less yield than the Bt check hybrid.

Under unprotected conditions, all the Bt cotton hybrids tested recorded higher yield than the non Bt check hybrids. However, as compared to the Bt check hybrid RCH 134 Bt, which recorded a mean seed cotton yield of 2478 kg/ha, only RCH 134 BG II (2565 kg/ha) was marginally superior to it by 4 per cent. IT 905 Bt and GK 206 Bt were on par with the Bt check hybrid.

Among the Bt hybrids tested, JKCH 1945 Bt and NCS 918 Bt were found susceptible to cotton leaf curl disease under natural condition as well as after artificial inoculation. Only BCHH 6317 Bt and Ankur 2226 Bt had a disease index value on par or below the standard check. The rest of the Bt hybrids had varying intensities of the disease.

As regards fibre quality, as many as 14 Bt Cotton hybrid entries, including RCH 134 BG II, IT 905 Bt and Sigma Bt, GK 206 Bt were on par with the Bt check hybrid RCH 134 Bt.

F. CONCLUSION

The overall boll worm infestation was low during the year. Boll worm damage, as seen from square damage, green boll damage, number of larvae/boll, open boll and locule damage was less on the Bt cotton hybrids as compared to non Bt check hybrids. There was no significant variation in natural enemy population between Bt and non Bt hybrids. All entries including the check hybrids were found to be susceptible to the sucking pests to some degree and required chemical intervention at certain growth stages. Four Bt hybrids viz., JKCH 1945 Bt, BCHH 6488-2 BG II, PCS 917 Bt and NCS 918 Bt had very high disease index for leaf curl disease under both natural and artificial conditions. The rest of hybrids had varying intensities of the disease.

All the Bt cotton hybrids tested registered higher seed cotton yield over the Non Bt check hybrids LHH 144 and CSHH 198 under both protected and unprotected conditions.

Of the 19 Bt cotton hybrids tested, only RCH 134 BG II recorded higher yield over the Bt check hybrid RCH 134 Bt under both protected and unprotected conditions by 4 to 5 percent. The next best hybrid was IT 905 Bt which recorded almost the same yield as that of RCH 134 BG II.

As regards fibre quality, as many as 14 Bt Cotton hybrid entries, including RCH 134 BG II and IT 905 Bt, were on par with the Bt check hybrid RCH 134 Bt.

Summary on the performance of Bt cotton hybrids

Entry	Seed cotton yield (kg/ha)	% Inc over RCH 134 Bt	Lint yield (kg/ha)	2.5 % Span Length (mm)	Micro-naire	Bundle Strength (g/tex)	Mean number of Jassid nymphs/3 leaves/plant	Mean number of Whitefly adults/ 3 leaves/ plant	Mean PBW larvae damage in green bolls (%)	Open boll damage (%) - Boll basis	Open boll damage (%) - Locule basis	Mean CLCuD Index after inoculation
Namcot.402 Bt	2299	-17	781	29.0	4.6	23.3	1.6	4.8	0.3	0.6	0.3	12.5
ACH 155-1 Bt	2062	-26	721	26.5	4.8	22.1	1.5	5.7	0.6	0.8	0.4	34.1
IT 905 Bt	2717	-2	943	27.4	4.5	22.1	1.6	5.3	2.1	0.7	0.4	16.7
BCHH 6317 Bt	2392	-14	863	27.9	4.8	21.4	1.7	5.0	2.0	0.7	0.4	12.7
Sigma BT	2663	-4	919	30.3	5.0	23.2	1.6	5.5	0.3	0.7	0.6	12.5
Ankur 2226 Bt	2158	-22	743	26.8	4.7	20.7	1.4	4.7	1.4	0.6	0.5	16.1
NCEH 9 Bt	2348	-16	858	26.9	4.9	22.0	1.7	4.5	0.3	0.5	0.3	25.0
NCS 918 Bt	2292	-18	813	29.2	4.7	23.1	2.0	4.8	1.4	1.8	0.8	75.0
GK 206 Bt	2450	-12	846	28.9	4.7	23.0	1.5	4.9	1.4	0.9	0.4	16.7
PCH 917 Bt	2425	-13	876	28.4	5.0	22.9	2.3	5.3	0.6	0.7	0.3	90.0
JKCH 1945 Bt	1962	-30	716	26.3	5.2	21.1	1.9	4.5	1.4	0.8	0.5	155.5
MLCH 315 BG II	2483	-11	844	29.8	4.7	22.9	1.7	4.8	0.6	1.0	0.5	17.5
RCH 134 BG II	2918	5	991	27.1	5.0	22.6	1.7	5.7	0.6	1.0	0.6	28.6
NCS 145 BG II	1972	-29	660	28.6	4.7	22.2	1.6	5.0	1.0	0.9	0.4	25.0
KDCHH 441 BG II	2093	-25	702	27.0	4.6	20.3	1.4	5.0	0.6	0.9	0.5	55.5
Ankur Jassi BG II	2275	-18	758	30.8	4.2	22.6	1.5	4.8	3.4	1.6	0.9	5.6
Tulasi 9 BG II	2441	-12	828	29.3	4.8	22.5	1.6	4.5	0.3	0.8	0.5	19.8
BCHH 6488-2 BG II	2293	-18	828	26.9	4.6	21.9	1.6	4.9	3.6	1.0	1.5	117.1
ACH 33.2 BG II	2381	-14	830	27.6	4.6	22.1	1.6	5.5	3.3	1.5	0.6	16.9
RCH 134 Bt (Bt c)	2783		960	27.5	5.0	23.0	1.6	5.8	3.7	3.0	1.4	12.5
CSHH 198 (c)	1645		556	26.5	4.6	22.0	1.6	5.2	21.0	14.0	6.6	6.3
LHH 144 (c)	1921		625	27.8	4.6	23.0	1.7	4.6	16.1	10.5	5.1	0.0

SECOND YEAR TRIAL (2006-07)

Entries

Two Bt Cotton hybrids were evaluated for the second year in succession for confirmatory results. The hybrids evaluated were MRC 7017 BG II and MRC 7031 BG II (Mahyco Seeds). There were three check hybrids viz., RCH 134 Bt (Bt check), LHH 144 and CSHH 198 (Non Bt checks)

Trial Locations

The trial was conducted at five locations:

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

Trial Details

No.of entries	: 2 + 3 checks
No.of Rows	: Three
Row length	: 6m
Spacing	: 75 x 60 cm
No.of Replications	: Five
Design	: Randomized Block
Fertilizers	: As per recommendation

I. 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 had exceeded.

II. EVALUATION UNDER UNPROTECTED CONDITIONS FOR BOLL WORMS

All the Bt cotton hybrids and the controls were evaluated against key pests of cotton.

Observations recorded

The biometrical observations recorded were Germination percentage, Final Plant Stand, Ginning Percentage, Lint Index, Seed Index, Seed Cotton Yield (Kg/ha) and Lint Yield (Kg/ha). The entomological observations on sap sucking pests, boll worm damage and natural enemies were recorded under ETL based plant protection trial. The pathological observations on incidences of cotton leaf curl virus disease and other foliar diseases were recorded.

A. BIOMETRICAL EVALUATION

Biometrical evaluation of all the entries in the trial were made in the ETL based plant protection trial. All the entries were tested at five locations and the sowings were completed during the second fortnight of May'2006.

Germination and Stand at harvest

Germination was good in all the entries in the trial and ranged from 84.6 to 89.8 percent (Table 31). The final stand at harvest was also satisfactory in all the entries (Table 32).

Table 31. Germination (%)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	94.1	96.7	79.4	88.0	88.9	89.4
MRC 7031 BG II	96.3	98.3	60.0	85.0	83.3	84.6
RCH 134 Bt (C)	94.8	95.0	77.0	84.0	93.3	88.8
LHH 144 (C)	91.1	95.0	80.6	90.0	92.2	89.8
CSHH 198 (C)	88.9	98.3	66.6	89.0	96.7	87.9

Table 32. Number of plants at harvest

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	23.0	23.8	27.8	23.4	27.2	25.0
MRC 7031 BG II	25.6	24.0	22.8	24.8	25.2	24.5
RCH 134 Bt (C)	25.8	23.8	28.6	24.2	25.4	25.6
LHH 144 (C)	25.4	23.0	27.6	25.8	24.8	25.3
CSHH 198 (C)	25.6	23.8	26.8	23.4	27.4	25.4

Boll Weight (g)

Both the test entries viz., MRC 7017 BG II (4.2g) and MRC 7031 BG II (4.0g) recorded better boll weight than the check hybrids which varied from 3.6 to 3.7 g (Table 33).

Table 33. Boll weight (g)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	4.4	4.4	3.9	3.8	4.5	4.2
MRC 7031 BG II	4.4	4.0	3.3	4.1	4.1	4.0
RCH 134 Bt (C)	4.4	4.1	3.2	3.5	3.4	3.7
LHH 144 (C)	4.8	4.5	3.2	3.4	2.3	3.6
CSHH 198 (C)	4.2	4.4	3.2	3.6	3.1	3.7
CD @ 5%	0.3	0.4	0.3		0.3	
CV(%)	4.1	6.1	7.3		6.8	

Ginning out turn (%)

The ginning outturn of the test entries varied from 33.5 to 34.1 percent and was on par with the Bt check hybrid RCH 134 Bt (34.7 %). The Non Bt check hybrid recorded 32.9 to 33.0 percent ginning out turn (Table 34).

Table 34. Ginning Outturn (%)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	33.4	31.6	33.9	38.8	29.9	33.5
MRC 7031 BG II	34.5	31.8	35.4	38.7	30.3	34.1
RCH 134 Bt (C)	34.3	31.3	38.8	38.2	30.7	34.7
LHH 144 (C)	33.0	32.0	34.8	38.2	26.4	32.9
CSHH 198 (C)	32.6	27.4	34.5	38.6	31.7	33.0
CD @ 5%	0.5	4.8	0.8		1.0	
CV(%)	0.8	11.5	1.7		2.6	

Lint Index and Seed Index

The test entries recorded higher lint and seed index than the check hybrids (Tables 35-36).

Table 35. Lint Index (g)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	4.7	5.3	4.8	5.6	4.8	5.0
MRC 7031 BG II	4.7	6.0	5.3	5.6	5.3	5.4
RCH 134 Bt (C)	4.7	5.1	5.5	4.8	4.1	4.8
LHH 144 (C)	4.9	5.3	4.2	5.0	3.7	4.6
CSHH 198 (C)	4.6	4.4	4.1	5.3	4.0	4.5
CD @ 5%	NS	0.9	0.3		0.3	
CV(%)	9.8	13.1	4.0		5.8	

Table 36. Seed Index (g)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganga-nagar	Mean
MRC 7017 BG II	9.5	11.4	9.3	8.9	11.2	10.1
MRC 7031 BG II	8.9	12.9	9.7	8.9	12.1	10.5
RCH 134 Bt (C)	9.0	11.2	8.7	7.8	9.3	9.2
LHH 144 (C)	10.0	11.3	7.8	8.1	10.2	9.5
CSHH 198 (C)	9.6	11.1	7.8	8.4	8.5	9.1
CD @ 5%	NS	0.4	0.3		0.8	
CV(%)	9.7	2.4	2.9		5.4	

Seed Cotton Yield

The two test entries viz., MRC 7017 BG II and MRC 7031 BG II were superior to the best non Bt check hybrid LHH 144 by 25 to 33 percent. The Bt check hybrid RCH 134 Bt recorded the highest seed cotton yield of 2799 kg/ha. The test hybrids MRC 7031 BG II (2596 kg/ha) and MRC 7017 BG II (2454 kg/ha) recorded 7 to 12 percent less yield than the Bt check hybrid (Table 37).

Table 37. Seed cotton yield (kg/ha)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144	% Inc over CSHH 198
MRC 7017 BG II	2178	2644	2769	1893	2787	2454	-12	25	47
MRC 7031 BG II	2527	3390	2336	1877	2852	2596	-7	33	56
RCH 134 Bt (C)	2968	3313	2872	2321	2523	2799			
LHH 144 (C)	2103	2928	1880	1235	1636	1956			
CSHH 198 (C)	1551	2353	1824	905	1713	1669			
CD @ 5%	245	415	387	253	356				
CV(%)	8.1	10.6	12.3	11.4	11.5				

Lint yield

In lint yield also RCH 134 Bt (966 kg/ha) recorded the highest yield followed by MRC 7031 BG II (873 kg/ha) and MRC 7017 BG II (814 Kg/ha). The non Bt check hybrids recorded the lowest yield. The test hybrids recorded 10 to 16 per cent less yield than the Bt check hybrid (Table 38).

Table 38. Lint yield (kg/ha)

Entry	Ludhiana	Faridkot	Sirsa	Hisar	Sriganganagar	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144	% Inc over CSHH 198
MRC 7017 BG II	728	835	939	735	835	814	-16	28	52
MRC 7031 BG II	872	1077	825	726	863	873	-10	37	63
RCH 134 Bt (C)	1018	1036	1114	887	774	966			
LHH 144 (C)	694	936	654	472	431	637			
CSHH 198 (C)	505	651	630	349	543	536			
CD @ 5%	88	170	132		113				
CV(%)	8.6	14.0	11.7		12.2				

B. FIBRE QUALITY EVALUATION

Fibre quality wise, MRC 7017 BG II was the best with a 2.5 % span length of 30.7 mm and fibre strength of 24.2 g/tex. The other test entry MRC 7031 BG II was also superior to the check hybrids in fibre length and strength (Tables 39 - 42).

Table 39. 2.5 % Span Length (mm)

Entry	Ludhiana	Faridkot	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	31.2	30.3	30.0	31.3	30.7
MRC 7031 BG II	30.4	28.1	30.0	30.1	29.7
RCH 134 Bt (C)	28.4	27.3	27.3	27.2	27.6
LHH 144 (C)	31.4	27.4	27.9	28.4	28.8
CSHH 198 (C)	29.6	27.0	27.5	26.7	27.7

Table 40. Uniformity Ratio

Entry	Ludhiana	Faridkot	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	52.0	48.0	48.0	51.0	49.8
MRC 7031 BG II	54.0	53.0	50.0	51.0	52.0
RCH 134 Bt (C)	53.0	54.0	50.0	50.0	51.8
LHH 144 (C)	52.0	51.0	50.0	50.0	50.8
CSHH 198 (C)	52.0	50.0	50.0	50.0	50.5

Table 41. Micronaire

Entry	Ludhiana	Faridkot	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	4.3	5.1	4.8	4.4	4.7
MRC 7031 BG II	4.2	4.6	4.6	4.2	4.4
RCH 134 Bt (C)	4.4	5.3	5.0	4.3	4.8
LHH 144 (C)	4.8	5.2	4.5	3.7	4.6
CSHH 198 (C)	4.5	5.0	4.8	3.8	4.5

Table 42. Bundle Strength (g/tex)

Entry	Ludhiana	Faridkot	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	23.2	24.4	24.5	24.5	24.2
MRC 7031 BG II	24.2	22.8	23.7	25.3	24.0
RCH 134 Bt (C)	22.0	23.8	23.6	24.0	23.4
LHH 144 (C)	22.4	23.8	23.1	25.1	23.6
CSHH 198 (C)	22.8	23.2	21.4	23.5	22.7

C. ENTOMOLOGICAL EVALUATION

1. EVALUATION UNDER ETL BASED PLANT PROTECTION

Jassids and Whitefly were the predominant sucking pests encountered during the season. Thrips was noticed at Sriganganagar and Sirsa. Aphid was absent at all the locations. *Helicoverpa armigera* population was nil or appeared only in traces. Spotted boll worm (*Earis vitella*) was observed at all the centres. *Spodoptera litura* was observed at Faridkot. Pink boll worm (*Pectinophora gossypiella*) appeared at the late stage of the crop growth at Sriganganagar & Faridkot.

Jassids & Whitefly

While Jassid population was high at Ludhiana, whitefly was more at Sriganganagar. However, there was not much difference between the test entries and the check hybrids in the sucking pest incidence and could be controlled through proper insecticide application (Tables 43 & 44).

Table 43. Mean number of Jassid nymphs/3 leaves/plant

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	2.6	1.1	0.8	1.0	1.7	1.4
MRC 7031 BG II	2.3	1.0	0.8	0.9	1.6	1.3
RCH 134 Bt (C)	2.6	1.4	0.8	1.0	1.3	1.4
LHH 144 (C)	2.5	1.0	0.8	0.9	1.7	1.4
CSHH 198 (C)	2.6	1.1	0.9	0.9	1.6	1.4

Table 44. - Mean number of Whitefly adults/3leaves/plant

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	3.3	2.4	1.0	1.5	9.7	3.6
MRC 7031 BG II	3.1	2.3	0.9	1.5	10.2	3.6
RCH 134 Bt (C)	3.7	3.1	1.0	1.5	11.8	4.2
LHH 144 (C)	3.8	2.5	1.0	1.5	11.5	4.0
CSHH 198 (C)	3.4	2.5	1.2	1.5	9.7	3.7

Percent square damage

Square damage due to boll worm was the minimum in Bt cotton entries and the Bt check hybrid and varied from 0.2 to 0.6 per cent. Mean per cent square damage in the non Bt check hybrids varied from 2.4 to 2.7 (Table 45).

Table 45. Per cent square damage

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	0.0	0.2	0.6	0.0	0.5	0.3
MRC 7031 BG II	0.0	0.2	1.8	0.0	1.2	0.6
RCH 134 Bt (C)	0.0	0.2	0.1	0.0	0.8	0.2
LHH 144 (C)	6.2	0.7	0.1	4.4	2.3	2.7
CSHH 198 (C)	6.2	1.2	0.2	1.9	2.8	2.4

Pink Boll Worm damage

Mean number of pink boll worm larvae per 20 bolls was very low in the Bt hybrids and varied from 0.2 to 0.4. On the other hand, the mean number of larvae ranged from 1.2 to 1.6 in the non Bt check hybrids (Table 46).

Table 46. Mean number of pink bollworm larvae/20 green bolls

Entry	Ludhiana	Faridkot	Sriganganagar	Mean
MRC 7017 BG II	0.0	0.1	0.7	0.2
MRC 7031 BG II	0.0	0.0	1.1	0.4
RCH 134 Bt (C)	0.0	0.0	0.7	0.2
LHH 144 (C)	1.2	0.5	2.0	1.2
CSHH 198 (C)	1.6	1.1	1.9	1.6

Green boll damage (%) due to Pink bollworm in Bt cotton hybrids varied from 0.4 to 1.3 at Faridkot and 0.7 to 1.3 at Sriganganagar. The non Bt hybrids on the other hand showed up to 15.6 per cent green boll damage (Table 47).

Table 47. Mean pink bollworm larvae damage in green bolls (%)

Entry	Faridkot	Sriganganagar	Mean
MRC 7017 BG II	1.3	0.7	1.0
MRC 7031 BG II	0.4	1.3	0.9
RCH 134 Bt (C)	0.4	1.0	0.7
LHH 144 (C)	4.9	11.0	7.9
CSHH 198 (C)	15.6	13.8	14.7

Open boll and locule damage

The test entry MRC 7017 BG II recorded the lowest open boll damage of 0.3 per cent as against 0.7 in RCH 134 (Bt check) and 11.1 per cent in CSHH 198 (non Bt check). Similarly the locule damage was only 0.3 to 0.6 per cent in Bt hybrids while it was 3.6 to 5.1 per cent in Non Bt hybrids (Tables 48-49).

Table 48. Open boll damage (%) - Boll basis

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Sriganganagar	Mean
MRC 7017 BG II	0.5	0.2	0.5	0.0	0.5	0.3
MRC 7031 BG II	1.0	0.0	1.2	0.0	3.4	1.1
RCH 134 Bt (C)	0.7	0.0	1.5	0.0	1.5	0.7
LHH 144 (C)	8.0	0.9	16.4	4.0	9.4	7.7
CSHH 198 (C)	8.2	7.6	18.9	3.1	17.8	11.1

Table 49. Open boll damage (%) - Loculi Basis

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
MRC 7017 BG II	0.2	0.2	0.3	0.5	0.3
MRC 7031 BG II	0.6	0.0	0.3	1.4	0.6
RCH 134 Bt (C)	0.5	0.0	0.4	0.4	0.3
LHH 144 (C)	4.1	0.3	6.9	3.1	3.6
CSHH 198 (C)	4.8	3.0	6.7	5.9	5.1

Insecticide application

While one to three rounds of insecticidal application was required at Sirsa, Hisar and Sriganganagar to control sucking pests in both Bt and non Bt hybrids, no spray was required at Faridkot (Table 50).

At Sirsa and Sriganganagar, the Bt hybrids did not cross the ETL for bollworm damage and hence no spray was given. The non Bt hybrids required one to two rounds of insecticide application to control boll worms. On the other hand, at Faridkot and Hisar, one to two rounds of insecticidal application were required for Bt hybrids and 2 to 3 rounds were required for non Bt hybrids to control the boll worms.

Table 50. Number of Sprays given for Sucking Pests Control

Entry	Faridkot	Hisar	Sirsa	Sriganganagar
MRC 7017 BG II	0	1	1	3
MRC 7031 BG II	0	2	1	3
RCH 134 Bt (C)	0	1	1	3
LHH 144 (C)	0	2	1	3
CSHH 198 (C)	0	2	1	3

For Boll Worm control

Entry	Faridkot	Hisar	Sirsa	Sriganganagar
MRC 7017 BG II	0	1	0	0
MRC 7031 BG II	1	2	0	0
RCH 134 Bt (C)	1	1	0	0
LHH 144 (C)	3	2	1	2
CSHH 198 (C)	1	2	0	2

II. EVALUATION UNDER UNPROTECTED CONDITIONS FOR BOLL WORMS:

Germination and plant stand

Germination percentage and Plant Stand were satisfactory in all the entries at all the locations (Tables 51 & 52).

Table 51. Germination Percentage

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
MRC 7017 BG II	80.0	85.0	70.0	92.2	81.8
MRC 7031 BG II	80.0	80.8	72.0	83.3	79.0
RCH 134 Bt (C)	83.7	87.5	74.0	93.3	84.6
LHH 144 (C)	75.6	88.3	77.0	91.1	83.0
CSHH 198 (C)	75.6	95.8	73.0	97.8	85.5

Table 52. Number of plants at harvest

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
MRC 7017 BG II	21.2	21.8	18.8	27.0	22.2
MRC 7031 BG II	22.8	19.8	19.2	24.0	21.5
RCH 134 Bt (C)	25.6	22.8	19.6	27.3	23.8
LHH 144 (C)	25.0	18.4	20.0	27.3	22.7
CSHH 198 (C)	24.6	23.2	19.4	28.7	24.0

Open Boll damage

The non Bt check hybrids showed considerable boll and locule damage under unprotected conditions. MRC 7017 BG II recorded the lowest mean boll damage of 1.1 percent as against 2.3 percent recorded in the Bt check hybrid RCH 134 Bt. The same trend was noticed for locule damage also (Tables 53 & 54).

Table 53. Open boll damage (%) - Boll basis

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
MRC 7017 BG II	2.2	1.0	0.7	0.5	1.1
MRC 7031 BG II	3.7	0.9	1.2	4.9	2.7
RCH 134 Bt (C)	4.0	0.9	1.5	2.8	2.3
LHH 144 (C)	14.8	8.8	18.3	14.9	14.2
CSHH 198 (C)	25.0	19.1	19.0	42.5	26.4

Table 54. Open boll damage (%) - Loculi Basis

Entry	Ludhiana	Faridkot	Hisar	Sriganganagar	Mean
MRC 7017 BG II	1.4	0.4	0.3	0.5	0.6
MRC 7031 BG II	2.0	0.3	0.3	2.1	1.2
RCH 134 Bt (C)	2.3	0.5	0.4	0.9	1.0
LHH 144 (C)	6.5	8.6	7.3	5.6	7.0
CSHH 198 (C)	14.0	8.6	7.3	13.1	10.7

Seed cotton yield

Both the Bt cotton entries tested viz., MRC 7017 BG II (1931 kg/ha) and MRC 7031 BG II (2082 kg/ha) even though recorded significantly higher seed cotton yield than the non Bt check hybrids, they were inferior to the Bt check hybrid RCH 134 Bt (2312 kg/ha) by 10 to 16 percent (Table 55).

Table 55. - Seed Cotton Yield (kg/ha)

Entry	Ludhiana	Faridkot	Hisar	Sirsa	Mean	% Inc over RCH 134 Bt	% Inc over LHH 144	% Inc over CSHH 198
MRC 7017 BG II	1691	2640	971	2420	1931	-16	29	62
MRC 7031 BG II	2056	2966	1207	2100	2082	-10	39	75
RCH 134 Bt (C)	2264	2932	1544	2510	2312	0	55	94
LHH 144 (C)	1637	1798	955	1584	1493	-35	0	25
CSHH 198 (C)	1315	1360	543	1551	1192	-48	-20	0
CD(0.05)	224	364	181	153				
CV(%)	9	12	13	6				

D. PATHOLOGICAL EVALUATION OF Bt COTTON HYBRIDS

During this year, the two BG II hybrids viz. MRC 7017 BG II and MRC 7031 BG II were tested against cotton leaf curl disease (CLCuD) under natural conditions in the five North Zone centres and also after artificial inoculation at Ludhiana and Sirsa. The hybrids were also assessed against other foliar diseases and para wilt.

Cotton Leaf Curl Disease

Cotton leaf curl disease was observed on the test hybrid MRC 7017 BG II only in Ludhiana and Faridkot with the disease index ranging from 12.9 to 16.7. This disease was not observed on this hybrid in Sirsa, Hisar and Sriganaganagar. On the second test hybrid, MRC 7031 BG II the CLCuD index ranged from 1.54 to 37.5 (Table 56). In Hisar, CLCuD was observed only on the susceptible check RS 921. Under artificial screening, both test hybrids were found resistant to the disease with a mean disease index of 5.0 to 7.8 as compared to 52.3 on RCH 134 Bt (Table 57).

Table 56. Incidence of CLCuD on the Second year trials under natural conditions– Disease index

S. No.	Entry	Faridkot	Ludhiana	Sriganganagar	Sirsa	Hisar	Mean disease index
1	MRC 7017 BG II	12.90	16.70	0.00	0.00	0.00	5.92
2	MRC 7031 BG II	37.50	10.00	7.10	1.54	0.00	11.23
3	RCH 134 Bt	105.70	159.80	16.90	1.67	0.00	56.81
4	LHH 144	17.40	0.00	12.30	0.00	0.00	5.94
5	CSHH 198	44.20	10.00	6.00	0.00	0.00	12.04
6	F 1861 (Standard Check)	9.60	35.00	15.40	0.00	0.00	12.00
7	RS 921 (Susceptible Check)	400.00	400.00	285.70	270.91	320.00	335.32

Table 57. Reaction of Bt entries to CLCuD under artificial screening – Disease index

S. No	Entry	Sirsa	Ludhiana	Mean
1	MRC 7017 BG II	0.0	10.0	5.0
2	MRC 7031 BG II	5.6	10.0	7.8
3	RCH 134 Bt	6.6	98.0	52.3
4	LHH 144	0.0	0.0	0.0
5	CSHH 198	0.0	0.0	0.0
6	F 1861 (Standard Check)	0.0	-	0.0
7	RS 921 (Susceptible Check)	60.0	-	60.0

Foliar diseases

The two test hybrids had shown high susceptibility to alternaria leaf spot under severe disease pressure in the Ludhiana centre where favourable climatic conditions viz. high rain fall (102.2mm), cloudy conditions, low temperature (21.5-26.5 C min. and 24.4 – 33.8 C max.) and a RH above 85% prevailed during the first fortnight of September leading to severe outbreak of the disease. There was low incidence of bacterial blight and other foliar diseases. There was no wilting of the plants (Table58).

Table 58. Incidence of Alternaria Leaf spot and Bacterial Blight (Grades)

S. No.	Entry	Alternaria Leaf spot			Bacterial Blight		
		Faridkot	Ludhiana	Reaction	Faridkot	Ludhiana	Reaction
1	MRC 7017 BG II	2.0	4.0	S	2.0	1.0	MR
2	MRC 7031 BG II	1.0	4.0	S	2.0	0.0	MR
3	RCH 134 Bt	2.0	3.0	MS	2.0	1.0	MR
4	LHH 144 Bt	1.0	2.0	MR	1.0	0.0	R
5	CSHH 198 Bt	2.0	3.0	MS	2.0	0.0	MR
6	F 1861(Standard Check)	3.0	1.0	MS	2.0	0.0	MR
7	RS 921 (Susceptible Check)	2.0	0.0	MR	3.0	0.0	MS

E. OVERALL ASSESSMENT

Two Bt cotton hybrids viz., MRC 7017 BG II and MRC 7031 BG II were evaluated for the second year for confirmatory results. There were three checks viz., RCH 134 Bt (Bt check), LHH 144 and CSHH 198 (Non Bt checks). The trial was conducted at five locations under both protected and unprotected conditions.

Boll worm damage as seen from square damage, green boll damage, number of larval boll, open boll and locule damage was less on the Bt cotton hybrids as compared to non Bt check hybrids. There was no significant variation in natural enemy population between Bt and non Bt hybrids. All entries including the check hybrids were found to be susceptible to the sucking pests to some degree and required chemical intervention at certain growth stages.

Under ETL based plant protection, the test entries viz., MRC 7017 BG II and MRC 7031 BG II were superior to the best non Bt check hybrid LHH 144 by 25 to 33 percent. The Bt check hybrid RCH 134 Bt recorded the highest seed cotton yield of 2799 kg/ha. The test hybrids MRC 7031 BG II (2596 kg/ha) and MRC 7017 BG II (2454 kg/ha) recorded 7 to 12 percent less yield than the Bt check hybrid.

In lint yield also, RCH 134 Bt (966 kg/ha) recorded the highest yield followed by MRC 7031 BG II (873 kg/ha) and MRC 7017 BG II (814 Kg/ha). The reduction in lint yield was of the order of 10 to 16 percent.

Under unprotected conditions, both the Bt cotton entries tested viz., MRC 7017 BG II (1931 kg/ha) and MRC 7031 BG II (2082 kg/ha) even though recorded significantly higher seed cotton yield than the non Bt check hybrids, they were inferior to the Bt check hybrid RCH 134 Bt (2312 kg/ha) by 10 to 16 percent

Against cotton leaf curl disease, the hybrid MRC 7017 BG II had a mean disease index of 5.92 and MRC 7031 BG II was having a disease index of 11.23 which is on par with standard resistant check F 1861 as well as the check hybrids. Both are susceptible to alternaria leaf spot.

F. CONCLUSION

Both the test hybrids MRC 7017 BG II and MRC 7031 BG II recorded higher seed cotton yield than the non Bt check hybrids LHH 144 and CSHH 198.

However, as compared to the Bt check hybrid RCH 134 Bt, both the test hybrids recorded less yield under both protected and unprotected condition. The reduction in yield ranged from 7 to 12 percent under protected and 10 to 16 per cent under unprotected condition.

Bollworm damage was less on Bt cotton hybrids and there was no significant difference in natural enemies population between Bt and Non Bt hybrids. All the hybrids needed chemical intervention to control sucking pests.

MRC 7017 BG II had a lesser CLCuD incidence than MRC 7031 BG II and at par with standard check F 1861. Both are, however, susceptible to alternaria leaf spot.

Quality wise the test hybrids were better than the check hybrids.

Summary on the performance of Bt cotton hybrids

Entry	Seed cotton yield (kg/ha)	% difference over RCH 134 Bt	Lint yield (kg/ha)	2.5 % Span Length (mm)	Micronaire	Bundle Strength (g/tex)
MRC 7017 BG II	2454	-12	814	30.7	4.7	24.2
MRC 7031 BG II	2596	-7	873	29.7	4.4	24.0
RCH 134 Bt (C)	2799		966	27.6	4.8	23.4
LHH 144 (C)	1956		637	28.8	4.6	23.6
CSHH 198 (C)	1669		536	27.7	4.5	22.7

Entry	Mean number of Jassid nymphs/ 3 leaves/ plant	Mean number of Whitefly adults/ 3 leaves/ plant	Mean PBW larvae damage in green bolls (%)	Open boll damage (%) - Boll basis	Open boll damage (%) - Locule basis	Mean CLCuD Index after inoculation
MRC 7017 BG II	1.4	3.6	1.0	0.3	0.3	5.0
MRC 7031 BG II	1.3	3.6	0.9	1.1	0.6	7.8
RCH 134 Bt (C)	1.4	4.2	0.7	0.7	0.3	52.3
LHH 144 (C)	1.4	4.0	7.9	7.7	3.6	0.0
CSHH 198 (C)	1.4	3.7	14.7	11.1	5.1	0.0

COMBINED REPORT OF TWO YEARS (2005-06 & 2006-07)

Two Bt Cotton hybrids were evaluated for two consecutive years during 2005-06 and 2006-07 in North Zone. The hybrids evaluated were MRC 7017 BG II and MRC 7031 BG II (Mahyco Seeds). There were three checks viz., RCH 134 Bt (Bt check), LHH 144 and CSHH 198 (Non Bt checks)

A. BIOMETRICAL EVALUATION.

Most of the Biometrical characters studied showed consistency over the years. Germination and Plant Stand were satisfactory in both the years (Table 59).

Entry	Germination (%)			Stand at harvest		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	89.0	89.4	89.2	25.9	25.0	25.5
MRC 7031 BG II	93.4	84.6	89.0	26.6	24.5	25.5
RCH 134 Bt (C)	95.8	88.8	92.3	27.5	25.6	26.5
LHH 144 (C)	86.5	89.8	88.1	24.5	25.3	24.9
CSHH 198 (C)	91.1	87.9	89.5	23.9	25.4	24.7

Boll weight was uniform in all the entries and ranged from 3.7 to 4.2 g only. The Bt check hybrid recorded the highest ginning out turn of 35 per cent. It ranged from 33.5 to 33.7 percent in the test entries. The non Bt check hybrids recorded the lowest ginning out turn ranging from 32.8 to 33.2 percent. There was not much variation among the entries in respect of lint index and seed index (Table 60).

Entry	Boll weight (g)			Ginning Outturn (%)			Lint Index (g)		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	3.7	4.2	4.0	33.8	33.5	33.7	4.4	5.0	4.7
MRC 7031 BG II	3.8	4.0	3.9	32.8	34.1	33.5	4.5	5.4	4.9
RCH 134 Bt (C)	3.7	3.7	3.7	35.3	34.7	35.0	5.2	4.8	5.0
LHH 144 (C)	3.8	3.6	3.7	33.5	32.9	33.2	4.7	4.6	4.7
CSHH 198 (C)	4.0	3.7	3.9	32.6	33.0	32.8	4.9	4.5	4.7

Seed Cotton Yield

The test entries MRC 7017 BG II and MRC 7031 BG II recorded significantly higher yield over the Non Bt check hybrids (Table 61). However, the Bt check hybrid RCH 134 Bt recorded the highest yield in both the years and recorded a mean seed cotton yield of 2846 kg/ha. The Bt test entries MRC 7017 BG II (2362 kg/ha) and MRC 7031 BG II (2389 kg/ha) recorded lower yield than the Bt check hybrid RCH 134 Bt ranging from 17 to 18 percent.

B. FIBRE QUALITY EVALUATION.

There was remarkable consistency in fibre quality parameters during both the years. The test hybrids showed a slightly higher 2.5 % span length than the check hybrids. In respect of other characters, there was not much variation among the entries (Table 61).

Entry	Seed Index (g)			Seed cotton yield (kg/ha)				2.5 % Span Length (mm)		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean	% difference over RCH 134 Bt	2005-06	2006-07	Mean
MRC 7017 BG II	8.5	10.1	9.3	2269	2454	2362	-17	28.3	30.7	29.5
MRC 7031 BG II	9.2	10.5	9.9	2182	2596	2389	-16	29.7	29.7	29.7
RCH 134 Bt (C)	9.3	9.2	9.2	2893	2799	2846		27.3	27.6	27.4
LHH 144 (C)	9.2	9.5	9.3	1350	1956	1653		28.2	28.8	28.5
CSHH 198 (C)	10	9.1	9.5	1426	1669	1548		27.1	27.7	27.4

Entry	Uniformity Ratio			Micronaire			Bundle Strength (g/tex)		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	40.0	49.8	44.9	4.3	4.7	4.5	21.8	24.2	23.0
MRC 7031 BG II	48.0	52.0	50.0	3.8	4.4	4.1	24.6	24.0	24.3
RCH 134 Bt (C)	52.0	51.8	51.9	4.4	4.8	4.6	23.6	23.4	23.5
LHH 144 (C)	49.0	50.8	49.9	4.1	4.6	4.3	23.8	23.6	23.7
CSHH 198 (C)	49.0	50.5	49.8	4.4	4.5	4.5	22.8	22.7	22.8

C. ENTOMOLOGICAL EVALUATION

I. EVALUATION UNDER ETL BASED PLANT PROTECTION

Jassids and Whitefly were the predominant sucking pests encountered during both the the seasons. *Helicoverpa armigera* population was nil or appeared only in traces. Spotted boll worm (*Earis vitella*) was observed at all the centres. Pink boll worm (*Pectinophora gossypiella*) appeared at the late stage of the crop growth at certain locations.

Jassids and Whitefly

The population of Jassids and Whitefly was found in equal numbers on both the test entries and the check hybrids (Table 62).

Entry	Mean number of Jassid /plant			Mean number of Whitefly /plant		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	1.7	1.4	1.6	4.9	3.6	4.2
MRC 7031 BG II	2.0	1.3	1.7	4.7	3.6	4.1
RCH 134 Bt (C)	2.0	1.4	1.7	3.9	4.2	4.1
LHH 144 (C)	1.7	1.4	1.5	4.0	4.0	4.0
CSHH 198 (C)	1.9	1.4	1.7	4.6	3.7	4.1

Percent square damage

Bt cotton hybrids consistently showed a lower square damage than the non Bt hybrids (Table 63).

Natural Enemies

There was no significant variation in natural enemy population between Bt and Non Bt hybrids (Table 63).

Entry	Mean number of Predators/5plants			Per cent square damage		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	3.5	2.0	2.7	0.3	0.3	0.3
MRC 7031 BG II	3.3	2.5	2.9	0.3	0.6	0.5
RCH 134 Bt (C)	3.9	2.5	3.2	0.5	0.2	0.4
LHH 144 (C)	3.3	2.2	2.7	3.1	2.7	2.9
CSHH 198 (C)	3.7	2.4	3.0	2.9	2.4	2.7

Pink bollworm damage

The Bt cotton hybrids showed less pink boll worm damage than the non Bt hybrids as observed from the number of larvae per boll and per cent green boll damage (Table 64).

Entry	Mean number of pink larvae / 20 green bolls			Mean pink boll worm larvae damage in green bolls (%)		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	0.2	0.2	0.2	2.9	1.0	1.9
MRC 7031 BG II	0.3	0.4	0.3	2.0	0.9	1.4
RCH 134 Bt (C)	0.3	0.2	0.3	3.4	0.7	2.1
LHH 144 (C)	1.2	1.2	1.2	15.4	7.9	11.7
CSHH 198 (C)	1.3	1.6	1.4	31.6	14.7	23.1

Open Boll damage

Open boll damage both in terms of boll and locule damage, was high in the non Bt check hybrids. Bt hybrids recorded lower boll damage (Table 65).

Entry	Open boll damage (%) - Boll basis			Open boll damage (%) - Locule basis		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	2.8	0.3	1.6	1.1	0.3	0.7
MRC 7031 BG II	3.5	1.1	2.3	1.3	0.6	0.9
RCH 134 Bt (C)	4.4	0.7	2.6	1.7	0.3	1.0
LHH 144 (C)	18.7	7.7	13.2	7.6	3.6	5.6
CSHH 198 (C)	21.6	11.1	16.3	8.2	5.1	6.7

II. EVALUATION UNDER UNPROTECTED CONDITIONS

Germination and Plant Stand

Germination and Plant stand were satisfactory in all the entries in both the years (Table 66).

Table 66. Entry	Germination Percentage			Plant stand		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	95.0	81.8	88.4	27.0	22.2	24.6
MRC 7031 BG II	92.0	79.0	85.5	26.0	21.5	23.7
RCH 134 Bt (C)	98.0	84.6	91.3	27.0	23.8	25.4
LHH 144 (C)	88.0	83.0	85.5	26.0	22.7	24.3
CSHH 198 (C)	88.0	85.5	86.8	25.0	24.0	24.5

Open Boll damage

Open boll and locule damage was high in the non Bt check hybrids and ranged from 19.3 to 26.0 per cent for boll damage and 8.5 to 10.5 per cent for locule damage. Bt hybrids on the other hand recorded very low boll (1.9 to 2.9 percent) and locule (0.9 to 1.2 percent) damage (Table 67).

Table 67. Entry	Open boll damage (%) - Boll basis			Open boll damage (%) - Locule basis		
	2005-06	2006-07	Mean	2005-06	2006-07	Mean
MRC 7017 BG II	2.6	1.1	1.9	1.2	0.6	0.9
MRC 7031 BG II	3.2	2.7	2.9	1.3	1.2	1.2
RCH 134 Bt (C)	3.0	2.3	2.7	1.1	1.0	1.1
LHH 144 (C)	24.3	14.2	19.3	10.0	7.0	8.5
CSHH 198 (C)	25.7	26.4	26.0	10.2	10.7	10.5

Seed Cotton Yield

Under unprotected conditions, as in the case of ETL based plant protection trial, the Bt cotton entries recorded higher seed cotton yield than the Non Bt check hybrids. However, the Bt check hybrid recorded the highest yield of 2605 kg/ha. The test hybrids MRC 7017 BG II (2173 kg/ha) and MRC 7031 BG II (2214 kg/ha) were inferior to the Bt check hybrid by 15 to 17 per cent (Table 68).

Table 68. Entry	Seed Cotton Yield (kg/ha)		
	2005-06	2006-07	Mean
MRC 7017 BG II	2415	1931	2173
MRC 7031 BG II	2346	2082	2214
RCH 134 Bt (C)	2897	2312	2605
LHH 144 (C)	1522	1493	1508
CSHH 198 (C)	1828	1192	1510

D. PATHOLOGICAL EVALUATION

Cotton leaf curl disease

The combined analysis of the two year data from field screening revealed that among the two test hybrids, MRC 7017 BG II has shown resistance to CLCuD and MRC 7031 BG II was moderately susceptible in Faridkot. However, the disease indices of these hybrids were on par with the check hybrids *viz.* LHH 144 and CSHH 198 and lower than the standard resistant check F 1861 (Table 69). Under artificial conditions also similar results were seen with MRC 7017 BG II showing better resistance than MRC 7031 BG II (Table 70)

Table 69. Cotton Leaf Curl Disease on Bt hybrids over two year period

Entry	Faridkot		Ludhiana		Sriganganagar	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
MRC 7017 BG II	0.0	12.9	0.0	16.7	0.0	0.0
MRC 7031 BG II	4.1	37.5	0.0	10.0	3.4	7.1
RCH 134 Bt	3.4	105.7	0.0	159.8	10.3	16.9
LHH 144	0.0	17.4	0.0	0.0	0.0	12.3
CSHH 198	0.0	44.2	0.0	10.0	0.8	6.0
F 1861 (Standard Check)	0.0	9.6	0.0	35.0	0.0	15.4
RS 921 (Susceptible Check)		400.0		400.0		285.7

Entry	Sirsa		Hisar		Mean disease index
	2005-06	2006-07	2005-06	2006-07	
MRC 7017 BG II	0.0	0.0	0.0	0.0	3.0
MRC 7031 BG II	0.0	1.5	0.0	0.0	6.4
RCH 134 Bt	0.0	1.7	0.0	0.0	29.8
LHH 144	0.0	0.0	0.0	0.0	3.0
CSHH 198	0.0	0.0	0.0	0.0	6.1
F 1861 (Standard Check)	131.6	0.0	0.0	0.0	19.2
RS 921 (Susceptible Check)		270.9		320.0	335.3

Table 70. Reaction of Bt entries under artificial screening – Disease index

S. No	Entry	Sirsa	Ludhiana
1	MRC 7017 BG II	0.0	10.0
2	MRC 7031 BG II	5.6	10.0
3	RCH 134 Bt	6.6	98.0
4	LHH 144	0.0	0.0
5	CSHH 198	0.0	0.0
6	F 1861 (Standard Check)	0.0	-
7	RS 921 (Susceptible Check)	60.0	-

Foliar Diseases

The test hybrids , MRC 7017 BG II and MRC 7031 BG II were susceptible to the alternaria leaf spot under severe disease pressure which prevailed during September 2006 in Ludhiana (Table 71)

Table 71. Incidence of alternaria leaf spot on Bt hybrids over two year period (Grade)

S. No.	Entry	Faridkot		Ludhiana	Reaction
		2005-06	2006-07	2006-07	
1	MRC 7017 BG II	2	2	4	S
2	MRC 7031 BG II	2	1	4	S
3	RCH 134 Bt	2	2	3	MS
4	LHH 144	2	1	2	MR
5	CSHH 198	2	2	3	MS
6	F 1861 (Standard Check)	1	3	1	MS
7	RS 921 (Susceptible Check)		2	0	MR

E. OVERALL ASSESSMENT

Two Bt cotton hybrids viz., MRC 7017 BG II and MRC 7031 BG II were evaluated for two years at five locations under both protected and unprotected conditions. They were compared against both Bt check (RCH 134 Bt) and Non Bt check (LHH 144 and CSHH198) hybrids.

Boll worm damage, as seen from square damage, green boll damage, number of larvae/boll, open boll and locule damage was less on the Bt cotton hybrids as compared to non Bt check hybrids. There was no significant variation in natural enemy population between Bt and non Bt hybrids. All entries including the check hybrids were found to be susceptible to the sucking pests to some degree and required chemical intervention at certain growth stages.

Bt cotton hybrids uniformly registered higher seed cotton yield over the Non Bt check hybrids LHH 144 and CSHH 198.

Under ETL based plant protection, the Bt check hybrid, RCH 134 Bt, recorded the highest yield in both the years and recorded a mean seed cotton yield of 2846 kg/ha. The Bt test entries MRC 7017 BG II (2362 kg/ha) and MRC 7031 BG II (2389 kg/ha) recorded lower yield than the Bt check hybrid RCH 134 Bt ranging from 17 to 18 percent.

Under unprotected conditions, as in the case of ETL based plant protection trial, the Bt check hybrid recorded the highest yield of 2605 kg/ha. The test hybrids MRC 7017 BG II (2173 kg/ha) and MRC 7031 BG II (2214 Kg/ha) were inferior to the Bt check hybrid by 15 to 17 per cent.

Overall both hybrids had lower CLCuD incidence than the resistant check F 1181 and on par with the check hybrid LHH 144 and CSHH 198. Both were susceptible to alternaria leaf spot.

The test hybrids showed better fibre length than the other entries in the trial.

F. CONCLUSION

Both the test hybrids viz., MRC 7017 BG II and MRC 7031 BG II recorded lesser yield than Bt check hybrid RCH 134 Bt under both protected and unprotected condition. The reduction in yield ranged from 17 to 18 percent under protected and 15 to 17 per cent under unprotected condition. However, the test hybrids recorded higher seed cotton yield than the non Bt check hybrids viz., LHH 144 and CSHH 198.

Bollworm damage was less on Bt cotton hybrids and there was no significant difference in natural enemy population between Bt and Non Bt hybrids. Both hybrids had lower CLCuD incidence but were susceptible to alternaria leaf spot.

Summary on the performance of Bt cotton hybrids over two years

Entry	Seed cotton yield (kg/ha)	% difference over RCH 134 Bt	2.5 % Span Length (mm)	Uniformity Ratio	Micronaire	Bundle Strength (g/tex)	Lint yield (kg/ha)
MRC 7017 BG II	2362	-17	29.5	44.9	4.5	23.0	814
MRC 7031 BG II	2389	-16	29.7	50.0	4.1	24.3	873
RCH 134 Bt (C)	2846		27.4	51.9	4.6	23.5	966
LHH 144 (C)	1653		28.5	49.9	4.3	23.7	637
CSH 198 (C)	1548		27.4	49.8	4.5	22.8	536

Entry	Mean number of Jassid / plant	Mean number of Whitefly / plant	Mean pink bollworm larvae damage in green bolls (%)	Open boll damage (%) - Boll basis	Open boll damage (%) - Locule basis	Mean CLCuD Index after inoculation
MRC 7017 BG II	1.6	4.2	1.9	1.6	0.7	5.0
MRC 7031 BG II	1.7	4.1	1.4	2.3	0.9	7.8
RCH 134 Bt (C)	1.7	4.1	2.1	2.6	1.0	52.3
LHH 144 (C)	1.5	4.0	11.7	13.2	5.6	0.0
CSH 198 (C)	1.7	4.1	23.1	16.3	6.7	0.0
