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EXECUTIVE SUMMARY

The All India Coordinated Cotton Improvement Project was assigned the task of evaluating Bt cotton hybrids in Central Zone. The hybrids were evaluated at five locations under both protected and unprotected conditions. At Khandwa (JNKVV, Madhya Pradesh) and Surat (NAU, Gujarat) the trial was conducted under irrigated conditions. At Akola (Dr. PDKV, Maharashtra), Nanded (MAU, Maharashtra) and Nagpur (CICR, Maharashtra) the trial was conducted under rainfed situations.

FIRST YEAR EVALUATION

Eleven Bt cotton hybrids were evaluated with three checks. All the entries tested were found to be susceptible to the sucking pests at varying levels and warranted chemical intervention. However, all the Bt hybrids recorded comparatively lower boll damage as compared to the non-Bt check.

In the irrigated trials, none of the entries were superior to the best check hybrid for mean seed cotton yield under protected conditions. Under unprotected conditions RCH 386 Bt, ACH 155-2 BG II and VICH 5 Bt were superior to the check.

Under rainfed conditions also in the protected trial none of the entries performed better than the best check hybrid for seed cotton yield. In the unprotected trial, nine entries were numerically superior to the Bt check hybrids. They are KDCHH 9810 Bt, MRC 7351 BG II, VICH 9 Bt, RCH 515 BG II, VICH 5 Bt, ACH 155-2 BG II, MRC 7341 BG II, KDCHH 621 BG II and JKCH 99 Bt.

SECOND YEAR EVALUATION

Twenty six Bt cotton hybrids were evaluated with three checks. All the entries tested showed susceptibility to the major sucking pests at different stages and warranted chemical intervention to contain the pests. However, for bollworms all the Bt entries recorded lower square and boll damage as compared to the non-Bt check and required nil to one round of pesticide application in most of the cases.

Under irrigated conditions, test hybrids GK 205 Bt, RCH 377 Bt, MRC 7347 BG II, MRC 7226 BG II and NCS 145 Bt were found to be higher yielding than the check hybrids under both protected and unprotected condition. Under rainfed situations, entries MRC 7347 BG II, RCH 377 Bt, GK 205 Bt and ACH 155-1 were promising.

Quality wise all the hybrids evaluated were on par with the Bt check hybrids.

COMBINED EVALUATION FOR TWO YEARS

Performance of twenty six Bt cotton hybrids and two common checks evaluated for two consecutive years (2004-05 and 2005-06) have been reported. Twenty six Bt hybrid entries were evaluated under irrigated conditions at Khandwa and Surat and under rainfed situation in Akola, Nanded and Nagpur for two years.

All the hybrids evaluated, including the check hybrids were found to be susceptible to sucking pests, especially jassids at varying levels during both the years. However, they could be easily kept under check through ETL based plant protection measures.

Bollworms infestation was moderate during both the years as indicated by low larval populations of *Earias* spp. and *Helicoverpa armigera* and square damage. Even under low infestation levels, the non-Bt check hybrid recorded more bollworm damage as compared to the Bt hybrids, indicating the good resistance provided by the Bt hybrids to bollworms. The bollworm reaction in respect of test entries were on par with the Bt check hybrid. The non-Bt check hybrid required 2.3 rounds of chemical sprayings to control bollworms. On the other hand Bt hybrids required nil to 0.5 rounds of sprayings.

An overall assessment of 26 Bt cotton hybrids under both Irrigated and Rainfed situations indicated that under **Irrigated Protected Conditions** only seven hybrids viz., GK 205 Bt, RCH 377 Bt, MRC 7226 BG II, MRC 7347 BG II, Krishna Bt, ACH 155-1 Bt and NCS 145 Bt recorded 5% or more seed cotton yield over the common Bt check hybrid RCH 2 Bt. The performance of these hybrids except Krishna Bt under unprotected condition also showed a yield increase ranging from 7 to 29 per cent. Krishna Bt recorded less seed cotton yield than the RCH 2 Bt check hybrid.

Under **Rainfed protected condition**, only two hybrids GK 205 Bt and RCH 377 Bt were found to be superior than the RCH 2 Bt check. They were also better than the common check hybrid RCH 2 Bt under unprotected conditions.

All the seven test hybrids were on par with the check hybrid RCH 2 Bt in fibre quality parameters.

**BT COTTON HYBRIDS EVALUATION REPORT
(CENTRAL ZONE)**

The All India Coordinated Cotton Improvement Project (AICCIP) was assigned the task of evaluating the Bt cotton hybrids in the Central Zone vide ICAR letter No. 2(4)/2005-CCI Dt. 13.05.2006 and 27.05.2006. The following are the details.

Test Entries

There were two sets of trials. In the first year trial, eleven hybrids were evaluated with three checks. The hybrids evaluated were

- i. KDCHH 9810 Bt and KDCHH 621 BG II from Krishidhan seeds,
- ii. RCH 386 Bt and RCH 515 BG II from Rasi seeds,
- iii. NCS 913 Bt from Nuziveedu seeds,
- iv. MRC 7351 BG II and MRC 7341 BG II from MAHYCO seeds,
- v. JKCH 99 Bt from JK seeds,
- vi. VICH 5 Bt and VICH 9 Bt from Vikram seeds and
- vii. ACH 155-2 BG II from Ajeet seeds.

The non-Bt check hybrid was NHH 44 and

Bt check hybrids were RCH 2 Bt and RCH 138 Bt.

In the second year trial, there were twenty six test hybrids with three checks. The hybrids tested were:

- i. RCH 377 Bt from Rasi seeds,
- ii. MRC 6352 Bt, MRC 7226 BG II and MRC 7347 BG II from MAHYCO seeds,
- iii. NCS 138 Bt and NCS 145 Bt from Nuziveedu seeds,
- iv. JKCH 555 Bt, JKCH 666 Bt and JKCH 226 Bt from JK seeds,
- v. NCEH 2R Bt and NCEH 3R Bt from Nath seeds,
- vi. Tulasi 4 Bt and Tulasi 117 Bt from Tulasi seeds,
- vii. NPH 2171 Bt from Prabhat seeds,
- viii. Brahma Bt, Kirtiman Bt and Krishna Bt from Emergent Genetics,
- ix. GK 204 Bt and GK 205 Bt from Ganga Kaveri seeds,
- x. ACH 33-1 Bt, ACH 155-1 Bt and ACH 11-2 Bt from Ajeet seeds,
- xi. KDCHH 9632 Bt and KDCHH 441 BG II from Krishidhan seeds,

xii. PRCH 102 Bt from Pravardhan seeds and

xiii. VCH 111 Bt from Vikkis agrotech .

NHH 44 was the non-Bt hybrid check.

The Bt check hybrids were RCH 2 Bt and RCH 118 Bt.

The trial locations

The following were the trial locations.

Irrigated trials

1. Cotton Research Station, Khandwa under Jawaharlal Nehru Krishi Vishwa Vidyalaya, Madhya Pradesh.
2. Cotton Research Station, Surat under Navsari Agricultural University, Gujarat.

Rainfed trials

1. Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra
2. Cotton Research Station, Nanded under Marathwada Agricultural University, Maharashtra and
3. Central Institute for Cotton Research, Nagpur, Maharashtra.

The trial details:

First Year Trial

Number of Entries	11 + 3 checks
Number of rows	Six
Row length	6 M
Spacing	90 x 60 Cm
Number of replications	Three
Design	Randomised Block Design
Fertilizers	As per local recommendation

Second Year Trial

Number of Entries	26 + 3 checks
Number of rows	Three
Row length	6 M
Spacing	90 x 60 Cm
Number of replications	Three
Design	Randomised Block Design
Fertilizers	As per local recommendation

Method of evaluation

1. Evaluation under ETL based plant protection

Weekly observations were recorded from 45 DAS against major sucking pests and bollworms. The insecticidal sprayings were given based on the economic threshold levels of the sap sucking pests and bollworms. The sprayings were undertaken in all the replication of an entry, even if the threshold level of infestation had exceeded only in one of the replications.

2. Evaluation under unprotected conditions

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, number of days for first and fifty per cent flowering, bolls per plant, mean boll weight, ginning percentage, lint and seed index and seed cotton yield were recorded in the ETL based plant protection trial. Important fibre quality attributes like 2.5% span length, uniformity ratio (%), micronaire and fibre strength were also determined through the High Volume Instrument. The entomological observations on sap sucking pests, bollworms, square damage, green boll damage, open boll damage and locule damage were also recorded in ETL based trial. Under unprotected conditions, boll and locule damage and seed cotton yield were assessed. The pathological evaluations were taken up for the incidences of diseases like alternaria leaf spot, bacterial blight and grey mildew.

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

FIRST YEAR EVALUATION

In this trial, eleven test hybrids *viz.*, KDCHH 9810 and KDCH 621 BG II (Krishidhan seeds), RCH 386 Bt and RCH 515 BG II (Rasi seeds), NCS 913 Bt (Nuziveedu seeds), MRC 7351 BG II and MRC 7341 BG II (MAHYCO seeds), JKCH 99 Bt (JK seeds), VICH 5 Bt and VICH 9 Bt (Vikram seeds) and ACH 155-2 BG II (Ajeet seeds) were evaluated. The Bt check hybrids were RCH 2 Bt and RCH 138 Bt. NHH 44 was the non-Bt check hybrid. The sowings were completed during the first fortnight of July 2005.

A. BIOMETRICAL EVALUATION

Biometrical observations recorded in the ETL based plant protection trial are reported below.

Germination and final plant stand

The germination of all the entries at all the locations was very good. The mean germination percentage ranged from 88 to 95 per cent (Table 1).

Table 1. Germination percentage

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	-	84	98	99	97	95
KDCHH 621 BG II	85	85	99	100	97	93
RCH 386 Bt	79	86	96	100	90	90
RCH 515 BG II	73	81	99	99	87	88
NCS 913 Bt	83	80	98	99	100	92
MRC 7351 BG II	84	90	99	99	97	94
MRC 7341 BG II	73	79	98	99	93	88
JKCH 99 Bt	82	83	100	99	100	93
VICH 5 Bt	85	87	94	98	90	91
VICH 9 Bt	84	86	100	99	93	92
ACH 155-2 BG II	83	81	100	99	100	93
NHH 44 (C.Hy)	75	84	99	97	97	90
RCH 2 Bt (Bt.C.hy)	74	84	98	99	93	90
RCH 138 Bt (Bt.C.hy)	87	88	100	97	90	92

The final plant stand was also very good in all the entries in all the locations. However, depending up on the spacing adopted and number of plants per hill, the plant stand per plot varied across locations (Table 2).

Table 2. Final plant stand

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	78	24	47	55	51.0
KDCHH 621 BG II	77	24	48	45	48.7
RCH 386 Bt	78	24	48	48	49.3
RCH 515 BG II	76	24	47	46	48.1
NCS 913 Bt	77	23	48	51	49.8
MRC 7351 BG II	77	24	47	50	49.5
MRC 7341 BG II	78	24	47	49	49.4
JKCH 99 Bt	76	24	47	48	48.9
VICH 5 Bt	78	24	48	56	51.3
VICH 9 Bt	77	24	47	49	49.3
ACH 155-2 BG II	78	24	47	50	49.7
NHH 44 (C.Hy)	77	24	46	55	50.3
RCH 2 Bt (Bt.C.hy)	76	24	47	56	51.0
RCH 138 Bt (Bt.C.hy)	78	24	45	54	50.2

First and 50 per cent flowering

Early flowering was observed at Surat as compared to other centres. The mean number of days for first flowering ranged from 55.0 to 63.7. MRC 7351 BG II was found to be earliest for first flowering (Table 3).

Table 3. First flowering (Days)

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	42.3	59.0	58.0	63.0	55.6
KDCHH 621 BG II	49.0	53.7	60.0	65.0	56.9
RCH 386 Bt	55.7	62.3	60.0	67.0	61.2
RCH 515 BG II	54.7	67.0	58.0	65.0	61.2
NCS 913 Bt	50.3	60.7	58.7	63.0	58.2
MRC 7351 BG II	44.7	56.0	55.0	64.3	55.0
MRC 7341 BG II	51.0	56.7	57.3	66.3	57.8
JKCH 99 Bt	56.7	64.0	63.3	70.7	63.7
VICH 5 Bt	54.7	61.0	59.3	68.0	60.7
VICH 9 Bt	52.7	62.3	60.3	65.7	60.2
ACH 155-2 BG II	49.0	60.0	56.7	63.0	57.2

NHH 44 (C.Hy)	47.0	55.3	63.0	65.0	57.6
RCH 2 Bt (Bt.C.hy)	57.3	61.7	64.3	65.0	62.1
RCH 138 Bt (Bt.C.hy)	50.7	63.7	57.0	63.3	58.7

The same trend was noticed for 50 per cent flowering also (Table 4).

Table 4. Fifty percent flowering (Days)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	77.7	53.3	72.0	63.0	66.7	66.5
KDCHH 621 BG II	84.0	59.0	62.5	66.7	74.3	69.3
RCH 386 Bt	85.0	67.7	72.3	67.3	74.3	73.3
RCH 515 BG II	82.3	64.7	72.0	63.7	79.0	72.3
NCS 913 Bt	85.3	62.0	69.7	65.0	69.3	70.3
MRC 7351 BG II	82.3	53.0	67.5	61.0	71.7	67.1
MRC 7341 BG II	77.3	62.0	66.3	64.0	72.7	68.5
JKCH 99 Bt	86.7	68.3	72.0	67.0	77.7	74.3
VICH 5 Bt	81.0	66.0	69.7	66.0	76.0	71.7
VICH 9 Bt	79.7	64.3	72.0	66.3	74.0	71.3
ACH 155-2 BG II	81.7	58.7	67.3	64.0	72.0	68.7
NHH 44 (C.Hy)	77.3	58.3	68.0	74.0	75.0	70.5
RCH 2 Bt (Bt.C.hy)	81.7	68.3	72.3	67.3	72.7	72.5
RCH 138 Bt (Bt.C.hy)	81.3	62.3	76.3	64.7	71.0	71.1

Bolls per plant

Baring Akola centre, the differences in boll number was significant at all the other locations. Most of the Bt hybrids recorded significantly higher boll number as compared to the non-Bt hybrid check (NHH 44). Mean number of bolls per plant ranged from 29.0 to 42.1 in the Bt hybrids, whereas it was 31.3 in NHH 44 (Table 5).

Table 5. Bolls/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	31.8		29.7	49.3	28.1	34.7
KDCHH 621 BG II	29.0	21.0	33.0	38.3	25.5	29.4
RCH 386 Bt	30.2	33.0	34.4	49.7	50.6	39.6
RCH 515 BG II	22.7	22.7	31.4	41.0	48.6	33.3
NCS 913 Bt	26.8	32.3	35.5	47.0	37.0	35.7
MRC 7351 BG II	21.9	23.7	35.0	36.0	38.0	30.9
MRC 7341 BG II	23.3	20.7	24.1	36.0	40.8	29.0
JKCH 99 Bt	23.8	38.3	29.4	50.7	66.7	41.8

VICH 5 Bt	19.8	23.3	32.3	36.3	37.0	29.7
VICH 9 Bt	27.9	29.3	31.5	44.0	59.5	38.4
ACH 155-2 BG II	29.3	30.3	36.5	50.3	49.3	39.1
NHH 44 (C.Hy)	25.4	16.7	35.5	20.7	58.3	31.3
RCH 2 Bt (Bt.C.hy)	30.6	39.3	35.1	52.7	52.8	42.1
RCH 138 Bt (Bt.C.hy)	26.6	32.7	38.1	45.3	49.5	38.4
CD at 5%	1.1	5.2	10.1	5.9	18.8	
CV %	13.3	11.0	22.0	8.2	27.3	

Boll weight

Boll weight varied significantly across locations. In general, mean boll weight was the lowest at Surat and highest at Nanded. KDCHH 621 BG II (5.7 g), MRC 7351 BG II (5.7 g), MRC 7341 BG II (5.5 g) and VICH 5 Bt (5.7 g) recorded high boll weight of above 5.5 g. NHH 44 recorded the lowest boll weight of 3.7 g (Table 6).

Table 6. Boll weight (g)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	2.8	4.6	5.5	5.7	5.6	4.8
KDCHH 621 BG II	3.3	5.0	8.3	6.0	6.1	5.7
RCH 386 Bt	3.3	4.6	6.0	5.6	5.1	4.9
RCH 515 BG II	3.5	5.3	5.5	6.0	5.7	5.2
NCS 913 Bt	2.6	4.2	6.2	4.7	4.6	4.5
MRC 7351 BG II	3.4	6.0	6.1	6.4	6.5	5.7
MRC 7341 BG II	3.0	5.6	5.9	6.9	6.0	5.5
JKCH 99 Bt	2.8	4.3	5.3	5.0	5.0	4.5
VICH 5 Bt	3.3	5.9	6.6	6.2	6.7	5.7
VICH 9 Bt	3.6	4.6	5.8	5.6	5.1	4.9
ACH 155-2 BG II	3.7	4.7	5.3	5.1	5.6	4.9
NHH 44 (C.Hy)	3.1	3.8	3.3	4.2	4.2	3.7
RCH 2 Bt (Bt.C.hy)	2.8	4.6	5.5	5.2	4.8	4.6
RCH 138 Bt (Bt.C.hy)	2.8	4.3	3.9	5.1	4.5	4.1
CD at 5%	0.4	0.8	0.7	0.5	0.9	
CV %	15	9	9	5	9	

Ginning Out turn

The ginning out turn was moderate and ranged from 33.6 (RCH 386 Bt) to 36.8 (RCH 515 BG II). NHH 44, the non-Bt check hybrid, recorded a mean ginning out turn of 33.8 per cent (Table 7).

Table 7. Ginning Out turn (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	31.9	32.2	36.5	36.0	35.4	34.4
KDCHH 621 BG II	32.0	34.1	40.4	37.3	36.6	36.1
RCH 386 Bt	29.3	34.1	37.5	34.3	32.9	33.6
RCH 515 BG II	33.4	37.2	38.7	38.1	36.6	36.8
NCS 913 Bt	33.4	33.7	39.4	38.8	37.6	36.6
MRC 7351 BG II	33.4	33.6	39.1	37.6	34.8	35.7
MRC 7341 BG II	28.8	32.2	40.7	34.7	35.4	34.4
JKCH 99 Bt	39.1	34.4	36.9	36.9	34.7	36.4
VICH 5 Bt	30.2	32.5	38.7	34.6	34.7	34.1
VICH 9 Bt	34.1	35.7	36.8	37.0	35.7	35.9
ACH 155-2 BG II	34.2	34.5	33.4	36.3	37.7	35.2
NHH 44 (C.Hy)	31.8	32.3	35.7	35.2	34.2	33.8
RCH 2 Bt (Bt.C.hy)	29.8	33.1	38.4	35.7	35.7	34.5
RCH 138 Bt (Bt.C.hy)	31.4	31.9	37.1	34.9	33.8	33.8
CD at 5%	0.5	2.1	2.6	1.5	1.4	
CV %	5.0	3.8	4.9	2.4	2.4	

Lint index (g)

As many as six hybrids recorded high lint index of 6.0 g and above. NHH 44 (4.3 g) recorded the lowest lint index (Table 8).

Table 8. Lint index (g)

Hybrid	Akola	Nagpur	Mean
KDCHH 9810 Bt	5.8	5.2	5.5
KDCHH 621 BG II	6.1	6.7	6.4
RCH 386 Bt	6.9	5.6	6.3
RCH 515 BG II	6.3	5.6	6.0
NCS 913 Bt	5.5	5.6	5.5
MRC 7351 BG II	6.0	5.7	5.9
MRC 7341 BG II	7.5	6.4	6.9
JKCH 99 Bt	6.4	6.4	6.4
VICH 5 Bt	7.9	6.1	7.0

VICH 9 Bt	5.9	5.9	5.9
ACH 155-2 BG II	4.9	6.1	5.5
NHH 44 (C.Hy)	3.7	5.0	4.3
RCH 2 Bt (Bt.C.hy)	6.1	5.8	5.9
RCH 138 Bt (Bt.C.hy)	4.8	4.6	4.7
CD at 5%	1.3	0.6	
CV %	15.5	6.1	

Seed index

All the test entries except NCS 913 Bt (9.3g) recorded high seed index of 10.0 g and above RCH 138 Bt (Bt check) had the lowest seed index of 9.0 g (Table 9).

Table 9. Seed index (g)

Hybrid	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	10.0	11.0	9.5	10.2
KDCHH 621 BG II	9.0	10.5	11.5	10.3
RCH 386 Bt	11.5	10.9	11.5	11.3
RCH 515 BG II	9.9	10.5	9.7	10.0
NCS 913 Bt	8.5	10.2	9.2	9.3
MRC 7351 BG II	9.3	10.6	10.7	10.2
MRC 7341 BG II	10.8	12.7	11.6	11.7
JKCH 99 Bt	10.9	11.0	12.0	11.3
VICH 5 Bt	12.5	12.0	11.6	12.0
VICH 9 Bt	10.1	10.2	10.6	10.3
ACH 155-2 BG II	9.7	11.7	10.1	10.5
NHH 44 (C.Hy)	9.3	9.8	9.5	9.5
RCH 2 Bt (Bt.C.hy)	9.8	11.5	10.4	10.6
RCH 138 Bt (Bt.C.hy)	8.2	9.6	9.1	9.0
CD at 5%	0.4	1.0	1.4	
CV %	2.6	5.3	8.0	

B). MEAN SEED COTTON YIELD UNDER PROTECTED CONDITIONS

i) Irrigated

The crop was raised under irrigated conditions at Khandwa and Surat. All the hybrids evaluated recorded higher seed cotton yield than the non-Bt check NHH 44. The yield increases were of order of 44 to 129 per cent.

RCH 2 Bt with a mean seed cotton yield of 1904 Kg/ha was the best Bt check hybrid. None of the test hybrids recorded higher yield over it.

ii) Rainfed

The crop was raised under rainfed conditions at Nagpur, Akola and Nanded. All the hybrids evaluated recorded higher yield over NHH 44, the non-Bt check hybrid. The yield increases were of the order of 7 to 50 per cent.

RCH 2 Bt was the best Bt check hybrid with a mean seed cotton yield of 2954 Kg/ha. None of the test hybrids recorded higher yield over it. (Table 10).

Table 10. Seed cotton yield (Kg/ha)

Hybrid	Irrigated			Rainfed			
	Khandwa	Surat	Mean	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	1251	2000	1626	2921	2906	1912	2580
KDCHH 621 BG II	883	1506	1195	2405	2926	973	2101
RCH 386 Bt	823	2252	1538	2711	3434	2513	2886
RCH 515 BG II	1156	1645	1401	3180	2828	2256	2755
NCS 913 Bt	1200	2077	1639	2522	2778	1693	2331
MRC 7351 BG II	1119	1877	1498	2830	2837	1861	2509
MRC 7341 BG II	1051	1627	1339	2780	2904	1983	2556
JKCH 99 Bt	934	2560	1747	2867	3221	2257	2782
VICH 5 Bt	953	2003	1478	2975	2849	2336	2720
VICH 9 Bt	961	2006	1484	3215	2803	2704	2907
ACH 155-2 BG II	1037	2121	1579	2980	2939	2267	2729
NHH 44 (C.Hy)	936	726	831	2805	1601	1491	1966
RCH 2 Bt (Bt.C.hy)	1049	2759	1904	2887	3234	2740	2954
RCH 138 Bt (Bt.C.hy)	1062	2176	1619	3215	2701	2371	2762
CD at 5%	258	300		412	444	627	
CV %	19.44	9.12		9.55	9.27	18.1	

C). FIBRE QUALITY EVALUATION

The fibre quality evaluations were done location wise.

As regards fibre length (Table 11), all the test hybrids were found to be better than NHH 44 (check). RCH 386 Bt and MRC 7341 BG II had high fibre length of 32.0 mm and above and were superior to the Bt check hybrids RCH 2 Bt (30.0 mm) and RCH 138 Bt (28.2 mm).

Table 11. Fibre quality - 2.5 % Span length (mm)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	27.6	30.3	29.5	27.1	28.6
KDCHH 621 BG II	29.5	29.5	28.8	28.0	28.9
RCH 386 Bt	31.4	33.7	32.6	31.2	32.2
RCH 515 BG II	27.2	28.9	29	27.9	28.3
NCS 913 Bt	29.5	29.1	30.3	28.4	29.3
MRC 7351 BG II	27.8	30.1	30.4	28.6	29.2
MRC 7341 BG II	30.8	33.8	33.2	30.0	32.0
JKCH 99 Bt	25.3	28.2	27.7	25.6	26.7
VICH 5 Bt	26.9	30.2	30.9	29.3	29.3
VICH 9 Bt	28.5	30.0	29.9	28.4	29.2
ACH 155-2 BG II	28.3	28.6	27.6	27.1	27.9
NHH 44 (C.Hy)	27.4	25.3	24.4	26.4	25.9
RCH 2 Bt (Bt.C.hy)	27.8	31.7	31.2	29.4	30.0
RCH 138 Bt (Bt.C.hy)	27.0	29.4	29.3	27.2	28.2

There was not much variation among the entries for uniformity ratio (%) and ranged from 48 to 52 per cent. The Micronaire range was from 3.5 to 4.6 (Table 12 and 13).

Table 12. Uniformity ratio (%)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	49	54	48	51	51
KDCHH 621 BG II	46	48	46	51	48
RCH 386 Bt	48	52	46	49	49
RCH 515 BG II	48	53	48	50	50
NCS 913 Bt	48	51	48	50	49
MRC 7351 BG II	48	51	46	49	49
MRC 7341 BG II	49	53	47	50	50
JKCH 99 Bt	49	56	50	54	52
VICH 5 Bt	46	52	48	50	49
VICH 9 Bt	47	51	46	51	49
ACH 155-2 BG II	46	50	50	53	50
NHH 44 (C.Hy)	47	53	51	50	50
RCH 2 Bt (Bt.C.hy)	47	53	48	51	50
RCH 138 Bt (Bt.C.hy)	47	54	50	50	50

Table 13. Micronaire ($\mu\text{g}/\text{inch}$)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	3.5	4.1	4.5	4.8	4.2
KDCHH 621 BG II	4.3	3.7	4.3	5.4	4.4
RCH 386 Bt	3.7	3.7	3.7	4.5	3.9
RCH 515 BG II	4.6	4.1	4.4	5.2	4.6
NCS 913 Bt	4.4	4.4	4.5	5.1	4.6
MRC 7351 BG II	3.9	3.6	4.3	5.0	4.2
MRC 7341 BG II	3.5	3.4	4.7	5.0	4.2
JKCH 99 Bt	3.7	5.0	4.7	5.7	4.8
VICH 5 Bt	3.9	3.7	4.6	4.9	4.3
VICH 9 Bt	3.8	3.9	4.4	5.0	4.3
ACH 155-2 BG II	4.1	4.0	4.5	5.0	4.4
NHH 44 (C.Hy)	3.9	3.4	3.9	4.7	4.0
RCH 2 Bt (Bt.C.hy)	3.5	3.4	4.4	5.0	4.1
RCH 138 Bt (Bt.C.hy)	3.3	3.1	3.6	4.1	3.5

The fibre strength (Table 14) ranged from 20.1 to 23.2 g/tex. NHH 44 (non-Bt check) recorded the lowest fibre strength, whereas MRC 7341 BG II the highest fibre strength.

Table 14. Fibre strength (g/tex)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	26.1	21.0	20.7	20.7	22.1
KDCHH 621 BG II	23.0	19.8	20.1	20.2	20.8
RCH 386 Bt	24.4	21.1	22.8	22.1	22.6
RCH 515 BG II	22.2	20.5	21.3	21.3	21.3
NCS 913 Bt	23.6	19.4	21.7	20.6	21.3
MRC 7351 BG II	24.9	20.2	21.6	21.8	22.1
MRC 7341 BG II	25.9	23.0	22.1	21.9	23.2
JKCH 99 Bt	22.2	19.0	20.1	20.2	20.4
VICH 5 Bt	21.6	22.0	20.2	21.3	21.3
VICH 9 Bt	22.9	19.5	19.6	20.9	20.7
ACH 155-2 BG II	21.6	20.9	19.4	20.6	20.6
NHH 44 (C.Hy)	21.8	19.5	18.4	20.6	20.1
RCH 2 Bt (Bt.C.hy)	21.9	20.2	20.9	20.9	21.0
RCH 138 Bt (Bt.C.hy)	22.3	23.0	22.2	21.0	22.1

MRC 7341 BG II with a 2.5% span length of 32.0 mm and fibre strength of 23.2 g/tex was the best quality hybrid followed by RCH 386 Bt (Table 15).

Table 15. Overall fibre properties of all the entries

Hybrid	2.5% Span length (mm)	Uniformity Ratio (%)	Micronaire ($\mu\text{g}/\text{inch}$)	Fibre Strength (g/tex)
KDCHH 9810 Bt	28.6	51	4.2	22.1
KDCHH 621 BG II	28.9	48	4.4	20.8
RCH 386 Bt	32.2	49	3.9	22.6
RCH 515 BG II	28.3	50	4.6	21.3
NCS 913 Bt	29.3	49	4.6	21.3
MRC 7351 BG II	29.2	49	4.2	22.1
MRC 7341 BG II	32.0	50	4.2	23.2
JKCH 99 Bt	26.7	52	4.8	20.4
VICH 5 Bt	29.3	49	4.3	21.3
VICH 9 Bt	29.2	49	4.3	20.7
ACH 155-2 BG II	27.9	50	4.4	20.6
NHH 44 (C.Hy)	25.9	50	4.0	20.1
RCH 2 Bt (Bt.C.hy)	30.0	50	4.1	21.0
RCH 138 Bt (Bt.C.hy)	28.2	50	3.5	22.1

D). ENTOMOLOGICAL EVALUATION

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

1. EVALUATION UNDER PLANT PROTECTION (ETL BASED)

Sucking pests

i). Jassids

Jassid was the predominant sap sucking pest seen throughout the main season at all locations. The incidence was very high at Khandwa even up to 90 days. However, at Nagpur, considerable incidence was noticed up to 40 DAS and the population was less there after. At Nanded, the incidence was at a low level and crossed the ETL only on 60 DAS. At Surat, jassids were seen throughout the season and crossed the ETL on different entries at different periods necessitating chemical intervention (Table 16).

Table 16. Jassids population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	5.6	3.6	2.7	1.7	2.3	3.2
KDCHH 621 BG II	5.1	3.7	2.4	1.4	2.4	3.0
RCH 386 Bt	5.7	2.6	2.4	1.7	1.8	2.9
RCH 515 BG II	7.7	2.8	2.8	1.6	1.9	3.4
NCS 913 Bt	7.6	2.6	3.0	1.5	2.1	3.4
MRC 7351 BG II	7.9	2.4	2.5	1.6	1.5	3.2
MRC 7341 BG II	7.9	2.8	3.2	1.7	1.9	3.5
JKCH 99 Bt	7.3	2.8	3.2	1.5	1.8	3.3
VICH 5 Bt	7.5	2.6	2.3	2.0	2.5	3.4
VICH 9 Bt	5.3	2.1	2.2	1.5	2.0	2.6
ACH 155-2 BG II	5.8	2.0	2.3	1.5	1.0	2.5
NHH 44 (C.Hy)	5.6	2.8	1.8	2.0	1.3	2.7
RCH 2 Bt (Bt.C.hy)	7.4	3.2	3.0	1.8	2.0	3.5
RCH 138 Bt (Bt.C.hy)	5.6	2.8	2.2	1.7	1.8	2.8

ii). Aphids

Aphid incidence was noticed on all the entries at Surat and crossed the ETL at 42 DAS. On certain entries it crossed the ETL twice. At Akola, eventhough the mean population was low, at 20 DAS the aphid population was very high ranging from 15 to 40 aphids /plant in various entries. At other centres the incidence was either low or absent (Table 17).

Table 17. Aphids population/plant

Hybrid	Surat	Akola	Nanded	Mean
KDCHH 9810 Bt	14.0	4.5	0.9	6.5
KDCHH 621 BG II	10.9	3.9	0.8	5.2
RCH 386 Bt	15.0	5.0	0.9	6.9
RCH 515 BG II	14.5	3.7	0.5	6.2
NCS 913 Bt	13.3	3.4	1.2	5.9
MRC 7351 BG II	13.0	5.1	0.9	6.3
MRC 7341 BG II	20.2	3.2	0.3	7.9
JKCH 99 Bt	10.5	3.2	1.1	5.0
VICH 5 Bt	13.6	2.9	0.8	5.8
VICH 9 Bt	9.4	3.0	0.9	4.4
ACH 155-2 BG II	15.0	4.3	1.0	6.7
NHH 44 (C.Hy)	13.4	4.9	1.3	6.6
RCH 2 Bt (Bt.C.hy)	9.5	3.3	0.7	4.5
RCH 138 Bt (Bt.C.hy)	16.8	4.3	0.7	7.2

iii). Thrips

Thrips incidence was high at Surat and Nanded and was moderate at other centres (Table 18). At Surat, the incidence was high at 45 DAS and 69 DAS and warranted chemical intervention. At Nanded, the peak thrips incidence was noticed at 40 DAS ranging from 31.07 to 76.20 thrips /plant. At Akola, the thrips population was high between 41 to 55 DAS.

Table 18. Thrips population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	0.3	21.9	5.8	8.7	2.9	7.9
KDCHH 621 BG II	0.4	19.8	7.3	11.3	2.1	8.2
RCH 386 Bt	0.3	22.3	7.4	15.5	3.6	9.8
RCH 515 BG II	0.3	27.4	6.1	14.7	3.0	10.3
NCS 913 Bt	0.2	20.6	7.0	15.2	2.3	9.1
MRC 7351 BG II	0.2	23.0	6.7	13.2	4.0	9.4
MRC 7341 BG II	0.2	36.9	6.9	9.9	2.7	11.3
JKCH 99 Bt	0.3	12.6	6.5	12.8	2.3	6.9
VICH 5 Bt	0.3	23.6	7.4	15.0	2.7	9.8
VICH 9 Bt	0.2	20.6	7.8	17.2	2.8	9.7
ACH 155-2 BG II	0.2	34.1	7.3	15.0	2.9	11.9
NHH 44 (C.Hy)	0.2	27.9	7.3	19.9	3.7	11.8
RCH 2 Bt (Bt.C.hy)	0.3	15.7	5.5	15.2	2.5	7.8
RCH 138 Bt (Bt.C.hy)	0.2	29.6	7.3	15.0	3.3	11.1

iv). Whitefly

Eventhough initial build up of whitefly was noticed, the population levels were very low and the differences were non-significant between the entries at different locations (Table 19).

Table 19. Whitefly population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	0.4	1.8	2.3	5.2	2.6	2.5
KDCHH 621 BG II	0.3	2.4	2.6	5.0	1.9	2.5
RCH 386 Bt	0.5	1.4	2.2	5.1	2.6	2.4
RCH 515 BG II	0.9	2.0	2.3	4.6	1.7	2.3
NCS 913 Bt	1.0	1.2	2.2	5.7	1.4	2.3
MRC 7351 BG II	1.1	1.1	2.3	5.7	2.4	2.5
MRC 7341 BG II	1.1	1.9	2.0	5.5	1.1	2.3
JKCH 99 Bt	1.1	1.8	2.3	6.9	1.7	2.8

VICH 5 Bt	1.0	1.4	2.4	5.5	2.3	2.5
VICH 9 Bt	0.5	1.2	2.5	5.0	1.7	2.2
ACH 155-2 BG II	0.4	1.5	2.5	6.7	1.5	2.5
NHH 44 (C.Hy)	0.5	1.2	2.5	4.3	1.5	2.0
RCH 2 Bt (Bt.C.hy)	1.1	0.7	2.0	5.3	1.4	2.1
RCH 138 Bt (Bt.C.hy)	0.6	1.1	2.1	6.3	2.0	2.4

Natural enemies

In general the natural enemies population was low in most of the test centres. The coccinellid grubs and adults, spiders and chrysopids were meager and sporadic in appearance at different locations. However, there was no discernable difference between the non-Bt check hybrid and the other Bt entries in harboring the natural enemies (Table 20).

Table 20. Natural enemies population/plant

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	0.3	1.0	0.1	5.8	1.8
KDCHH 621 BG II	0.3	1.0	0.1	5.6	1.7
RCH 386 Bt	0.3	1.0	0.1	8.1	2.3
RCH 515 BG II	0.2	1.0	0.2	1.4	0.7
NCS 913 Bt	0.3	1.1	0.3	2.8	1.1
MRC 7351 BG II	0.2	0.9	0.1	5.3	1.6
MRC 7341 BG II	0.2	1.0	0.2	4.4	1.5
JKCH 99 Bt	0.2	1.0	0.2	1.7	0.8
VICH 5 Bt	0.3	0.9	0.2	3.9	1.3
VICH 9 Bt	0.2	0.9	0.2	2.8	1.0
ACH 155-2 BG II	0.2	1.0	0.2	1.4	0.7
NHH 44 (C.Hy)	0.4	0.8	0.3	2.8	1.1
RCH 2 Bt (Bt.C.hy)	0.3	0.8	0.2	1.7	0.7
RCH 138 Bt (Bt.C.hy)	0.2	0.8	0.2	3.6	1.2

Bollworms

Larval population

The larval populations of *Earias* spp. (Table 21), *Helicoverpa armigera* (Table 22) and *Pectinophora gossypiella* (Table 23) were very low. *Earias* larval population ranged from 0 to 0.1 in Bt hybrids whereas it was 0.4 in NHH 44, the non-Bt check hybrid. The mean *Helicoverpa armigera* population ranged from 0.01 to 0.18 per plant in

Bt hybrids and 0.55 in NHH 44. At Surat, all the entries recorded larval population of *Earias* and *Helicoverpa armigera* below ETL except NHH 44 and ACH 155-2 BG II.

Table 21. *Earias* sp. population/plant

Hybrid	Surat	Akola	Nagpur	Mean
KDCHH 9810 Bt	0.0	0.0	0.0	0.0
KDCHH 621 BG II	0.0	0.0	0.0	0.0
RCH 386 Bt	0.0	0.0	0.0	0.0
RCH 515 BG II	0.0	0.0	0.3	0.1
NCS 913 Bt	0.0	0.0	0.0	0.0
MRC 7351 BG II	0.0	0.0	0.0	0.0
MRC 7341 BG II	0.0	0.0	0.0	0.0
JKCH 99 Bt	0.0	0.0	0.0	0.0
VICH 5 Bt	0.1	0.0	0.1	0.0
VICH 9 Bt	0.0	0.0	0.0	0.0
ACH 155-2 BG II	0.3	0.0	0.1	0.1
NHH 44 (C.Hy)	0.6	0.1	0.5	0.4
RCH 2 Bt (Bt.C.hy)	0.0	0.0	0.0	0.0
RCH 138 Bt (Bt.C.hy)	0.1	0.0	0.0	0.0

Table 22. *Helicoverpa armigera* population/plant

Hybrid	Surat	Akola	Nagpur	Mean
KDCHH 9810 Bt	0.0	0.1	0.1	0.05
KDCHH 621 BG II	0.0	0.1	0.1	0.04
RCH 386 Bt	0.0	0.0	0.1	0.03
RCH 515 BG II	0.0	0.0	0.0	0.01
NCS 913 Bt	0.1	0.1	0.2	0.09
MRC 7351 BG II	0.0	0.0	0.0	0.01
MRC 7341 BG II	0.0	0.0	0.0	0.01
JKCH 99 Bt	0.0	0.0	0.0	0.01
VICH 5 Bt	0.3	0.1	0.1	0.18
VICH 9 Bt	0.0	0.2	0.0	0.05
ACH 155-2 BG II	0.4	0.2	0.2	0.26
NHH 44 (C.Hy)	1.2	0.3	0.1	0.55
RCH 2 Bt (Bt.C.hy)	0.2	0.1	0.1	0.12
RCH 138 Bt (Bt.C.hy)	0.0	0.1	0.0	0.03

Table 23. *Pectinophora gossypiella* population/ 20 Green Bolls

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	0.0	0.1	0.5	0.0	0.2
KDCHH 621 BG II	0.0	0.0	0.3	0.0	0.1
RCH 386 Bt	0.0	0.0	0.0	0.0	0.0
RCH 515 BG II	0.2	0.0	0.7	0.0	0.2
NCS 913 Bt	0.0	0.0	0.7	0.0	0.2
MRC 7351 BG II	0.1	0.0	0.3	0.0	0.1
MRC 7341 BG II	0.0	0.0	0.7	0.0	0.2
JKCH 99 Bt	0.0	0.0	0.7	0.0	0.2
VICH 5 Bt	0.0	0.0	0.7	0.0	0.2
VICH 9 Bt	0.0	0.0	0.5	0.0	0.1
ACH 155-2 BG II	0.0	0.0	0.5	0.0	0.1
NHH 44 (C.Hy)	4.1	1.3	1.2	0.0	1.7
RCH 2 Bt (Bt.C.hy)	0.0	0.0	0.7	0.0	0.2
RCH 138 Bt (Bt.C.hy)	0.0	0.0	0.3	0.0	0.1

Pink bollworm larval population was noticed on NHH 44 (non-Bt check) at all locations except Nagpur and ranged from 1.2 to 4.1 larvae /20 Green Bolls. On the other hand, the larval population ranged from 0 to 0.7 larvae /plant on the Bt hybrids. At Surat, the larval population was noticed on NHH 44 at 135 DAS and at Akola and Nanded on 120 DAS. At Nagpur, the pink bollworm did not appear.

Square damage

Mean square damage (%) due to bollworms was fairly high (14.2 %) on NHH 44, the non-Bt check hybrid. On the other hand, the incidence of square damage on Bt hybrids ranged from 1.4 to 5.2 per cent. MRC 7341 BG II had the lowest square damage of 1.4 per cent (Table 24).

Table 24. Square damage (%)

Hybrid	Surat	Nanded	Nagpur	Mean
KDCHH 9810 Bt	0.4	5.0	3.7	3.0
KDCHH 621 BG II	0.2	2.9	4.3	2.4
RCH 386 Bt	0.7	4.6	3.1	2.8
RCH 515 BG II	0.3	4.7	3.6	2.9
NCS 913 Bt	1.1	4.2	2.4	2.6
MRC 7351 BG II	0.0	3.6	3.4	2.3
MRC 7341 BG II	0.2	1.8	2.2	1.4

JKCH 99 Bt	0.2	2.4	3.5	2.1
VICH 5 Bt	3.5	3.1	4.8	3.8
VICH 9 Bt	0.5	5.0	3.6	3.0
ACH 155-2 BG II	6.8	5.4	3.5	5.2
NHH 44 (C.Hy)	9.6	7.6	25.3	14.2
RCH 2 Bt (Bt.C.hy)	0.5	3.9	4.0	2.8
RCH 138 Bt (Bt.C.hy)	0.6	3.8	3.1	2.5

Square damage at selected centres

At Nagpur, the square damage was observed on all the entries from 95 DAS. The highest damage was noticed on NHH 44 (non-Bt check). As many as six entries had greater than 10 per cent damage at least once. The other entries had at all time less than 10 per cent square damage (Table 25)

Table 25: Square damage (%) at Nagpur

Hybrid	95 DAS	102 DAS	110 DAS	116 DAS	Mean
KDCHH 9810 Bt	8.21	9.29 (16.11)	6.85 (11.54)	1.39 (6.17)	3.68
KDCHH 621 BG II	6.00	14.16 (21.33)	6.44 (11.31)	0.00 (4.05)	4.28
RCH 386 Bt	4.79	8.66 (16.50)	3.63 (10.23)	1.99 (7.39)	3.10
RCH 515 BG II	3.45	6.99 (14.97)	8.75 (15.19)	0.60 (5.19)	3.65
NCS 913 Bt	5.93	6.87 (13.35)	2.08 (7.46)	0.00 (4.05)	2.36
MRC 7351 BG II	3.93	10.51 (17.65)	8.38 (15.73)	0.00 (4.05)	3.42
MRC 7341 BG II	4.22	8.47 (16.63)	2.55 (8.54)	0.00 (4.05)	2.18
JKCH 99 Bt	4.09	6.71 (13.99)	5.42 (11.99)	0.00 (4.05)	3.54
VICH 5 Bt	11.49	9.70 (16.72)	9.88 (16.92)	0.83 (5.53)	4.82
VICH 9 Bt	2.01	10.93 (18.72)	9.01 (15.57)	0.00 (4.05)	3.61
ACH 155-2 BG II	3.92	10.36 (18.51)	4.87 (11.48)	2.38 (7.08)	3.49
NHH 44 (C.Hy)	6.36	43.73 (43.06)	89.26 (75.90)	33.02 (33.20)	25.35
RCH2Bt (Bt.C.hy)	4.47	8.25 (15.77)	12.61 (17.93)	1.04 (5.79)	4.03
RCH 138Bt (Bt.C.hy)	2.99	11.34 (19.19)	3.07 (9.12)	2.71 (8.19)	3.14
F Test	NS	***	***	***	-
CD (P = 0.05)	-	10.23	10.92	6.86	-
CV %	67.39	47.32	55.48	81.01	-

At Nanded, NHH 44 (non-Bt check) and VICH 9 Bt crossed the ETL at 60 DAS while eight other entries crossed the ETL level on 70 DAS (Table 26).

Table 26. Square damage (%) by bollworms Nanded

Entry	No. of observation			Mean
	50 DAS	60 DAS	70 DAS	
KDCHH 9810 Bt	2.80 (9.34)	1.42 (5.56)	10.88 (19.22)	5.03 (11.37)
KDCHH 621 BG II	2.85 (9.70)	1.50 (5.57)	4.23 (11.86)	2.86 (9.04)
RCH 386 Bt	2.51 (8.98)	0.95 (4.58)	10.24 (18.64)	4.57 (10.73)
RCH 515 BG II	3.15 (10.17)	1.24 (6.30)	9.59 (17.88)	4.66 (11.45)
NCS 913 Bt	2.86 (9.61)	1.33 (6.43)	8.42 (16.63)	4.20 (10.89)
MRC 7351 BG II	4.95 (12.24)	1.52 (6.86)	4.20 (11.79)	3.56 (10.30)
MRC 7341 BG II	1.88 (6.39)	1.48 (5.69)	2.08 (6.77)	1.81 (6.28)
JKCH 99 Bt	1.11 (3.50)	2.13 (8.36)	4.09 (11.58)	2.44 (7.81)
VICH 5 Bt	3.77 (11.12)	1.48 (5.39)	4.03 (11.54)	3.09 (9.35)
VICH 9 Bt	4.46 (12.17)	6.30 (14.15)	4.27 (11.90)	5.01 (12.74)
ACH 155-2 BG II	3.67 (10.98)	1.10 (4.62)	11.54 (19.75)	5.4 (11.78)
NHH 44 (C.Hy)	4.50 (12.30)	8.34 (16.40)	10.00 (18.28)	7.61 (15.66)
RCH 2 Bt (Bt.C.hy)	2.60 (9.15)	0.79 (3.99)	8.21 (16.41)	3.8 (9.85)
RCH 138 Bt (Bt.C.hy)	2.13 (8.20)	1.70 (6.11)	7.55 (15.83)	3.79 (10.05)
F Test	1.58	2.10	1.61	-
CD (P=0.05)	4.58	6.11	4.69	-
CV%	28.62	50.84	18.82	-

Green boll damage

Green boll damage was appreciable in Khandwa and ranged from 2.2 to 8.8 per cent (Table 27).

Table 27. Green boll damage (%)

Hybrid	Khandwa	Surat	Akola	Mean
KDCHH 9810 Bt	2.6	0.0	2.1	1.6
KDCHH 621 BG II	8.8	0.0	2.2	3.7
RCH 386 Bt	7.8	0.0	0.8	2.9
RCH 515 BG II	2.4	0.2	1.5	1.4
NCS 913 Bt	8.1	0.1	1.2	3.1
MRC 7351 BG II	2.6	0.0	0.5	1.0
MRC 7341 BG II	2.9	0.0	0.3	1.0
JKCH 99 Bt	7.8	0.2	1.0	3.0
VICH 5 Bt	3.2	0.8	2.3	2.1
VICH 9 Bt	2.7	0.8	2.4	1.9
ACH 155-2 BG II	2.2	4.9	3.5	3.5
NHH 44 (C.Hy)	8.0	6.5	8.7	7.8
RCH 2 Bt (Bt.C.hy)	2.3	0.1	0.5	1.0
RCH 138 Bt (Bt.C.hy)	2.6	0.1	1.5	1.4

Pink bollworm damage (%) was observed in green bolls by destructive sampling. The non-Bt check hybrid recorded the highest damage of 18.2 per cent. In Bt hybrids the damage varied from 2.7 to 7.2 per cent (Table 28).

Table 28. Pink bollworm damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	6.8	10.0	0.6	5.0	0.0	4.5
KDCHH 621 BG II	8.0	14.2	0.0	4.2	0.0	5.3
RCH 386 Bt	8.4	5.8	0.0	4.1	0.0	3.7
RCH 515 BG II	7.1	18.3	0.0	5.4	0.0	6.2
NCS 913 Bt	8.7	0.0	0.0	4.9	0.0	2.7
MRC 7351 BG II	6.0	10.0	0.0	2.9	0.0	3.8
MRC 7341 BG II	6.3	24.2	0.6	4.9	0.0	7.2
JKCH 99 Bt	9.1	5.8	0.0	5.1	0.0	4.0
VICH 5 Bt	6.2	4.2	1.1	4.3	0.0	3.1
VICH 9 Bt	6.6	4.2	1.1	6.6	0.0	3.7
ACH 155-2 BG II	7.1	11.7	0.0	5.2	0.0	4.8
NHH 44 (C.Hy)	9.0	65.0	7.8	9.2	0.0	18.2
RCH 2 Bt (Bt.C.hy)	5.7	10.0	0.0	4.0	0.0	3.9
RCH 138 Bt (Bt.C.hy)	6.2	5.0	0.0	5.0	0.0	3.2

Open boll and locule damage

Open boll damage was the highest in NHH 44 (15.1 %). In Bt hybrids, the mean boll damage ranged from 6.1 to 9.7 per cent. However, the open boll damage was the highest at Nanded on Bt hybrids. The open boll damage in Bt check hybrids and other Bt entries was on par with each other. (Table 29)

Table 29. Open boll damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	9.3	3.4	3.3	25.7	2.4	8.8
KDCHH 621 BG II	12.8	3.3	3.3	24.5	3.0	9.4
RCH 386 Bt	12.8	1.9	3.3	25.8	4.4	9.7
RCH 515 BG II	8.4	1.4	3.3	20.3	2.2	7.1
NCS 913 Bt	11.7	3.1	1.1	18.8	4.1	7.8
MRC 7351 BG II	7.1	3.7	2.2	18.9	3.6	7.1
MRC 7341 BG II	6.6	2.6	5.6	22.3	2.1	7.8
JKCH 99 Bt	12.2	2.4	1.1	16.1	1.3	6.6
VICH 5 Bt	7.1	5.0	2.2	18.2	3.6	7.2
VICH 9 Bt	7.0	5.3	3.3	18.5	2.1	7.2

ACH 155-2 BG II	6.9	9.2	4.4	18.1	7.5	9.2
NHH 44 (C.Hy)	10.9	16.2	17.8	26.2	4.7	15.1
RCH 2 Bt (Bt.C.hy)	7.4	1.6	4.4	19.8	0.7	6.8
RCH 138 Bt (Bt.C.hy)	7.2	5.0	0.0	17.5	1.0	6.1

The same trend was noticed in locule damage also. NHH 44 had the maximum locule damage of 9.8 per cent. The least damage (4.2 to 4.7 %) was noticed in Bt check hybrids. The locule damage in test entries varied from 4.8 to 6.8 per cent (Table 30).

Table 30. Locule damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	6.1	2.3	1.4	17.5	0.9	5.7
KDCHH 621 BG II	9.6	1.6	1.2	14.5	2.9	5.9
RCH 386 Bt	9.7	0.9	1.5	18.9	3.4	6.8
RCH 515 BG II	5.2	0.7	1.1	16.2	1.6	5.0
NCS 913 Bt	8.5	2.5	0.5	15.2	2.1	5.8
MRC 7351 BG II	3.9	3.7	0.9	14.4	1.9	5.0
MRC 7341 BG II	3.4	1.8	2.1	18.2	1.3	5.3
JKCH 99 Bt	9.0	1.4	0.3	12.8	0.7	4.8
VICH 5 Bt	3.9	3.0	0.9	14.3	2.8	5.0
VICH 9 Bt	3.8	3.4	1.4	15.0	0.9	4.9
ACH 155-2 BG II	3.7	7.2	1.7	14.0	5.0	6.3
NHH 44 (C.Hy)	7.7	13.2	4.5	20.5	2.9	9.8
RCH 2 Bt (Bt.C.hy)	4.2	0.5	1.9	16.5	0.3	4.7
RCH 138 Bt (Bt.C.hy)	4.0	1.3	0.0	15.1	0.5	4.2

Plant protection measures

Jassids, aphids and thrips were the most predominant sucking pests noticed. All entries tested including the check hybrids were found to be susceptible to these pests at varying degrees and at different stages of crop growth at all locations, warranting chemical intervention. Maximum intervention was required at Surat and Khandwa (Table 31).

Table 31. Spray schedule for sucking pests

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	2	3	2	2	2	2.2
KDCHH 621 BG II	2	4	2	2	2	2.4
RCH 386 Bt	2	3	2	2	2	2.2
RCH 515 BG II	3	3	2	2	2	2.4
NCS 913 Bt	3	3	2	2	2	2.4
MRC 7351 BG II	3	4	2	2	2	2.6
MRC 7341 BG II	3	4	2	2	2	2.6
JKCH 99 Bt	3	3	2	2	2	2.4
VICH 5 Bt	3	3	3	2	2	2.6
VICH 9 Bt	2	3	1	2	2	2.0
ACH 155-2 BG II	2	4	2	2	2	2.4
NHH 44 (C.Hy)	2	3	1	2	2	2.0
RCH 2 Bt (Bt.C.hy)	3	4	1	2	2	2.4
RCH 138 Bt (Bt.C.hy)	2	3	3	2	2	2.4

Bollworm damage was moderate during the year. NHH 44, the non-Bt check required one (at Nagpur) to six (at Surat) rounds of insecticidal application to control bollworms. ACH 155-2 BG II required five sprays at Surat, three sprays on VICH 5 Bt at Surat and 2 sprays at Akola, VICH 9 Bt required two sprays at Akola to control bollworms. All other entries required 0 to one spray (Table 32).

Table 32. Spray schedule for bollworms

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
KDCHH 9810 Bt	1	0	1	1	0	0.6
KDCHH 621 BG II	0	0	0	0	0	0.0
RCH 386 Bt	1	0	0	1	0	0.4
RCH 515 BG II	1	0	0	1	1	0.6
NCS 913 Bt	1	0	1	1	0	0.6
MRC 7351 BG II	0	0	0	0	0	0.0
MRC 7341 BG II	0	0	0	0	0	0.0
JKCH 99 Bt	0	0	0	0	0	0.0
VICH 5 Bt	0	3	2	0	1	1.2
VICH 9 Bt	1	0	2	1	1	1.0
ACH 155-2 BG II	1	5	1	1	1	1.8
NHH 44 (C.Hy)	2	6	4	2	1	3.0
RCH 2 Bt (Bt.C.hy)	1	0	1	1	0	0.6
RCH 138 Bt (Bt.C.hy)	1	0	1	1	0	0.6

2. EVALUATION UNDER UNPROTECTED CONDITIONS

All the fourteen entries in the trial were also evaluated under unsprayed conditions for bollworms. However, they were protected against sucking pests based on their ETL values. At Nagpur, the trial results were vitiated due to heavy rains and water logging and hence, as per monitoring team's suggestion the trial results were not taken for compilation.

Germination

The germination in all the entries across locations was satisfactory. The mean germination ranged from 87 to 96 per cent (Table 33). Consequently the final stand was also adequate.

Table 33. Germination percentage

Hybrid	Khandwa	Surat	Akola	Nanded	Mean
KDCHH 9810 Bt	78	79	98	100	89
KDCHH 621 BG II	70	82	100	99	88
RCH 386 Bt	78	96	100	100	94
RCH 515 BG II	81	70	98	98	87
NCS 913 Bt	93	92	98	99	96
MRC 7351 BG II	83	82	98	98	90
MRC 7341 BG II	84	74	99	100	89
JKCH 99 Bt	72	79	98	98	87
VICH 5 Bt	89	86	98	99	93
VICH 9 Bt	78	75	100	100	88
ACH 155-2 BG II	75	84	99	100	90
NHH 44 (C.Hy)	81	87	98	98	91
RCH 2 Bt (Bt.C.hy)	74	77	99	99	87
RCH 138 Bt (Bt.C.hy)	79	89	100	97	91

The open boll damage and locule damage were assessed at harvest. Maximum open boll damage of 20.4 per cent was recorded in the non-Bt check hybrid NHH 44. The check Bt hybrids recorded a mean boll damage of 12.0 per cent. Hybrids RCH 515 BG II, NCS 913 Bt, MRC 7351 BG II, JKCH 99 Bt, VICH 5 Bt, VICH 9 Bt and ACH 155-2 BG II were on par with the Bt check hybrids in open boll damage. KDCHH 9810 Bt and RCH 386 Bt recorded 15.9 and 15.0 per cent open boll damage, respectively (Table 34).

Table 34. Open boll damage (%)

Hybrid	Khandwa		Surat		Nanded		Mean
	% damage	TV	% damage	TV	% damage	TV	
KDCHH 9810 Bt	10.08	18.51	7.87	15.47	29.8	33.0	15.9
KDCHH 621 BG II	13.54	21.58	3.55	9.66	25.5	30.3	14.2
RCH 386 Bt	13.62	21.61	2.93	9.65	28.6	32.2	15.0
RCH 515 BG II	9.16	17.61	3.71	11.05	23.3	28.8	12.0
NCS 913 Bt	12.48	20.69	4.28	11.57	21.3	27.5	12.7
MRC 7351 BG II	7.91	16.33	5.74	13.43	23.8	29.2	12.5
MRC 7341 BG II	7.37	15.75	7.32	14.49	27.2	31.4	14.0
JKCH 99 Bt	13.02	21.15	2.04	6.84	21.6	27.6	12.2
VICH 5 Bt	7.86	16.28	6.18	13.87	24.4	29.4	12.8
VICH 9 Bt	7.79	16.21	5.25	13.19	24.4	29.6	12.5
ACH 155-2 BG II	7.64	16.05	6.31	14.34	24.3	29.4	12.7
NHH 44 (C.Hy)	11.67	19.98	14.68	21.33	34.7	36.1	20.4
RCH 2 Bt (Bt.C.hy)	8.21	16.65	1.95	7.25	25.9	30.5	12.0
RCH 138 Bt (Bt.Chy)	7.98	16.4	4.30	11.94	23.7	29.0	12.0
CD at 5%		1.043		NS		NS	
CV %				24.28		10.9	

TV=Transformed values

Maximum locule damage of 13.7 per cent was also recorded in NHH 44. The lowest locule damage of 6.8 and 7.6 per cent was recorded in the Bt check hybrids RCH 2 Bt and RCH 138 Bt, respectively. RCH 386 Bt recorded the highest locule damage of 11.4 per cent. Other Bt hybrid entries recorded a mean locule damage ranging from 6.8 to 10.8 per cent. At Khandwa, KDCHH 621 BG II, RCH 386 Bt and JKCH 99 Bt recorded significantly high boll damage over the check hybrids. At Surat and Nanded, the differences were not significant (Table 35).

Table 35. Locule damage (%)

Hybrid	Khandwa		Surat		Nanded		Mean
	damage %	TV	damage %	TV	damage %	TV	
KDCHH 9810 Bt	6.98	15.32	4.92	12.07	20.5	26.9	10.8
KDCHH 621 BG II	10.44	18.85	1.96	7.09	17.5	24.7	10.0
RCH 386 Bt	10.53	18.84	2.06	8.10	21.5	27.3	11.4
RCH 515 BG II	6.06	14.25	1.98	7.93	18.0	25.1	8.7
NCS 913 Bt	9.39	17.84	2.40	8.46	17.8	24.9	9.9
MRC 7351 BG II	4.82	12.67	2.98	9.39	18.3	25.3	8.7

MRC 7341 BG II	4.28	11.92	4.18	10.58	17.0	24.3	8.5
JKCH 99 Bt	9.92	18.35	0.95	4.62	14.0	21.9	8.3
VICH 5 Bt	4.77	12.59	2.64	9.22	17.3	24.5	8.2
VICH 9 Bt	4.7	12.5	3.08	10.04	16.3	23.8	8.0
ACH 155-2 BG II	4.55	12.31	3.33	10.43	17.8	25.0	8.6
NHH 44 (C.Hy)	8.58	17.03	10.67	17.86	21.7	27.6	13.7
RCH 2 Bt (Bt.C.hy)	5.11	13.07	1.23	5.69	14.2	22.0	6.8
RCH 138 Bt (Bt.Chy)	4.89	12.76	2.39	8.77	15.4	23.1	7.6
CD at 5%		1.20		NS		NS	
CV %				24.28		8.7	

TV=Transformed values

E). SEED COTTON YIELD UNDER UNPROTECTED CONDITIONS

i) Irrigated

The crop was raised under irrigated condition at Khandwa and Surat. All the hybrids evaluated recorded higher seed cotton yield over the non-Bt check hybrid NHH 44. The yield increases were of the order of 43 to 138 per cent (Table 36)

RCH 2 Bt with a mean seed cotton yield of 1587 Kg/ha was the best Bt check hybrid. Three hybrids recorded higher seed cotton yield over the best check hybrid. They are RCH 386 Bt (1663 Kg/ha; 5% increase), ACH 155-2 BG II (1623 Kg/ha; 2% increase) and VICH 5 Bt (1601 Kg/ha; 1% increase).

ii) Rainfed

The crop was raised under rainfed conditions at Akola and Nanded (Table 36). As the trial at Nagpur was vitiated due to excess rainfall and water logging, as per monitoring team report, they were not considered.

All the hybrids evaluated were found to be superior to the non-Bt check hybrid NHH 44, by 68 to 99 per cent.

RCH 138 Bt was the best Bt check hybrid (2509 Kg/ha) and as compared to it nine hybrids were numerically superior to it. They are KDCHH 9810 Bt (2777 Kg/ha; 11% increase), MRC 7351 BG II (2749 Kg/ha; 10% increase), VICH 9 Bt (2731 Kg/ha; 9% increase), RCH 515 BG II (2695 Kg/ha; 7% increase), VICH 5 Bt (2693 Kg/ha; 7% increase), ACH 155-2 BG II (2685 Kg/ha; 7% increase), MRC 7341 BG II (2594 Kg/ha; 3% increase), KDCHH 621 BG II (2573 Kg/ha; 3% increase) and JKCH 99 Bt (2511 Kg/ha; less than 1% increase).

Table 36. Seed cotton yield (Kg/ha) under unprotected condition

Hybrid	Irrigated			Rainfed		
	Khandwa	Surat	Mean	Akola	Nanded	Mean
KDCHH 9810 Bt	1056	1750	1403	2792	2761	2777
KDCHH 621 BG II	1113	883	998	2269	2877	2573
RCH 386 Bt	1185	2141	1663	2041	2875	2458
RCH 515 BG II	967	1683	1325	2557	2832	2695
NCS 913 Bt	1212	1731	1472	1915	2767	2341
MRC 7351 BG II	1039	2054	1547	2729	2769	2749
MRC 7341 BG II	969	1662	1316	2472	2716	2594
JKCH 99 Bt	781	2153	1467	2248	2773	2511
VICH 5 Bt	1191	2011	1601	2441	2945	2693
VICH 9 Bt	921	1980	1451	2553	2909	2731
ACH 155-2 BG II	1115	2132	1624	2769	2600	2685
NHH 44 (C.Hy)	901	496	699	1687	1104	1396
RCH 2 Bt (Bt.C.hy)	662	2512	1587	2091	2913	2502
RCH 138 Bt (Bt.C.hy)	1191	1876	1534	2387	2630	2509
CD at 5%	555	603		640	312	
CV %		21.6		16.2	7	

F). PATHOLOGICAL EVALUATION

Eleven new Bt entries along with two Bt checks (RCH 2 Bt and RCH 138 Bt) and one non-Bt check (NHH 44) were evaluated for their reaction against various foliar diseases and parawilt. Bacterial leaf blight was noticed in all the five centres where these hybrids have been evaluated. Alternaria leaf spot and grey mildew were noticed at Nagpur and Nanded and myrothecium leaf spot at Nagpur and Khandwa. Parawilt was reported from Khandwa.

Bacterial blight

A disease incidence ranging from 30.0 to 46.55 per cent was found at Akola on all hybrids tested. RCH 386 Bt (46.55 %) had the highest incidence and followed by the two Bt checks *viz.*, RCH 2 Bt and RCH 138 Bt (45.55 %). The Bt hybrid ACH 155-2 BG II had the least incidence (30.0 %). At Surat, MRC 7341 BG II had the highest disease incidence (14.33%) followed by VICH 5 Bt (12.5 %). Rest of the hybrids had negligible or no disease. At Nanded, VICH 5 Bt (20.11%) followed by JKCH 99 Bt (17.0 %) had the highest disease incidence and the rest had negligible or no disease (Table 37).

Table 37. Per cent Disease Incidence (PDI) of Bacterial blight on Bt hybrids

Hybrid	Nagpur	Nanded	Akola	Khandwa	Surat
KDCHH 9810 Bt	2.83	-	31.00	2.3	2.17
KDCHH 621 BG II	-	2.30	41.00	1.6	0.00
RCH 386 Bt	4.29	2.00	46.55	2.5	0.00
RCH 515 BG II	1.3	-	41.11	2.4	0.00
NCS 913 Bt	-	-	44.44	2.7	0.00
MRC 7351 BG II	5.71	-	41.11	2.7	0.00
MRC 7341 BG II	-	5.00	36.66	2.8	14.33
JKCH 99 Bt	6.49	17.00	40.00	3.1	1.50
VICH 5 Bt	2.23	20.11	42.22	2.7	12.50
VICH 9 Bt	3.14	-	37.78	1.6	0.00
ACH 155-2 BG II	5.06	3.50	30.00	1.8	0.33
NHH 44 (C.Hy)	0.91	3.50	31.11	3.0	0.00
RCH 2 Bt (Bt.C.hy)	5.52	3.50	45.55	2.6	6.83
RCH 138 Bt (Bt.C.hy)	2.53	-	45.56	2.7	0.00

Fungal foliar diseases

Grey mildew and Alternaria leaf spot were noticed both at Nagpur and Nanded, where as the myrothecium leaf spot was present at very low level only at Nagpur and Khandwa. Among these diseases, grey mildew was a major one showing substantial incidence at Nanded where the highest disease incidence of 25.21 per cent was noticed on the entry JKCH 99 Bt followed by VICH 5 Bt and MRC 7341 BG II (20.75%), RCH 138 Bt (20.10%) and RCH 386 Bt (20.0%). Against Alternaria leaf spot the KDCHH 621 BG II had the highest disease incidence of 26.92 per cent at Nagpur (Table 38).

Table 38. Fungal foliar disease incidences on Bt hybrids (PDI)

Hybrid	Alternaria leaf blight		Grey mildew		Myrothecium leaf spot	
	Nagpur	Nanded	Nagpur	Nanded	Nagpur	Khandwa
KDCHH 9810 Bt	7.78	4.90	7.31	5.75	0.47	1.80
KDCHH 621 BG II	26.92	5.20	9.62	15.00	1.28	1.80
RCH 386 Bt	2.81	7.80	2.37	20.00	0.15	3.70
RCH 515 BG II	14.61	7.11	6.79	6.00	0.65	3.30
NCS 913 Bt	7.78	15.50	9.07	4.90	1.30	3.50
MRC 7351 BG II	3.81	5.00	8.10	9.00	0.24	3.80
MRC 7341 BG II	3.70	5.00	1.23	20.75	0.31	3.20
JKCH 99 Bt	6.49	4.50	0.97	25.21	0.32	2.50
VICH 5 Bt	4.69	4.00	5.80	20.75	1.79	3.20
VICH 9 Bt	4.78	4.83	4.23	15.00	0.82	2.90
ACH 155-2 BG II	3.31	15.20	11.40	10.24	0.74	3.30
NHH 44 (C.Hy)	8.53	4.50	5.49	10.23	0.91	3.30
RCH 2 Bt (Bt.C.hy)	3.64	4.90	0.70	17.71	2.46	3.50
RCH 138 Bt (Bt.C.hy)	8.54	5.15	1.58	20.10	-	3.30

Parawilt

Parawilt was noticed only at Khandwa. JKCH 99 Bt had the highest per cent of wilted plants (12.22%) followed by KDCHH 9810 Bt, RCH 515 BG II and MRC 7351 BG II (8.89%) (Table 39).

Table 39. Incidence of Parawilt on Bt hybrids (%)

Hybrid	Khandwa
KDCHH 9810 Bt	8.89
KDCHH 621 BG II	1.11
RCH 386 Bt	0.00
RCH 515 BG II	8.89
NCS 913 Bt	3.33
MRC 7351 BG II	8.89
MRC 7341 BG II	1.11
JKCH 99 Bt	12.22
VICH 5 Bt	7.78
VICH 9 Bt	0.00
ACH 155-2 BG II	2.22
NHH 44 (C.Hy)	0.00
RCH 2 Bt (Bt.C.hy)	0.00
RCH 138 Bt (Bt.C.hy)	6.67

G). OVERALL ASSESSMENT

Eleven Bt cotton hybrids were evaluated under ETL and unprotected conditions along with NHH 44 (non-Bt check), RCH 2 Bt and RCH 138 Bt (Bt checks). The trial was conducted at Khandwa and Surat under irrigated conditions and at Akola, Nanded and Nagpur under rainfed conditions.

The overall incidence of bollworm was low in the trial as indicated by the low square damage and low bollworm larval populations on both Bt and non-Bt hybrids. Even under low bollworm incidence level, considerable differences could be seen in the boll and locule damage at harvest. Most of the Bt entries recorded comparatively low boll and locule damage as compared to the non-Bt hybrid NHH 44.

Jassid was the main sucking pest noticed at all the locations and all the entries tested including check hybrids crossed the ETL values at different periods necessitating chemical intervention more than once to contain the pest. For bollworm control most of the Bt entries required only 0 to one round of spray.

The Bt hybrids were also evaluated against various foliar diseases. Among these, bacterial blight at Akola, grey mildew at Nanded and Alternaria leaf spot at Nagpur were

the predominant diseases. None of the hybrids including the check hybrids showed resistance to bacterial blight. Against alternaria leaf spot KDCHH 621 BG II and RCH 515 BG II were found susceptible. Except KDCHH 9810 Bt, RCH 515 BG II, NCS 913 Bt and MRC 7351 BG II, the rest of the entries were found to be highly susceptible to grey mildew.

For mean seed cotton yield, all the test hybrids were superior to the non-Bt check hybrid NHH 44 both under irrigated and rainfed situations. Similarly, under both protected and unprotected condition also the Bt test entries established their superiority over NHH 44 .

RCH 2 Bt was the best Bt check hybrid and under protected condition none of the hybrids established superiority over it either under irrigated or under rainfed situation.

Under unprotected conditions, RCH 2 Bt was the best check under irrigated conditions. Three hybrids *viz.*, RCH 386 Bt, ACH 155-2 BG II and VICH 5 Bt were superior to the best Bt check hybrid by 1 to 5 per cent. Under rainfed situations, RCH 138 Bt was the best Bt check hybrid. Nine hybrids established numerical superiority over it. The percentage increase ranged from one to 11 per cent.

SECOND YEAR EVALUATION

Twenty six Bt cotton hybrids were evaluated for the second year in succession for confirmatory results. The hybrids evaluated were RCH 377 Bt from Rasi seeds, MRC 6352 Bt, MRC 7226 BG II and MRC 7347 BG II from MAHYCO seeds NCS 138 Bt and NCS 145 Bt from Nuziveedu seeds, JKCH 555 Bt, JKCH 666 Bt and JKCH 226 Bt from JK seeds, NCEH 2R Bt and NCEH 3R Bt from Nath seeds, Tulasi 4 Bt and Tulasi 117 Bt from Tulasi seeds, NPH 2171 Bt from Prabhat seeds, Brahma Bt, Kirtiman Bt and Krishna Bt from Emergent Genetics, GK 204 Bt and GK 205 Bt from Ganga Kaveri seeds, ACH 33-1 Bt, ACH 155-1 Bt and ACH 11-2 Bt from Ajeet seeds, KDCHH 9632 Bt and KDCHH 441 BG II from Krishidhan seeds, PRCH 102 Bt from Pravardhan seeds and VCH 111 Bt from Vikki's Agro Tech. There were three checks in the trial. NHH 44 was the non-Bt hybrid check. The Bt check hybrids were RCH 2 Bt and RCH 118 Bt.

A. BIOMETRICAL EVALUATION

Biometrical evaluations of the twenty six Bt test entries along with the three check hybrids were made in the ETL based plant protection trial.

Germination and final plant stand

Germination in all the entries at all the locations was very good. Mean germination of the entries ranged from 88 to 96 per cent (Table 1). Final plant stand was also good in all the entries across locations (Table 2).

Table 1. Germination percentage

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	90	88	100	96	93	94
MRC 6352 Bt	91	90	100	99	100	96
MRC 7226 BG II	90	88	100	96	97	94
MRC 7347 BG II	91	86	100	99	100	95
NCS 138 Bt	92	91	99	100	100	96
NCS 145 Bt	94	85	100	100	97	95
JKCH 555 Bt	94	85	100	100	100	96
JKCH 666 Bt	92	87	99	100	90	94
JKCH 226 Bt	77	82	99	99	100	91
NCEH 2R Bt	87	84	99	97	97	93
NCEH 3R Bt	90	85	99	99	97	94
TULASI 4 Bt	93	84	100	99	100	95

TULASI 117 Bt	82	82	98	99	100	92
NPH 2171 Bt	77	78	98	100	97	90
BRAHMA Bt	85	88	100	97	100	94
KIRTIMAN Bt	89	85	99	99	100	94
KRISHNA Bt	77	80	99	99	100	91
GK 204 Bt	81	83	100	100	100	93
GK 205 Bt	92	76	99	100	90	92
ACH 33-1 Bt	84	80	99	97	97	92
ACH 155-1 Bt	84	84	99	100	97	93
ACH 11-2 Bt	85	85	98	99	97	93
KDCHH 9632 Bt	93	79	99	100	100	94
KDCHH 441 BG II	79	81	100	97	100	92
PRCH 102 BT	59	81	100	100	100	88
VCH 111 Bt.	84	83	100	100	100	93
NHH 44 Bt (C.Hy)	71	81	99	100	100	90
RCH 2 Bt (Bt.C.hy)	89	75	100	100	97	92
RCH 118 Bt (Bt.C.hy)	93	74	100	100	97	93

Table 2. Final plant stand

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	39.0	24.0	21.3	29.7	28.5
MRC 6352 Bt	39.0	22.7	23.7	28.3	28.4
MRC 7226 BG II	39.0	23.7	21.7	29.0	28.3
MRC 7347 BG II	39.0	24.0	23.7	28.3	28.8
NCS 138 Bt	38.7	22.3	24.0	28.3	28.3
NCS 145 Bt	39.0	24.0	23.7	28.3	28.8
JKCH 555 Bt	39.0	23.7	23.7	27.7	28.5
JKCH 666 Bt	38.3	24.0	23.7	27.3	28.3
JKCH 226 Bt	38.0	23.3	22.3	27.3	27.7
NCEH 2R Bt	39.0	23.3	22.7	26.7	27.9
NCEH 3R Bt	38.0	23.3	23.3	28.0	28.2
TULASI 4 Bt	38.3	23.7	23.0	27.0	28.0
TULASI 117 Bt	39.0	23.7	23.3	27.7	28.4
NPH 2171 Bt	39.0	23.7	23.3	28.0	28.5
BRAHMA Bt	38.7	23.7	22.3	28.7	28.3
KIRTIMAN Bt	38.7	24.0	22.7	27.0	28.1
KRISHNA Bt	39.0	23.0	22.7	28.0	28.2
GK 204 Bt	39.0	23.7	23.7	28.3	28.7
GK 205 Bt	39.0	23.7	24.0	28.7	28.8

ACH 33-1 Bt	39.0	24.0	23.0	28.3	28.6
ACH 155-1 Bt	39.0	23.0	24.0	28.0	28.5
ACH 11-2 Bt	39.0	23.7	23.0	28.3	28.5
KDCHH 9632 Bt	39.0	23.7	23.7	28.0	28.6
KDCHH 441 BG II	37.7	24.0	22.7	28.0	28.1
PRCH 102 BT	39.0	24.0	22.7	29.0	28.7
VCH 111 Bt.	39.0	24.0	24.0	28.0	28.8
NHH 44 Bt (C.Hy)	38.7	24.0	24.0	28.0	28.7
RCH 2 Bt (Bt.C.hy)	38.7	23.0	23.3	29.3	28.6
RCH 118 Bt (Bt.C.hy)	38.7	24.0	23.7	28.7	28.8

First and 50 per cent flowering

Early flowering was observed at Surat. Mean days for first flowering ranged from 54.8 (MRC 6352 Bt) to 68.8 (NCEH 2R Bt) (Table 3).

Table 3. First flowering (Days)

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	56.0	73.3	65.7	64.0	64.7
MRC 6352 Bt	40.3	58.3	56.3	64.3	54.8
MRC 7226 BG II	52.3	68.7	63.3	64.3	62.2
MRC 7347 BG II	59.0	74.0	63.0	66.3	65.6
NCS 138 Bt	44.7	56.0	62.0	63.7	56.6
NCS 145 Bt	52.0	58.0	60.3	64.0	58.6
JKCH 555 Bt	45.3	63.7	60.3	64.0	58.3
JKCH 666 Bt	48.7	64.0	57.7	63.7	58.5
JKCH 226 Bt	49.7	63.0	59.3	65.0	59.2
NCEH 2R Bt	63.3	72.3	66.0	73.7	68.8
NCEH 3R Bt	61.0	73.3	64.3	69.3	67.0
TULASI 4 Bt	55.0	61.7	71.0	66.7	63.6
TULASI 117 Bt	59.7	73.7	62.3	68.3	66.0
NPH 2171 Bt	49.3	75.0	61.7	63.3	62.3
BRAHMA Bt	56.0	71.0	61.7	67.7	64.1
KIRTIMAN Bt	58.0	62.0	59.0	64.3	60.8
KRISHNA Bt	48.3	74.0	62.0	66.0	62.6
GK 204 Bt	49.7	67.0	56.3	64.7	59.4
GK 205 Bt	59.3	74.0	57.7	66.7	64.4
ACH 33-1 Bt	48.0	67.3	60.7	64.7	60.2
ACH 155-1 Bt	41.3	65.0	55.7	63.7	56.4
ACH 11-2 Bt	51.0	75.3	58.3	64.0	62.2
KDCHH 9632 Bt	43.0	60.3	58.7	62.7	56.2

KDCHH 441 BG II	57.0	63.3	64.3	70.3	63.7
PRCH 102 BT	60.7	63.3	62.3	72.0	64.6
VCH 111 Bt.	55.7	75.0	61.0	67.7	64.8
NHH 44 Bt (C.Hy)	54.0	65.7	62.3	66.7	62.2
RCH 2 Bt (Bt.C.hy)	59.7	73.0	64.0	66.0	65.7
RCH 118 Bt (Bt.C.hy)	61.0	74.3	65.7	69.3	67.6

The same trend was observed for 50 per cent flowering also (Table 4).

Table 4. Fifty per cent flowering (Days)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	83.7	66.3	82.3	68.0	71.0	74.3
MRC 6352 Bt	75.3	49.7	67.3	63.3	72.0	65.5
MRC 7226 BG II	80.7	64.7	81.0	67.3	69.3	72.6
MRC 7347 BG II	86.3	69.7	83.3	67.0	75.0	76.3
NCS 138 Bt	75.7	56.7	66.7	64.0	69.3	66.5
NCS 145 Bt	78.0	63.0	69.7	66.7	73.7	70.2
JKCH 555 Bt	79.3	57.0	75.7	65.3	70.7	69.6
JKCH 666 Bt	81.7	59.0	75.7	65.0	71.7	70.6
JKCH 226 Bt	76.3	60.7	75.0	65.7	75.7	70.7
NCEH 2R Bt	84.0	74.3	81.7	69.3	81.3	78.1
NCEH 3R Bt	81.3	72.3	83.7	69.7	79.3	77.3
TULASI 4 Bt	87.0	66.3	73.0	68.0	74.5	73.8
TULASI 117 Bt	83.3	70.3	82.0	70.0	82.0	77.5
NPH 2171 Bt	80.7	59.7	84.0	66.0	71.0	72.3
BRAHMA Bt	83.7	67.3	83.7	66.3	80.0	76.2
KIRTIMAN Bt	83.0	69.0	73.7	65.3	72.3	72.7
KRISHNA Bt	84.7	59.3	85.0	65.3	74.3	73.7
GK 204 Bt	84.3	60.7	76.7	63.7	72.0	71.5
GK 205 Bt	81.7	69.3	84.3	65.3	77.5	75.6
ACH 33-1 Bt	77.3	58.7	75.0	66.3	81.0	71.7
ACH 155-1 Bt	81.3	52.3	73.7	64.0	76.0	69.5
ACH 11-2 Bt	84.7	63.7	83.3	65.7	74.7	74.4
KDCHH 9632 Bt	76.3	53.0	67.7	65.0	69.3	66.3
KDCHH 441 BG II	83.0	67.0	72.0	66.7	77.0	73.1
PRCH 102 BT	78.3	72.3	74.0	67.3	80.5	74.5
VCH 111 Bt.	81.0	65.7	85.3	66.3	79.0	75.5
NHH 44 Bt (C.Hy)	87.3	65.0	76.7	68.3	83.3	76.1
RCH 2 Bt (Bt.C.hy)	76.7	71.7	84.7	68.0	79.7	76.1
RCH 118 Bt (Bt.C.hy)	81.0	71.7	84.7	70.3	79.3	77.4

Bolls per plant

Mean number of bolls per plant showed considerable variability across locations

(Table 5).

Table 5. Bolls/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	32.3	39.7	35.5	54.7	44.1	41.2
MRC 6352 Bt	21.2	25.7	21.0	37.0	23.3	25.6
MRC 7226 BG II	18.4	32.3	24.8	45.3	27.7	29.7
MRC 7347 BG II	21.3	30.3	25.3	36.7	35.3	29.8
NCS 138 Bt	28.9	34.3	35.5	56.0	27.6	36.5
NCS 145 Bt	23.2	33.3	28.8	51.3	35.6	34.5
JKCH 555 Bt	28.6	52.0	24.5	49.0	30.6	36.9
JKCH 666 Bt	28.4	30.7	26.7	38.7	29.2	30.7
JKCH 226 Bt	27.0	21.3	28.3	47.3	24.7	29.7
NCEH 2R Bt	29.4	26.0	38.5	38.0	40.7	34.5
NCEH 3R Bt	32.7	29.0	29.0	42.3	42.0	35.0
TULASI 4 Bt	25.8	31.7	33.3	44.7	42.6	35.6
TULASI 117 Bt	36.8	31.7	32.6	55.3	41.8	39.7
NPH 2171 Bt	33.2	20.7	30.1	45.3	29.3	31.7
BRAHMA Bt	29.6	30.7	27.5	40.3	37.8	33.2
KIRTIMAN Bt	31.0	31.7	32.6	53.3	33.0	36.3
KRISHNA Bt	35.3	45.0	37.5	59.3	47.5	44.9
GK 204 Bt	29.0	27.0	26.3	47.7	40.7	34.1
GK 205 Bt	34.5	45.7	33.1	53.3	42.6	41.9
ACH 33-1 Bt	35.7	39.0	35.6	47.3	40.1	39.5
ACH 155-1 Bt	34.5	36.7	31.5	44.7	33.8	36.2
ACH 11-2 Bt	34.3	34.7	29.7	46.0	36.0	36.1
KDCHH 9632 Bt	20.2	31.0	32.1	40.3	27.4	30.2
KDCHH 441 BG II	28.7	13.3	31.5	48.0	46.0	33.5
PRCH 102 BT	22.2	27.0	33.5	42.3	34.1	31.8
VCH 111 Bt.	25.0	31.3	26.2	46.3	27.0	31.2
NHH 44 (C.Hy)	33.6	21.0	40.3	32.0	52.0	35.8
RCH 2 Bt (Bt.C.hy)	26.4	37.3	32.5	50.3	46.2	38.5
RCH 118 Bt (Bt.C.hy)	20.7	36.7	34.7	52.3	35.6	36.0
CD at 5%	1.7	3.6	4.3	9.6	10.4	
CV %	19.1	7.0	8.3	13.0	18.2	

Boll weight

Boll weight also showed variability across locations. Mean boll weight of all the entries was lower in Khandwa as compared to other centres. NHH 44 showed the lowest boll weight of 3.9 g. Six Bt test entries recorded a mean boll weight of 5.0 g and above. The Bt check hybrids recorded a boll weight of 4.6 to 4.8 g (Table 6).

Table 6. Boll weight (g)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	3.8	4.7	5.1	5.2	4.7	4.7
MRC 6352 Bt	3.1	4.9	5.7	6.3	5.5	5.1
MRC 7226 BG II	3.5	5.3	5.5	6.1	5.2	5.1
MRC 7347 BG II	3.8	6.0	7.5	6.4	6.0	5.9
NCS 138 Bt	3.1	4.0	5.3	4.7	5.2	4.5
NCS 145 Bt	3.2	4.8	5.4	5.4	5.1	4.8
JKCH 555 Bt	2.6	3.6	3.9	4.5	4.3	3.8
JKCH 666 Bt	2.8	3.9	5.0	4.7	4.7	4.2
JKCH 226 Bt	2.9	3.7	4.5	4.4	4.5	4.0
NCEH 2R Bt	3.5	4.9	5.9	5.7	5.0	5.0
NCEH 3R Bt	3.3	5.1	5.7	5.8	4.6	4.9
TULASI 4 Bt	3.5	4.8	5.7	4.6	4.8	4.7
TULASI 117 Bt	3.7	4.4	5.1	5.2	5.1	4.7
NPH 2171 Bt	3.2	4.5	5.1	4.9	5.2	4.6
BRAHMA Bt	4.0	5.4	5.7	5.8	5.8	5.4
KIRTIMAN Bt	3.9	5.0	5.3	5.2	4.8	4.9
KRISHNA Bt	3.1	3.4	4.1	4.4	4.2	3.8
GK 204 Bt	2.4	4.0	4.4	4.9	5.2	4.2
GK 205 Bt	3.6	4.2	5.0	4.6	4.7	4.4
ACH 33-1 Bt	3.4	3.7	4.3	4.7	4.5	4.1
ACH 155-1 Bt	3.3	4.5	5.9	5.1	5.2	4.8
ACH 11-2 Bt	2.8	3.6	4.6	4.5	4.6	4.0
KDCHH 9632 Bt	3.9	4.3	5.9	5.4	5.1	4.9
KDCHH 441 BG II	3.8	5.1	5.5	6.5	5.4	5.2
PRCH 102 BT	3.4	4.7	4.2	5.9	5.1	4.7
VCH 111 Bt.	3.3	4.2	5.3	5.1	5.3	4.6
NHH 44 (C.Hy)	3.7	3.5	4.0	4.5	3.6	3.9
RCH 2 Bt (Bt.C.hy)	2.9	4.4	5.5	5.2	4.8	4.6
RCH 118 Bt (Bt.C.hy)	3.3	4.4	5.8	5.3	5.0	4.8
CD at 5%	0.5	0.3	0.6	0.6	0.8	
CV %	17.6	4.3	6.5	6.9	9.9	

Ginning out turn

Mean ginning out turn of the check hybrids ranged from 33.0 to 34.6. JKCH 226 Bt recorded the highest mean ginning out turn of 38.4 per cent followed by JKCH 555 Bt (38.3) and PRCH 102 Bt (38.0) (Table 7).

Table 7. Ginning out turn

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	35.5	32.3	36.0	35.0	33.8	34.5
MRC 6352 Bt	34.9	34.0	34.1	37.3	35.8	35.2
MRC 7226 BG II	32.1	31.9	30.6	32.6	31.9	31.8
MRC 7347 BG II	32.6	33.1	41.7	34.2	34.7	35.3
NCS 138 Bt	33.4	34.5	34.4	34.6	34.8	34.3
NCS 145 Bt	33.3	34.7	33.3	36.1	33.7	34.2
JKCH 555 Bt	36.4	39.8	33.4	42.4	39.3	38.3
JKCH 666 Bt	34.6	36.8	36.1	40.5	37.4	37.1
JKCH 226 Bt	37.7	37.5	35.0	41.7	40.1	38.4
NCEH 2R Bt	35.8	35.1	35.6	38.6	35.9	36.2
NCEH 3R Bt	34.5	32.2	36.0	35.5	34.6	34.6
TULASI 4 Bt	37.2	34.2	38.6	37.3	33.9	36.2
TULASI 117 Bt	34.1	33.7	33.6	35.5	33.7	34.1
NPH 2171 Bt	34.8	33.3	35.3	37.1	34.6	35.0
BRAHMA Bt	33.7	32.9	36.3	36.3	33.1	34.5
KIRTIMAN Bt	34.1	34.4	33.5	34.3	33.9	34.0
KRISHNA Bt	34.1	33.5	34.3	34.6	33.1	33.9
GK 204 Bt	33.4	32.8	36.4	34.9	32.6	34.0
GK 205 Bt	35.1	34.8	36.5	36.7	35.3	35.7
ACH 33-1 Bt	32.5	34.3	37.9	37.3	34.9	35.4
ACH 155-1 Bt	31.4	34.6	31.7	37.1	36.4	34.2
ACH 11-2 Bt	33.4	33.3	34.9	33.9	32.2	33.5
KDCHH 9632 Bt	35.0	35.3	36.1	36.1	36.4	35.8
KDCHH 441 BG II	37.3	34.1	35.0	37.0	35.5	35.8
PRCH 102 BT	38.8	36.3	42.0	37.7	35.1	38.0
VCH 111 Bt.	36.2	35.5	37.3	37.5	35.9	36.5
NHH 44 (C.Hy)	34.6	31.5	33.9	35.0	30.2	33.0
RCH 2 Bt (Bt.C.hy)	33.5	34.0	33.0	36.9	34.3	34.3
RCH 118 Bt (Bt.C.hy)	32.8	34.4	35.0	36.3	34.3	34.6
CD at 5%	1.8	1.6	1.7	1.7	2.5	
CV %	18.6	2.9	2.2	2.9	4.4	

Lint index (g)

Four entries recorded a mean lint index of 6.0 g and above (Table 8).

Table 8. Lint index (g)

Hybrid	Akola	Nagpur	Mean
RCH 377 Bt	6.9	5.5	6.2
MRC 6352 Bt	5.5	5.8	5.6
MRC 7226 BG II	4.7	5.2	5.0
MRC 7347 BG II	8.7	6.1	7.4
NCS 138 Bt	5.7	5.0	5.3
NCS 145 Bt	5.4	5.2	5.3
JKCH 555 Bt	3.6	4.8	4.2
JKCH 666 Bt	4.5	5.0	4.8
JKCH 226 Bt	3.8	5.2	4.5
NCEH 2R Bt	4.6	5.1	4.8
NCEH 3R Bt	5.4	5.2	5.3
TULASI 4 Bt	6.7	5.3	6.0
TULASI 117 Bt	5.3	5.0	5.1
NPH 2171 Bt	5.2	5.0	5.1
BRAHMA Bt	6.2	5.1	5.6
KIRTIMAN Bt	4.3	5.2	4.7
KRISHNA Bt	4.3	4.5	4.4
GK 204 Bt	4.0	4.8	4.4
GK 205 Bt	4.6	5.7	5.2
ACH 33-1 Bt	5.1	4.6	4.9
ACH 155-1 Bt	4.2	5.8	5.0
ACH 11-2 Bt	5.0	4.7	4.9
KDCHH 9632 Bt	5.9	5.7	5.8
KDCHH 441 BG II	5.6	5.5	5.6
PRCH 102 BT	7.4	5.4	6.4
VCH 111 Bt.	5.0	5.4	5.2
NHH 44 (C.Hy)	5.1	3.9	4.5
RCH 2 Bt (Bt.C.hy)	5.1	5.8	5.4
RCH 118 Bt (Bt.C.hy)	6.1	5.7	5.9
CD at 5%	0.6	0.7	
CV %	3.1	7.7	

Seed index (g)

Several entries recorded mean seed index of 10.0 g and above. Bt check hybrids were also characterized by bold seeds with a seed index of 11.1 to 11.2 g (Table 9). JKCH Bt hybrids recorded the lowest mean seed index of 7.9 to 8.4 g

Table 9. Seed index (g)

Hybrid	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	11.9	12.6	10.7	11.7
MRC 6352 Bt	10.3	11.5	10.4	10.7
MRC 7226 BG II	10.4	11.6	11.2	11.1
MRC 7347 BG II	11.8	12.5	11.4	11.9
NCS 138 Bt	10.6	10.5	9.4	10.2
NCS 145 Bt	10.6	11.6	10.2	10.8
JKCH 555 Bt	7.6	8.8	7.5	7.9
JKCH 666 Bt	7.7	9.0	8.4	8.4
JKCH 226 Bt	8.0	9.0	7.7	8.2
NCEH 2R Bt	8.1	9.2	9.0	8.8
NCEH 3R Bt	9.4	11.1	9.7	10.1
TULASI 4 Bt	10.3	11.0	10.3	10.6
TULASI 117 Bt	10.7	9.7	9.8	10.1
NPH 2171 Bt	9.2	10.0	9.5	9.6
BRAHMA Bt	10.6	11.5	10.3	10.8
KIRTIMAN Bt	10.2	11.4	10.1	10.6
KRISHNA Bt	8.1	9.6	9.2	9.0
GK 204 Bt	8.4	10.0	10.0	9.5
GK 205 Bt	9.7	11.0	10.5	10.4
ACH 33-1 Bt	8.2	10.7	8.6	9.2
ACH 155-1 Bt	9.4	10.9	10.2	10.2
ACH 11-2 Bt	9.2	10.9	9.9	10.0
KDCHH 9632 Bt	10.2	10.0	9.9	10.0
KDCHH 441 BG II	10.2	11.5	10.1	10.6
PRCH 102 BT	10.0	10.9	10.0	10.3
VCH 111 Bt.	8.3	10.0	9.6	9.3
NHH 44 (C.Hy)	9.8	11.0	8.6	9.8
RCH 2 Bt (Bt.C.hy)	10.1	12.2	11.1	11.1
RCH 118 Bt (Bt.C.hy)	11.0	11.7	10.9	11.2
CD at 5%	0.5	1.0	0.9	0.8
CV %	2.9	6.0	5.4	4.7

B). MEAN SEED COTTON YIELD UNDER PROTECTED CONDITIONS

i) Irrigated

The crop was raised under irrigated conditions at Khandwa and Surat. Except KDCHH 441 BG II all the other hybrids evaluated recorded high seed cotton yield than the non-Bt check NHH 44. The yield increases were of the order of 9 to 117 per cent.

RCH 118 Bt was the best Bt check in the trial with a mean seed cotton yield of 1987 Kg/ha. Nine hybrids recorded higher seed cotton yield over the best check. They are: GK 205 Bt (2470 Kg/ha; 24% increase), RCH 377 Bt (2321 Kg/ha; 17% increase), ACH 155-1 Bt (2278 Kg/ha; 15% increase), MRC 7347 BG II (2258 Kg/ha; 14% increase), JKCH 555 Bt (2155 Kg/ha; 8% increase), Brahma Bt (2134 Kg/ha; 7% increase), MRC 7226 BG II (2114 Kg/ha; 6% increase), NCS 145 Bt (2088 Kg/ha; 5% increase) and NCEH 3R Bt (2002 Kg/ha; 1% increase).

ii) Rainfed

The crop was raised under rainfed conditions at Akola, Nanded and Nagpur. All the hybrids evaluated recorded higher seed cotton yield than the non-Bt check hybrid NHH 44. The yield increases were of the order of 15 to 62 per cent.

RCH 2 Bt was the best Bt check hybrid with a mean seed cotton yield of 2698 Kg/ha. Five hybrid recorded higher seed cotton yield as compared to the best check hybrid. They are: Brahma Bt (2858 Kg/ha; 6% increase), MRC 7347 BG II (2804 Kg/ha; 4% increase), RCH 377 Bt (2762 Kg/ha; 2% increase), GK 205 Bt (2716 Kg/ha; 1% increase) and ACH 155-1 Bt (2712 Kg/ha; 1% increase).

Table 10. Seed cotton yield (Kg/ha)

Hybrid	Irrigated			Rainfed			
	Khandwa	Surat	Mean	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	1887	2754	2321	2542	3074	2669	2762
MRC 6352 Bt	1279	1808	1544	1991	2462	1720	2058
MRC 7226 BG II	1486	2742	2114	2449	3138	1992	2526
MRC 7347 BG II	1798	2719	2259	2659	3382	2370	2804
NCS 138 Bt	1848	2126	1987	2495	3267	1757	2506
NCS 145 Bt	1694	2482	2088	2292	3171	2109	2524
JKCH 555 Bt	1511	2799	2155	1788	3033	1372	2064
JKCH 666 Bt	1424	1773	1599	2112	2431	1677	2073
JKCH 226 Bt	1336	1144	1240	2162	2526	1403	2030

NCEH 2R Bt	1598	1798	1698	2296	2508	2521	2442
NCEH 3R Bt	1863	2142	2003	2140	3017	2128	2428
TULASI 4 Bt	1703	2103	1903	2647	2855	2424	2642
TULASI 117 Bt	1768	2175	1972	2196	2997	2640	2611
NPH 2171 Bt	1388	1364	1376	2477	2557	1710	2248
BRAHMA Bt	1795	2474	2135	2712	2925	2938	2858
KIRTIMAN Bt	1577	2375	1976	2611	3061	1885	2519
KRISHNA Bt	1030	2379	1705	2608	2850	2191	2550
GK 204 Bt	1658	1592	1625	2124	2876	2335	2445
GK 205 Bt	1908	3031	2470	2679	2945	2525	2716
ACH 33-1 Bt	1585	2287	1936	2742	2559	1667	2323
ACH 155-1 Bt	1915	2640	2278	2700	2816	2619	2712
ACH 11-2 Bt	1548	1799	1674	2559	2433	1926	2306
KDCHH 9632 Bt	1478	2075	1777	2308	2683	1675	2222
KDCHH 441 BG II	1298	843	1071	2630	2919	2556	2702
PRCH 102 BT	1132	1718	1425	2567	3099	2066	2577
VCH 111 Bt.	1620	2027	1824	2407	2842	1877	2375
NHH 44 (C.Hy)	1330	944	1137	2618	1507	1181	1769
RCH 2 Bt (Bt.C.hy)	1441	2473	1957	2357	3254	2484	2698
RCH 118 Bt (Bt.C.hy)	1505	2469	1987	2303	2881	2093	2426
CD at 5%	504	265		494	453	471	
CV %	12.5	7.7		12.2	10.1	14	

C). FIBRE QUALITY EVALUATION

The fibre quality evaluations were done location wise.

2.5 % span length of the test entries ranged from 27.1 mm to 31.7 mm (Table 11).

Table 11. 2.5 % Span length (mm)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	30.0	33.6	33.5	28.9	31.5
MRC 6352 Bt	28.9	29.8	30.7	27.4	30.3
MRC 7226 BG II	27.1	30.2	29.4	26.1	28.7
MRC 7347 BG II	28.7	32.3	33.5	29.1	29.6
NCS 138 Bt	27.0	27.5	29.9	26.5	29.3
NCS 145 Bt	28.1	32.1	32.2	29.3	29.1
JKCH 555 Bt	26.2	28.2	28.3	25.4	28.7
JKCH 666 Bt	26.2	28.6	29.6	27.0	27.4
JKCH 226 Bt	26.8	28.3	28.6	24.7	27.5
NCEH 2R Bt	29.0	31.3	30.4	29.3	28.6
NCEH 3R Bt	28.4	32.0	31.5	29.1	30.1

TULASI 4 Bt	30.3	32.9	32.3	29.8	30.8
TULASI 117 Bt	27.3	31.5	31.7	30.3	30.8
NPH 2171 Bt	27.7	28.9	29.2	27.5	29.3
BRAHMA Bt	30.1	33.1	33.1	30.5	30.0
KIRTIMAN Bt	30.5	32.8	33.0	30.2	31.7
KRISHNA Bt	26.0	27.1	28.0	26.1	29.2
GK 204 Bt	26.4	28.3	30.1	27.0	27.4
GK 205 Bt	27.6	28.8	29.8	26.7	28.1
ACH 33-1 Bt	28.8	27.3	29.9	27.2	28.3
ACH 155-1 Bt	25.5	28.4	28.8	26.8	27.8
ACH 11-2 Bt	25.8	27.5	28.0	25.9	27.1
KDCHH 9632 Bt	27.9	30.4	29.7	28.9	29.5
KDCHH 441 BG II	27.7	30.5	27.6	27.5	28.8
PRCH 102 BT	25.6	30.5	28.0	28.2	28.2
VCH 111 Bt.	28.0	29.6	31.3	28.4	28.7
NHH 44 (C.Hy)	27.3	26.3	28.2	25.1	26.8
RCH 2 Bt (Bt.C.hy)	29.4	32.1	31.8	29.4	28.7
RCH 118 Bt (Bt.C.hy)	28.5	30.6	31.1	28.9	30.2

Uniformity ratio ranged from 44 to 52 per cent (Table 12).

Table 12. Uniformity ratio (%)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	48	53	49	48	50
MRC 6352 Bt	48	54	48	51	50
MRC 7226 BG II	49	56	49	51	51
MRC 7347 BG II	48	58	49	50	51
NCS 138 Bt	49	56	5	51	46
NCS 145 Bt	46	51	48	48	44
JKCH 555 Bt	50	52	48	50	49
JKCH 666 Bt	50	56	49	51	51
JKCH 226 Bt	49	52	50	50	51
NCEH 2R Bt	46	53	48	50	50
NCEH 3R Bt	52	53	47	46	49
TULASI 4 Bt	46	52	46	49	49
TULASI 117 Bt	45	54	46	47	48
NPH 2171 Bt	45	52	51	49	49
BRAHMA Bt	46	50	45	48	48
KIRTIMAN Bt	50	52	46	50	48
KRISHNA Bt	49	50	49	50	50

GK 204 Bt	49	53	49	51	50
GK 205 Bt	50	52	48	50	50
ACH 33-1 Bt	49	52	50	50	50
ACH 155-1 Bt	49	53	51	52	51
ACH 11-2 Bt	49	55	51	53	52
KDCHH 9632 Bt	46	52	48	49	49
KDCHH 441 BG II	45	52	50	48	49
PRCH 102 BT	46	53	50	50	49
VCH 111 Bt.	43	50	47	49	49
NHH 44 (C.Hy)	48	47	50	50	50
RCH 2 Bt (Bt.C.hy)	47	55	48	50	49
RCH 118 Bt (Bt.C.hy)	51	50	46	48	49

Micronaire ranged from 3.8 to 4.5 (Table 13).

Table 13. Micronaire

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	4.1	4.5	4.3	5.1	4.5
MRC 6352 Bt	3.7	4.2	4.4	5.2	4.4
MRC 7226 BG II	4.6	4.2	4.3	5.6	4.5
MRC 7347 BG II	3.8	3.9	3.9	5.1	4.4
NCS 138 Bt	4.1	4.7	4.3	5.1	4.4
NCS 145 Bt	4.4	3.8	4.1	5.0	4.4
JKCH 555 Bt	4.4	4.6	4.8	5.2	4.5
JKCH 666 Bt	3.1	3.8	3.9	4.6	4.3
JKCH 226 Bt	3.6	4.1	4.5	5.0	4.1
NCEH 2R Bt	4.1	3.6	3.9	4.5	4.2
NCEH 3R Bt	3.8	3.4	3.6	5.0	4.0
TULASI 4 Bt	4.1	3.9	4.6	5.0	4.2
TULASI 117 Bt	3.8	4.3	4.1	4.7	4.3
NPH 2171 Bt	3.6	3.9	3.9	5.0	4.2
BRAHMA Bt	4.0	3.9	4.1	4.6	4.1
KIRTIMAN Bt	3.9	3.9	3.7	4.8	4.1
KRISHNA Bt	4.1	3.6	3.9	4.7	4.1
GK 204 Bt	2.9	3.0	3.6	4.6	3.8
GK 205 Bt	3.5	3.8	4.0	5.0	3.8
ACH 33-1 Bt	3.5	3.7	4.0	4.9	4.1
ACH 155-1 Bt	3.9	4.0	4.3	4.7	4.1
ACH 11-2 Bt	3.8	3.9	4.3	5.1	4.3
KDCHH 9632 Bt	3.3	4.0	3.8	4.8	4.0

KDCHH 441 BG II	3.7	4.9	4.1	5.4	4.3
PRCH 102 BT	3.6	4.8	4.0	5.7	4.5
VCH 111 Bt.	3.8	3.6	4.0	4.9	4.3
NHH 44 (C.Hy)	3.6	4.6	4.3	4.6	4.3
RCH 2 Bt (Bt.C.hy)	3.6	4.0	4.5	5.1	4.3
RCH 118 Bt (Bt.C.hy)	3.5	4.1	3.9	4.8	4.2

Fibre strength ranged from 19.9 to 22.1 g/tex (Table 14).

Table 14. Fibre strength (g/tex)

Hybrid	Khandwa	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	24.2	21.7	21.8	20.5	22.1
MRC 6352 Bt	22.3	20.6	20.5	20.2	21.5
MRC 7226 BG II	21.4	22.3	20.4	20.3	21.0
MRC 7347 BG II	24.2	23.8	22.0	20.9	21.9
NCS 138 Bt	21.7	20.5	19.8	19.1	21.5
NCS 145 Bt	20.9	20.7	22.9	20.3	20.7
JKCH 555 Bt	19.6	19.7	18.9	19.2	20.3
JKCH 666 Bt	22.6	20.7	21.1	20.1	20.2
JKCH 226 Bt	21.0	19.7	21.5	19.1	20.7
NCEH 2R Bt	21.0	21.9	21.5	22.4	21.0
NCEH 3R Bt	22.3	23.3	21.9	20.1	21.8
TULASI 4 Bt	21.2	21.0	20.8	21.2	21.5
TULASI 117 Bt	21.7	20.5	20.2	20.9	20.9
NPH 2171 Bt	21.6	21.4	21.8	19.6	21.0
BRAHMA Bt	21.9	20.9	21.8	21.4	21.3
KIRTIMAN Bt	21.1	22.1	21.1	22.0	21.5
KRISHNA Bt	19.4	18.0	20.7	19.9	20.5
GK 204 Bt	20.0	20.2	20.7	20.3	19.9
GK 205 Bt	21.2	18.5	19.7	20.0	20.1
ACH 33-1 Bt	19.5	19.4	21.6	19.9	20.0
ACH 155-1 Bt	19.7	20.3	20.4	20.6	20.2
ACH 11-2 Bt	20.5	19.8	19.9	20.8	20.2
KDCHH 9632 Bt	21.1	20.5	22.0	21.2	20.6
KDCHH 441 BG II	20.5	20.3	20.8	19.8	20.8
PRCH 102 BT	19.4	21.3	20.8	21.0	20.5
VCH 111 Bt.	20.2	19.4	21.0	21.0	20.5
NHH 44 (C.Hy)	20.6	17.7	20.2	19.6	19.9
RCH 2 Bt (Bt.C.hy)	22.3	20.7	21.2	19.7	20.2
RCH 118 Bt (Bt.C.hy)	20.5	18.4	21.9	19.4	20.5

As many as six Bt entries recorded more than 30 mm fibre length. But with fibre strength ranging from 21 to 22 g/tex, they did not meet the prescribed norms of fibre length and strength ratio (Table 15).

Table 15. Overall fibre properties of all the entries

Hybrid	2.5% Span length (mm)	Uniformity Ratio (%)	Micronaire ($\mu\text{g}/\text{inch}$)	Fibre Strength (g/tex)
RCH 377 Bt	31.5	50	4.5	22.1
MRC 6352 Bt	30.3	50	4.4	21.5
MRC 7226 BG II	28.7	51	4.5	21.0
MRC 7347 BG II	29.6	51	4.4	21.9
NCS 138 Bt	29.3	46	4.4	21.5
NCS 145 Bt	29.1	44	4.4	20.7
JKCH 555 Bt	28.7	49	4.5	20.3
JKCH 666 Bt	27.4	51	4.3	20.2
JKCH 226 Bt	27.5	51	4.1	20.7
NCEH 2R Bt	28.6	50	4.2	21.0
NCEH 3R Bt	30.1	49	4.0	21.8
TULASI 4 Bt	30.8	49	4.2	21.5
TULASI 117 Bt	30.8	48	4.3	20.9
NPH 2171 Bt	29.3	49	4.2	21.0
BRAHMA Bt	30.0	48	4.1	21.3
KIRTIMAN Bt	31.7	48	4.1	21.5
KRISHNA Bt	29.2	50	4.1	20.5
GK 204 Bt	27.4	50	3.8	19.9
GK 205 Bt	28.1	50	3.8	20.1
ACH 33-1 Bt	28.3	50	4.1	20.0
ACH 155-1 Bt	27.8	51	4.1	20.2
ACH 11-2 Bt	27.1	52	4.3	20.2
KDCHH 9632 Bt	29.5	49	4.0	20.6
KDCHH 441 BG II	28.8	49	4.3	20.8
PRCH 102 BT	28.2	49	4.5	20.5
VCH 111 Bt.	28.7	49	4.3	20.5
NHH 44 (C.Hy)	26.8	50	4.3	19.9
RCH 2 Bt (Bt.C.hy)	28.7	49	4.3	20.2
RCH 118 Bt (Bt.C.hy)	30.2	49	4.2	20.5

D). ENTOMOLOGICAL EVALUATIONS

The entomological evaluations were primarily targeted against the bollworms and sap sucking insects.

1. EVALUATION UNDER PLANT PROTECTION (ETL BASED)

Sucking pests

i). Jassids

Jassid was the main sucking pest observed at all the locations (Table 16). The incidence was heavy at Khandwa even up to 75 days. At Nanded, the peak jassid infestation was observed on 60 DAS with a range of 1.8 to 4.6 jassids /plant. At Nagpur, the nymphal population of jassids did not differ among entries statistically. However, usual observations showed that several entries showed susceptible reaction. At Akola, jassid incidence was seen even up to 90 DAS. At Surat, four entries crossed ETL on 69 DAS and all the entries crossed ETL at 96 DAS.

Table 16. Jassid population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	6.5	1.4	2.3	1.5	1.1	2.6
MRC 6352 Bt	6.1	1.9	3.2	1.5	1.9	2.9
MRC 7226 BG II	7.5	1.5	3.1	2.2	1.5	3.2
MRC 7347 BG II	5.9	1.7	1.9	1.6	1.4	2.5
NCS 138 Bt	6.2	1.6	2.7	1.4	2.2	2.8
NCS 145 Bt	6.9	1.6	3.0	1.7	1.5	2.9
JKCH 555 Bt	6.6	2.7	5.4	2.1	1.5	3.7
JKCH 666 Bt	7.1	2.8	3.4	1.9	1.2	3.3
JKCH 226 Bt	6.3	1.9	2.8	1.5	1.9	2.9
NCEH 2R Bt	5.8	1.7	2.6	2.0	1.1	2.7
NCEH 3R Bt	5.1	1.9	2.8	2.0	0.9	2.6
TULASI 4 Bt	5.9	1.6	3.1	1.3	1.6	2.7
TULASI 117 Bt	6.3	2.0	3.2	1.7	1.7	3.0
NPH 2171 Bt	6.0	2.5	3.3	2.5	2.2	3.3
BRAHMA Bt	5.8	2.1	2.9	2.5	1.5	3.0
KIRTIMAN Bt	7.0	1.3	2.8	2.7	0.9	2.9
KRISHNA Bt	6.0	1.6	2.9	2.2	1.4	2.8
GK 204 Bt	7.1	2.0	3.9	2.3	1.8	3.4
GK 205 Bt	6.2	1.6	2.2	1.9	1.0	2.6
ACH 33-1 Bt	6.1	1.6	2.3	2.2	1.7	2.8
ACH 155-1 Bt	6.0	2.0	1.9	2.0	1.4	2.6

ACH 11-2 Bt	5.1	1.7	2.4	2.3	1.1	2.5
KDCHH 9632 Bt	6.0	1.9	2.9	2.5	1.5	3.0
KDCHH 441 BG II	6.5	2.6	3.1	1.7	1.3	3.0
PRCH 102 BT	7.3	2.0	3.7	2.3	0.7	3.2
VCH 111 Bt.	6.0	2.2	3.7	1.7	1.9	3.1
NHH 44 (C.Hy)	6.5	1.6	2.0	2.2	1.2	2.7
RCH 2 Bt (Bt.C.hy)	7.5	2.6	4.5	2.1	1.5	3.6
RCH 118 Bt (Bt.C.hy)	6.2	3.0	5.4	1.8	1.6	3.6

ii). Aphids

Aphid incidence was heavy at Surat (Table 17) and crossed the ETL even on 42 DAS. At 49 DAS and 69 DAS also on certain entries the ETL was crossed, necessitating chemical intervention. At Akola, the ETL was reached even on 26th Day. Aphids was absent at Nagpur.

Table 17. Aphids population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Mean
RCH 377 Bt	6.5	9.2	6.0	0.8	5.6
MRC 6352 Bt	6.1	11.8	8.8	0.7	6.9
MRC 7226 BG II	7.5	9.1	8.0	0.8	6.4
MRC 7347 BG II	5.9	18.6	5.1	0.6	7.6
NCS 138 Bt	6.2	22.2	7.8	1.0	9.3
NCS 145 Bt	6.9	18.4	9.2	0.7	8.8
JKCH 555 Bt	6.6	16.9	7.1	1.0	7.9
JKCH 666 Bt	7.1	17.7	8.1	0.8	8.4
JKCH 226 Bt	6.3	18.4	7.5	0.7	8.2
NCEH 2R Bt	5.8	20.1	6.1	0.7	8.2
NCEH 3R Bt	5.1	23.4	7.2	0.8	9.1
TULASI 4 Bt	5.9	19.3	6.3	0.7	8.0
TULASI 117 Bt	6.3	17.6	8.7	0.4	8.2
NPH 2171 Bt	6.0	21.7	5.5	0.5	8.4
BRAHMA Bt	5.8	25.3	6.5	0.8	9.6
KIRTIMAN Bt	7.0	14.5	6.7	0.6	7.2
KRISHNA Bt	6.0	20.5	6.9	0.5	8.5
GK 204 Bt	7.1	10.8	6.7	0.4	6.2
GK 205 Bt	6.2	11.2	5.0	0.6	5.8
ACH 33-1 Bt	6.1	15.7	6.2	0.7	7.2
ACH 155-1 Bt	6.0	18.9	8.1	0.8	8.5
ACH 11-2 Bt	5.1	19.9	7.7	1.0	8.4

KDCHH 9632 Bt	6.0	26.0	5.9	0.2	9.6
KDCHH 441 BG II	6.5	16.0	5.8	0.3	7.1
PRCH 102 BT	7.3	20.7	6.1	0.4	8.6
VCH 111 Bt.	6.0	21.5	6.7	0.3	8.6
NHH 44 (C.Hy)	6.5	20.8	7.6	0.4	8.8
RCH 2 Bt (Bt.C.hy)	7.5	8.6	5.5	0.2	5.4
RCH 118 Bt (Bt.C.hy)	6.2	13.0	6.8	0.6	6.7

iii). Thrips

A considerable population of thrips was noticed on all entries at Surat, Akola and Nanded (Table 18). At Surat, Thrips population crossing ETL was noticed between 60 and 70 days. Up to 70 thrips /plant were noticed on certain entries. At Akola, the thrips population was high ranging from 42 to 57 days and thereafter remained low. At Nanded, the thrips population crossed the ETL on 40 DAS and the population ranged from 10.8 to 54.8 thrips/plant.

Table 18. Thrips population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	0.9	19.0	8.1	8.8	3.0	7.9
MRC 6352 Bt	1.0	32.6	9.7	7.7	3.3	10.9
MRC 7226 BG II	0.4	17.4	9.7	14.8	3.2	9.1
MRC 7347 BG II	0.7	23.5	7.6	12.5	3.9	9.6
NCS 138 Bt	0.4	23.6	10.8	8.1	3.7	9.3
NCS 145 Bt	1.1	40.6	7.9	6.4	3.2	11.8
JKCH 555 Bt	0.5	18.8	6.3	7.7	2.4	7.1
JKCH 666 Bt	0.9	18.4	8.3	10.9	3.2	8.3
JKCH 226 Bt	0.7	22.0	8.1	10.0	2.4	8.6
NCEH 2R Bt	0.4	23.9	7.2	10.5	3.3	9.0
NCEH 3R Bt	0.5	20.6	8.1	13.7	3.1	9.2
TULASI 4 Bt	0.6	27.8	6.8	7.6	4.0	9.4
TULASI 117 Bt	1.1	12.9	6.9	6.8	3.0	6.1
NPH 2171 Bt	1.2	25.9	8.7	8.3	3.5	9.5
BRAHMA Bt	0.5	20.3	8.7	11.5	2.5	8.7
KIRTIMAN Bt	1.0	17.0	9.4	10.0	2.7	8.0
KRISHNA Bt	0.5	23.2	9.1	11.4	4.6	9.8
GK 204 Bt	0.3	18.0	9.1	6.6	3.9	7.6
GK 205 Bt	0.2	18.6	9.1	7.1	4.0	7.8
ACH 33-1 Bt	1.2	26.0	9.9	9.6	4.5	10.2
ACH 155-1 Bt	1.2	26.3	9.2	10.9	3.7	10.3

ACH 11-2 Bt	0.4	23.3	9.2	10.7	3.0	9.3
KDCHH 9632 Bt	0.3	18.8	8.3	9.8	3.6	8.2
KDCHH 441 BG II	0.4	17.2	8.7	10.0	3.4	7.9
PRCH 102 BT	0.8	19.7	7.4	5.9	2.6	7.3
VCH 111 Bt.	0.5	21.1	8.2	3.1	4.3	7.4
NHH 44 (C.Hy)	0.8	20.8	8.1	9.4	2.8	8.4
RCH 2 Bt (Bt.C.hy)	0.5	9.4	7.0	8.2	2.6	5.6
RCH 118 Bt (Bt.C.hy)	1.0	12.4	6.5	9.2	3.0	6.4

iv). Whitefly

Probably due to good rains, whitefly population was very minimal in the test centres and there were no significant differences among the entries for whitefly population and the ETL levels were not reached (Table 19).

Table 19. Whitefly population/plant

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	0.5	0.9	2.3	3.8	2.1	1.9
MRC 6352 Bt	0.6	1.4	2.4	5.0	1.0	2.1
MRC 7226 BG II	0.6	2.0	2.8	5.5	1.1	2.4
MRC 7347 BG II	0.4	1.2	2.9	6.1	2.4	2.6
NCS 138 Bt	0.2	1.7	2.5	5.4	2.4	2.4
NCS 145 Bt	1.0	0.8	2.3	5.0	1.2	2.0
JKCH 555 Bt	0.8	1.0	2.3	5.6	1.3	2.2
JKCH 666 Bt	0.4	1.6	2.5	1.6	1.0	1.4
JKCH 226 Bt	0.6	1.3	2.3	5.3	1.1	2.1
NCEH 2R Bt	0.6	0.8	2.2	4.9	1.4	2.0
NCEH 3R Bt	0.6	1.3	1.8	5.8	1.6	2.2
TULASI 4 Bt	0.8	0.8	2.0	5.8	1.5	2.2
TULASI 117 Bt	0.3	0.7	2.0	4.8	1.1	1.8
NPH 2171 Bt	0.4	1.0	2.2	6.8	0.9	2.3
BRAHMA Bt	0.4	0.7	1.8	6.2	1.3	2.1
KIRTIMAN Bt	0.7	1.4	2.3	6.6	1.0	2.4
KRISHNA Bt	0.7	2.0	2.1	6.7	3.7	3.0
GK 204 Bt	1.0	1.0	2.0	5.7	1.3	2.2
GK 205 Bt	0.4	1.1	2.2	5.4	1.3	2.1
ACH 33-1 Bt	0.6	1.3	2.5	5.1	1.5	2.2
ACH 155-1 Bt	0.4	1.4	2.3	5.3	1.9	2.2
ACH 11-2 Bt	0.5	1.4	2.3	5.9	2.1	2.4
KDCHH 9632 Bt	0.4	1.5	2.0	7.9	1.8	2.7

KDCHH 441 BG II	0.4	3.1	1.9	5.9	1.4	2.5
PRCH 102 BT	0.4	1.0	2.0	5.3	1.2	2.0
VCH 111 Bt.	0.9	1.0	2.3	5.0	1.2	2.1
NHH 44 (C.Hy)	0.7	1.6	2.1	7.9	0.9	2.6
RCH 2 Bt (Bt.C.hy)	1.1	0.7	1.7	5.4	0.8	1.9
RCH 118 Bt (Bt.C.hy)	0.4	0.8	2.1	4.7	1.3	1.9

Natural enemies

The common natural enemies noticed were coccinellids grubs and adults, spiders and chrysopids. Natural enemy population was very low and there were no significant differences between natural enemy populations on non-Bt check and other Bt entries (Table 20).

Table 20. Natural enemies population/plant

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	0.1	0.8	0.1	0.3	0.3
MRC 6352 Bt	0.1	0.7	0.1	0.3	0.3
MRC 7226 BG II	0.1	0.9	0.1	0.3	0.3
MRC 7347 BG II	0.2	0.8	0.1	0.3	0.4
NCS 138 Bt	0.1	0.9	0.2	0.4	0.4
NCS 145 Bt	0.1	0.8	0.1	0.2	0.3
JKCH 555 Bt	0.1	0.9	0.1	0.4	0.4
JKCH 666 Bt	0.1	0.7	0.1	0.2	0.3
JKCH 226 Bt	0.1	0.8	0.1	0.3	0.3
NCEH 2R Bt	0.2	0.8	0.1	0.5	0.4
NCEH 3R Bt	0.2	0.8	0.2	0.3	0.4
TULASI 4 Bt	0.1	0.8	0.1	0.2	0.3
TULASI 117 Bt	0.1	0.8	0.2	0.3	0.3
NPH 2171 Bt	0.2	0.9	0.1	0.3	0.4
BRAHMA Bt	0.2	0.7	0.1	0.3	0.3
KIRTIMAN Bt	0.1	1.0	0.1	0.4	0.4
KRISHNA Bt	0.2	1.0	0.2	0.3	0.4
GK 204 Bt	0.1	1.1	0.1	0.6	0.5
GK 205 Bt	0.1	0.9	0.1	0.2	0.4
ACH 33-1 Bt	0.1	1.0	0.1	0.3	0.4
ACH 155-1 Bt	0.2	0.9	0.1	0.2	0.4
ACH 11-2 Bt	0.2	1.0	0.0	0.6	0.5
KDCHH 9632 Bt	0.1	0.7	0.1	0.3	0.3
KDCHH 441 BG II	0.2	0.8	0.0	0.5	0.4

PRCH 102 BT	0.1	0.9	0.1	0.3	0.3
VCH 111 Bt.	0.1	0.7	0.1	0.4	0.4
NHH 44 (C.Hy)	0.1	0.9	0.2	0.1	0.3
RCH 2 Bt (Bt.C.hy)	0.1	0.9	0.2	0.3	0.4
RCH 118 Bt (Bt.C.hy)	0.1	0.6	0.1	0.3	0.3

Bollworms

Larval population

The larval population of *Earias* sp (Table 21), *Helicoverpa armigera* (Table 22) and *Pectinophora gossypiella* (Table 23) were very low. However, comparatively the non-Bt check hybrid NHH 44 recorded more larval population than the Bt entries. Larval population of *Earias* sp. was noticed only on 10 Bt entries and it ranged from 0.01 to 0.18. The maximum larval population was noticed on ACH 33-1 Bt and ACH 155-1 Bt. NHH 44 recorded a mean of 0.27 larva /plant. Larval population of *Helicoverpa armigera* ranged from 0.01 to 0.27 on Bt cotton entries. The maximum larval population was noticed on ACH 33-1 Bt (0.21 larva/plant) and ACH 155-1 Bt (0.27 larva/plant). The non-Bt check hybrid NHH 44 recorded 0.41 larva/plant. The Bt check hybrids RCH 2 Bt (0.02 larva/plant) and RCH 118 Bt (0.01 larva/plant) recorded low larvae per plant.

The larval population of pink bollworm was either absent or very low in most of the Bt entries. At Surat, ETL was reached on 150 DAS only on ACH 155-1 Bt. At other centres also pink bollworm was observed only after 120 DAS.

Table 21. *Earias* sp. population/plant

Hybrid	Surat	Akola	Nagpur	Mean
RCH 377 Bt	0.0	0.0	0.1	0.03
MRC 6352 Bt	0.0	0.0	0.0	0.01
MRC 7226 BG II	0.0	0.0	0.2	0.06
MRC 7347 BG II	0.0	0.0	0.0	0.00
NCS 138 Bt	0.0	0.0	0.0	0.00
NCS 145 Bt	0.0	0.0	0.0	0.00
JKCH 555 Bt	0.0	0.0	0.0	0.00
JKCH 666 Bt	0.0	0.0	0.0	0.00
JKCH 226 Bt	0.0	0.0	0.0	0.01
NCEH 2R Bt	0.0	0.0	0.0	0.00
NCEH 3R Bt	0.0	0.0	0.0	0.00
TULASI 4 Bt	0.1	0.0	0.0	0.02
TULASI 117 Bt	0.0	0.0	0.1	0.03

NPH 2171 Bt	0.0	0.0	0.0	0.00
BRAHMA Bt	0.0	0.0	0.0	0.00
KIRTIMAN Bt	0.0	0.0	0.0	0.00
KRISHNA Bt	0.0	0.0	0.0	0.00
GK 204 Bt	0.0	0.0	0.0	0.00
GK 205 Bt	0.0	0.0	0.0	0.00
ACH 33-1 Bt	0.2	0.0	0.3	0.16
ACH 155-1 Bt	0.2	0.0	0.3	0.18
ACH 11-2 Bt	0.0	0.0	0.1	0.04
KDCHH 9632 Bt	0.0	0.0	0.0	0.00
KDCHH 441 BG II	0.0	0.0	0.0	0.00
PRCH 102 BT	0.0	0.0	0.0	0.00
VCH 111 Bt.	0.0	0.0	0.0	0.00
NHH 44 (C.Hy)	0.1	0.1	0.7	0.27
RCH 2 Bt (Bt.C.hy)	0.0	0.0	0.0	0.01
RCH 118 Bt (Bt.C.hy)	0.0	0.0	0.0	0.00

Table 22. *Helicoverpa armigera* population/plant

Hybrid	Surat	Akola	Nagpur	Mean
RCH 377 Bt	0.0	0.0	0.0	0.02
MRC 6352 Bt	0.0	0.0	0.1	0.05
MRC 7226 BG II	0.0	0.0	0.0	0.02
MRC 7347 BG II	0.0	0.0	0.2	0.09
NCS 138 Bt	0.0	0.1	0.1	0.06
NCS 145 Bt	0.0	0.0	0.1	0.05
JKCH 555 Bt	0.0	0.0	0.0	0.01
JKCH 666 Bt	0.0	0.0	0.2	0.06
JKCH 226 Bt	0.0	0.0	0.0	0.01
NCEH 2R Bt	0.0	0.0	0.0	0.02
NCEH 3R Bt	0.0	0.0	0.1	0.04
TULASI 4 Bt	0.1	0.0	0.1	0.06
TULASI 117 Bt	0.0	0.0	0.3	0.10
NPH 2171 Bt	0.1	0.0	0.1	0.06
BRAHMA Bt	0.0	0.1	0.2	0.09
KIRTIMAN Bt	0.0	0.0	0.0	0.01
KRISHNA Bt	0.0	0.0	0.2	0.07
GK 204 Bt	0.0	0.0	0.0	0.00
GK 205 Bt	0.0	0.1	0.3	0.10
ACH 33-1 Bt	0.4	0.1	0.2	0.21
ACH 155-1 Bt	0.5	0.1	0.2	0.27

ACH 11-2 Bt	0.3	0.1	0.2	0.17
KDCHH 9632 Bt	0.0	0.1	0.3	0.11
KDCHH 441 BG II	0.0	0.0	0.2	0.08
PRCH 102 BT	0.0	0.0	0.0	0.02
VCH 111 Bt.	0.2	0.0	0.0	0.08
NHH 44 (C.Hy)	0.4	0.2	0.7	0.41
RCH 2 Bt (Bt.C.hy)	0.0	0.0	0.0	0.02
RCH 118 Bt (Bt.C.hy)	0.0	0.0	0.0	0.01

Table 23. *Pectinophora gossypiella* population/20 Green Bolls

Hybrid	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	0.0	0.0	0.7	0.0	0.17
MRC 6352 Bt	0.2	0.0	1.2	0.0	0.33
MRC 7226 BG II	0.0	0.1	0.5	0.0	0.15
MRC 7347 BG II	0.2	0.1	0.3	0.0	0.15
NCS 138 Bt	0.0	0.1	0.2	0.0	0.07
NCS 145 Bt	0.0	0.0	0.3	0.0	0.09
JKCH 555 Bt	0.0	0.0	0.3	0.0	0.08
JKCH 666 Bt	0.0	0.0	0.5	0.0	0.13
JKCH 226 Bt	0.0	0.0	0.7	0.0	0.17
NCEH 2R Bt	0.0	0.0	1.0	0.0	0.25
NCEH 3R Bt	0.0	0.0	0.7	0.0	0.17
TULASI 4 Bt	0.0	0.1	0.3	0.0	0.11
TULASI 117 Bt	0.0	0.0	0.3	0.0	0.09
NPH 2171 Bt	0.3	0.1	0.2	0.0	0.15
BRAHMA Bt	0.3	0.0	0.2	0.0	0.13
KIRTIMAN Bt	0.3	0.0	0.2	0.0	0.13
KRISHNA Bt	0.0	0.0	0.8	0.0	0.21
GK 204 Bt	0.0	0.0	0.3	0.0	0.09
GK 205 Bt	0.0	0.0	0.5	0.0	0.13
ACH 33-1 Bt	0.8	0.6	0.7	0.0	0.52
ACH 155-1 Bt	5.0	0.4	0.5	0.0	1.49
ACH 11-2 Bt	0.0	0.6	0.5	0.0	0.27
KDCHH 9632 Bt	0.0	0.7	0.3	0.0	0.25
KDCHH 441 BG II	0.0	0.2	0.7	0.0	0.22
PRCH 102 BT	0.0	0.0	0.5	0.0	0.13
VCH 111 Bt.	0.0	0.0	0.8	0.0	0.21
NHH 44 (C.Hy)	2.2	1.6	1.5	0.7	1.47
RCH 2 Bt (Bt.C.hy)	0.0	0.0	0.5	0.0	0.13
RCH 118 Bt (Bt.C.hy)	0.0	0.1	0.5	0.0	0.15

Square damage

Square damage due to bollworms was fairly high (10.0 %) on the non-Bt check hybrid NHH 44. Bt check hybrids RCH 2 Bt and RCH 118 Bt recorded a mean square damage of 3.8 and 3.7 per cent, respectively. The mean square damage in Bt test entries varied from 2.5 to 6.6 per cent. Krishna Bt had the lowest square damage of 2.5 per cent (Table 24).

Table 24. Square damage (%)

Hybrid	Khandwa	Surat	Nanded	Nagpur	Mean
RCH 377 Bt	7.4	0.5	2.1	1.9	3.0
MRC 6352 Bt	6.8	0.2	3.6	4.9	3.9
MRC 7226 BG II	6.9	0.3	3.4	3.1	3.4
MRC 7347 BG II	7.3	0.4	3.0	3.5	3.6
NCS 138 Bt	6.1	0.3	1.5	4.0	3.0
NCS 145 Bt	5.6	0.6	2.6	14.1	5.7
JKCH 555 Bt	6.3	0.5	2.5	3.0	3.1
JKCH 666 Bt	6.7	0.4	2.5	5.1	3.7
JKCH 226 Bt	5.7	0.5	2.1	4.5	3.2
NCEH 2R Bt	7.0	0.5	2.2	5.7	3.8
NCEH 3R Bt	6.5	0.3	4.2	7.4	4.6
TULASI 4 Bt	5.0	1.2	2.2	2.8	2.8
TULASI 117 Bt	4.7	0.4	2.1	4.0	2.8
NPH 2171 Bt	10.0	0.6	3.3	4.4	4.5
BRAHMA Bt	3.6	0.8	3.6	3.1	2.8
KIRTIMAN Bt	4.1	0.2	2.1	5.9	3.1
KRISHNA Bt	5.4	0.5	1.9	2.0	2.5
GK 204 Bt	7.2	0.3	2.4	3.4	3.3
GK 205 Bt	6.5	0.4	2.3	4.5	3.4
ACH 33-1 Bt	9.0	3.8	4.0	5.6	5.6
ACH 155-1 Bt	9.7	6.5	2.4	7.8	6.6
ACH 11-2 Bt	5.0	2.1	2.0	5.0	3.5
KDCHH 9632 Bt	7.9	0.9	2.7	2.4	3.5
KDCHH 441 BG II	6.6	0.2	1.8	5.2	3.4
PRCH 102 BT	5.1	0.4	1.7	3.5	2.7
VCH 111 Bt.	7.4	0.4	1.5	1.9	2.8
NHH 44 (C.Hy)	7.6	8.0	3.9	20.7	10.0
RCH 2 Bt (Bt.C.hy)	5.9	0.4	4.5	4.4	3.8
RCH 118 Bt (Bt.C.hy)	9.7	0.5	1.9	2.6	3.7

Square damage at selected centres

At Nagpur, square damage due to bollworms differed significantly from 95 DAS to 115 DAS. Every entry suffered square damage at one or another stage. NHH 44 and NCS 145 Bt had greater than 10 per cent damage continuously for 3 weeks, while other entries had for 2 weeks or only one week (Table 25).

Table 25: Square damage (%) at Nagpur

Hybrid	95 DAS	102 DAS	110 DAS	116 DAS	Mean
RCH 377 Bt	3.25 (9.27)	5.45 (12.17)	3.09 (9.16)	1.39 (6.17)	1.88
MRC 6352 Bt	2.81 (8.12)	14.30 (22.08)	14.18 (18.64)	0.00 (4.05)	4.87
MRC 7226 BG II	0.88 (5.59)	16.01 (23.17)	1.52 (6.30)	0.00 (4.05)	3.07
MRC 7347 BG II	0.67 (5.30)	18.58 (24.10)	5.28 (11.45)	0.00 (4.05)	3.50
NCS 138 Bt	4.65 (10.02)	10.39 (17.54)	11.52 (18.14)	0.00 (4.05)	3.96
NCS 145 Bt	11.53 (16.51)	60.30 (30.21)	16.49 (19.76)	3.25 (8.77)	14.09
JKCH 555 Bt	0.93 (5.65)	5.13 (11.22)	10.38 (15.01)	3.33 (7.81)	2.96
JKCH 666 Bt	2.01 (7.80)	17.38 (23.77)	9.84 (14.81)	0.00 (4.05)	5.14
JKCH 226 Bt	4.68 (9.64)	8.52 (14.58)	5.41 (10.61)	4.17 (8.78)	4.48
NCEH 2R Bt	8.65 (15.87)	10.87 (17.75)	6.59 (13.14)	8.94 (14.90)	5.70
NCEH 3R Bt	8.45 (14.38)	14.33 (20.91)	14.13 (21.05)	0.98 (5.72)	7.43
TULASI 4 Bt	4.45 (10.42)	7.99 (15.01)	5.55 (12.02)	0.00 (4.05)	2.82
TULASI 117 Bt	4.17 (9.59)	13.74 (21.34)	7.97 (15.08)	1.89 (7.29)	3.97
NPH 2171 Bt	2.24 (7.56)	11.62 (19.63)	14.82 (19.87)	0.00 (4.05)	4.36
BRAHMA Bt	1.39 (6.17)	8.69 (16.66)	3.13 (8.63)	0.00 (4.05)	3.11
KIRTIMAN Bt	2.99 (8.69)	15.46 (22.14)	15.60 (19.52)	0.00 (4.05)	5.94
KRISHNA Bt	0.48 (5.00)	7.85 (15.33)	2.84 (8.21)	0.79 (5.48)	2.05
GK 204 Bt	4.10 (10.09)	14.90 (22.37)	4.97 (11.15)	0.00 (4.05)	3.42
GK 205 Bt	3.21 (8.39)	16.97 (21.43)	6.50 (13.05)	0.00 (4.05)	4.45
ACH 33-1 Bt	6.22 (12.23)	18.39 (24.14)	11.93 (17.64)	1.52 (6.30)	5.59
ACH 155-1 Bt	10.98 (15.95)	6.66 (13.97)	18.28 (20.55)	0.69 (5.34)	7.76
ACH 11-2 Bt	1.65 (7.26)	10.57 (16.76)	6.38 (13.32)	12.39 (14.51)	5.02
KDCHH 9632 Bt	5.95 (13.04)	10.63 (18.72)	0.00 (4.05)	0.00 (4.05)	2.37
KDCHH 441 BG II	5.85 (11.97)	12.51 (19.20)	8.29 (15.09)	2.44 (7.90)	5.18
PRCH 102 BT	2.54 (8.52)	7.95 (15.41)	6.93 (13.54)	0.76 (5.43)	3.54
VCH 111 Bt.	0.00 (4.05)	9.70 (17.80)	0.00 (4.05)	2.56 (7.23)	1.94
NHH 44 Bt (C.Hy)	15.59 (21.04)	38.67 (37.25)	30.25 (32.72)	51.94 (47.85)	20.68
RCH 2 Bt (Bt.C.hy)	1.57 (6.88)	15.28 (22.36)	6.53 (12.34)	0.00 (4.05)	4.43
RCH 118Bt(Bt.Chy)	6.30 (11.80)	7.96 (15.34)	2.08 (6.83)	0.00 (4.05)	2.57
F Test	*	*	*	***	-
CD@5%	8.90	11.35	13.39	8.17	-
CV%	78.82	50.36	83.86	96.16	-

At Surat, on NHH 44 the ETL was crossed three times, ACH 155-1 Bt four times, ACH 33-1 Bt twice and Tulasi 4 Bt once. Rest of the entries recorded below ETL damage (Table 26).

Table 26: Square damage (%) at Surat

Hybrids	96 DAS		103 DAS		116 DAS		130 DAS		Mean	
RCH 377 Bt	0.83	(5.08)	0.00	(0.41)	0.99	(4.73)	0.00	(0.41)	0.47	(2.57)
MRC 6352 Bt	0.00	(0.41)	0.00	(0.41)	0.76	(4.77)	0.57	(2.78)	0.24	(1.68)
MRC 7226 BG II	0.00	(0.41)	0.00	(0.41)	0.81	(4.36)	1.47	(4.31)	0.33	(1.62)
MRC 7347 BG II	0.00	(0.41)	0.00	(0.41)	1.44	(5.75)	1.19	(3.90)	0.44	(2.03)
NCS 138 Bt	0.00	(0.41)	0.00	(0.41)	0.47	(2.54)	1.23	(3.96)	0.31	(1.60)
NCS 145 Bt	0.00	(0.41)	0.44	(2.48)	1.48	(5.86)	1.33	(4.11)	0.57	(2.57)
JKCH 555 Bt	1.85	(3.84)	0.00	(0.41)	0.83	(3.30)	1.13	(3.79)	0.54	(1.89)
JKCH 666 Bt	0.00	(0.41)	0.00	(0.41)	2.14	(7.02)	0.46	(2.53)	0.42	(1.97)
JKCH 226 Bt	0.00	(0.41)	0.85	(3.34)	2.46	(7.43)	0.59	(2.83)	0.53	(2.18)
NCEH 2R Bt	0.88	(3.38)	0.00	(0.41)	1.06	(3.70)	0.74	(3.12)	0.45	(2.06)
NCEH 3R Bt	0.68	(3.01)	0.00	(0.41)	1.06	(3.70)	0.58	(2.80)	0.29	(1.45)
TULASI 4 Bt	0.00	(0.41)	0.46	(2.53)	0.38	(2.31)	0.58	(2.80)	1.20	(3.72)
TULASI 117 Bt	0.00	(0.41)	0.00	(0.41)	0.57	(2.78)	1.61	(6.09)	0.38	(1.78)
NPH 2171 Bt	0.00	(0.41)	0.00	(0.41)	4.03	(11.54)	0.49	(2.59)	0.57	(2.07)
BRAHMA Bt	1.97	(4.30)	0.75	(3.16)	0.87	(3.38)	0.74	(3.12)	0.79	(2.91)
KIRTIMAN Bt	0.00	(0.41)	0.00	(0.41)	0.56	(2.77)	1.23	(3.97)	0.22	(1.15)
KRISHNA Bt	0.00	(0.41)	0.94	(3.49)	1.33	(4.11)	0.87	(3.38)	0.47	(1.93)
GK 204 Bt	0.98	(3.56)	0.59	(2.83)	0.40	(2.38)	0.75	(3.16)	0.34	(1.70)
GK 205 Bt	0.75	(4.17)	0.43	(2.44)	0.44	(2.39)	1.42	(4.24)	0.42	(2.07)
ACH 33-1 Bt	0.00	(0.41)	0.00	(0.41)	1.36	(4.15)	2.70	(5.78)	3.78	(7.82)
ACH 155-1 Bt	8.23	(16.65)	11.67	(19.96)	13.34	(21.40)	9.30	(17.74)	6.49	(11.85)
ACH 11-2 Bt	0.00	(0.41)	0.65	(2.95)	4.49	(11.73)	3.51	(6.58)	2.07	(5.17)
KDCHH 9632 Bt	0.00	(0.41)	0.00	(0.41)	0.44	(2.47)	0.99	(3.59)	0.87	(3.38)
KDCHH 441 BG II	0.00	(0.41)	0.00	(0.41)	0.79	(3.23)	0.45	(2.49)	0.16	(1.02)
PRCH 102 BT	0.00	(0.41)	0.00	(0.41)	1.26	(4.01)	0.72	(3.09)	0.36	(1.96)
VCH 111 Bt.	0.74	(3.12)	0.00	(0.41)	0.85	(3.34)	1.23	(3.96)	0.35	(1.56)
NHH 44 Bt (C.Hy)	0.00	(0.41)	14.04	(21.89)	24.99	(31.06)	1.71	(4.64)	7.97	(12.52)
RCH2Bt (Bt.Chy)	0.00	(0.41)	0.00	(0.41)	1.86	(6.43)	1.01	(3.61)	0.41	(1.80)
RCH118Bt(Bt.Chy)	0.00	(0.41)	0.00	(0.41)	0.87	(3.38)	1.88	(6.52)	0.49	(2.26)
C.D.(P=0.05)		3.87		3.78		7.33		NS		3.67

Figures in the parenthesis are Arcsin transformed values

At Nanded, on seven entries the ETL was crossed and among those NHH 44, the non-Bt check hybrid crossed the ETL twice (Table 27)

Table 27. Square damage (%) by bollworms -Nanded

Hybrid	No. of observation				Mean
	50 DAS	60 DAS	70 DAS	80 DAS	
RCH 377 Bt	2.67 (7.42)	1.16 (5.03)	4.63 (12.27)	0.00 (0.00)	2.12 (6.18)
MRC 6352 Bt	4.15 (11.70)	1.24 (6.32)	6.51 (14.76)	2.38 (5.16)	3.57 (9.49)
MRC 7226 BG II	3.34 (10.31)	1.37 (6.56)	7.28 (15.59)	1.39 (3.92)	3.35 (9.10)
MRC 7347 BG II	2.99 (8.14)	1.37 (6.46)	4.76 (12.54)	2.67 (5.47)	2.95 (8.15)
NCS 138 Bt	1.45 (4.01)	0.00 (0.00)	4.69 (12.39)	0.00 (0.00)	1.54 (4.10)
NCS 145 Bt	3.68 (10.93)	0.99 (5.71)	4.83 (12.31)	0.93 (3.19)	2.61 (8.04)
JKCH 555 Bt	2.91 (9.54)	1.61 (7.27)	4.44 (11.91)	0.83 (3.03)	2.45 (7.94)
JKCH 666 Bt	3.44 (10.38)	1.80 (7.68)	4.88 (12.19)	0.00 (0.00)	2.53 (7.56)
JKCH 226 Bt	2.29 (7.11)	1.37 (6.70)	4.02 (10.94)	0.69 (2.76)	2.09 (6.88)
NCEH 2R Bt	2.92 (7.46)	0.84 (4.26)	4.91 (12.74)	0.00 (0.00)	2.17 (6.12)
NCEH 3R Bt	3.01 (7.97)	0.18 (1.39)	10.54 (18.93)	3.01 (8.02)	4.19 (9.08)
TULASI 4 Bt	2.39 (8.66)	1.11 (6.04)	3.85 (11.29)	1.43 (5.58)	2.20 (7.89)
TULASI 117 Bt	1.93 (6.50)	1.54 (7.07)	4.77 (12.54)	0.00 (0.00)	2.06 (6.53)
NPH 2171 Bt	2.31 (8.64)	1.78 (7.58)	8.96 (17.37)	0.00 (0.00)	3.26 (8.40)
BRAHMA Bt	3.53 (10.65)	3.91 (11.23)	4.59 (12.32)	2.47 (7.38)	3.63 (10.40)
KIRTIMAN Bt	2.41 (8.92)	1.28 (6.38)	4.81 (12.65)	0.00 (0.00)	2.13 (6.99)
KRISHNA Bt	2.78 (9.55)	1.32 (6.54)	3.65 (10.94)	0.00 (0.00)	1.94 (6.76)
GK 204 Bt	2.53 (8.98)	1.98 (7.85)	4.03 (11.53)	1.11 (3.50)	2.41 (7.97)
GK 205 Bt	2.03 (8.13)	2.01 (7.95)	4.99 (12.83)	0.00 (0.00)	2.26 (7.23)
ACH 33-1 Bt	4.66 (12.43)	1.86 (7.79)	7.73 (16.09)	1.85 (4.54)	4.03 (10.21)
ACH 155-1 Bt	2.51 (9.04)	2.97 (9.92)	4.05 (11.56)	0.00 (0.00)	2.38 (7.63)
ACH 11-2 Bt	2.49 (8.79)	1.83 (6.31)	3.83 (11.21)	0.00 (0.00)	2.04 (6.58)
KDCHH 9632 Bt	3.83 (11.19)	2.19 (8.43)	4.95 (12.79)	0.00 (0.00)	2.74 (8.10)
KDCHH 441 BG II	1.94 (6.52)	0.62 (3.61)	4.58 (12.09)	0.00 (0.00)	1.79 (5.56)
PRCH 102 BT	2.21 (8.35)	0.18 (1.40)	4.21 (11.79)	0.00 (0.00)	1.65 (5.39)
VCH 111 Bt.	1.87 (7.77)	0.69 (3.90)	3.58 (10.78)	0.00 (0.00)	1.54 (5.61)
NHH 44 (C.Hy)	4.91 (12.60)	5.24 (13.18)	7.35 (15.31)	1.75 (4.41)	3.92 (9.90)
RCH 2 Bt (Bt.C.hy)	3.61 (10.91)	2.83 (9.66)	10.62 (18.81)	1.01 (3.34)	4.52 (10.68)
RCH 118 Bt (Bt.C.hy)	1.53 (5.75)	1.55 (7.11)	4.60 (12.17)	0.00 (0.00)	1.92 (6.26)
F Test	NS	1.24	1.42	NS	-
CD (P=0.05)	6.57	3.45	3.94	6.77	-

Green boll damage percentage

Green boll damage was high at Khandwa and ranged from 4.2 to 11.0 per cent. Green boll damage on Bt check hybrid RCH 118 Bt was 10.6 per cent. On NHH 44, the non-Bt check hybrid, it was 8.4 per cent. At Surat and Akola, NHH 44 recorded 2.5 and 6.5 per cent boll damage, respectively. The Bt hybrids recorded less boll damage. ACH 155-1 Bt recorded a mean boll damage of 5.6 per cent as against 5.8 per cent in NHH 44 (Table 28).

Table 28. Green boll damage (%)

Hybrid	Khandwa	Surat	Akola	Mean
RCH 377 Bt	7.5	0.0	1.1	2.9
MRC 6352 Bt	7.3	0.0	0.3	2.5
MRC 7226 BG II	6.9	0.3	0.1	2.4
MRC 7347 BG II	7.6	0.1	0.2	2.6
NCS 138 Bt	6.3	0.0	2.0	2.8
NCS 145 Bt	5.7	0.1	1.1	2.3
JKCH 555 Bt	6.4	0.0	0.4	2.3
JKCH 666 Bt	5.8	0.0	0.8	2.2
JKCH 226 Bt	5.1	0.2	0.6	2.0
NCEH 2R Bt	7.5	0.0	1.9	3.1
NCEH 3R Bt	5.2	0.2	0.2	1.9
TULASI 4 Bt	5.6	0.0	0.5	2.0
TULASI 117 Bt	5.3	0.0	0.2	1.8
NPH 2171 Bt	11.0	0.2	0.4	3.9
BRAHMA Bt	4.7	0.3	0.5	1.8
KIRTIMAN Bt	5.4	0.0	0.1	1.8
KRISHNA Bt	5.2	0.0	0.2	1.8
GK 204 Bt	7.8	0.1	0.4	2.8
GK 205 Bt	5.1	0.2	0.7	2.0
ACH 33-1 Bt	10.3	0.2	1.9	4.1
ACH 155-1 Bt	10.3	4.5	2.1	5.6
ACH 11-2 Bt	5.6	0.3	3.0	3.0
KDCHH 9632 Bt	8.2	0.1	1.6	3.3
KDCHH 441 BG II	7.7	0.0	0.2	2.6
PRCH 102 BT	5.0	0.1	1.4	2.2
VCH 111 Bt.	7.0	0.0	1.5	2.8
NHH 44 (C.Hy)	8.4	2.5	6.5	5.8
RCH 2 Bt (Bt.C.hy)	5.2	0.1	0.2	1.9
RCH 118 Bt (Bt.C.hy)	10.6	0.0	0.2	3.6

Pink bollworm damage (%)

The pink bollworm damage (%) was assessed in green bolls through destructive sampling. NHH 44 recorded the maximum pink bollworm damage of 13.2 per cent. The Bt check hybrids, RCH 2 Bt and RCH 118 Bt recorded a mean pink bollworm damage of 5.9 per cent and 8.6 per cent respectively. Among the test entries, NCEH 3R Bt recorded

the lowest mean pink bollworm damage of 3.0 per cent and ACH 33-1 Bt had the highest (7.9 %) (Table 29).

Table 29. Pink bollworm damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	7.7	17.5	0.0	3.3	0.0	5.7
MRC 6352 Bt	7.9	20.0	0.0	4.3	0.0	6.4
MRC 7226 BG II	7.4	11.7	0.0	3.0	0.0	4.4
MRC 7347 BG II	7.8	13.3	0.0	2.1	0.0	4.6
NCS 138 Bt	8.1	10.0	0.0	5.3	0.0	4.7
NCS 145 Bt	8.3	5.8	0.0	5.7	0.0	4.0
JKCH 555 Bt	8.3	5.0	0.0	4.7	0.0	3.6
JKCH 666 Bt	8.2	4.2	0.0	5.7	0.0	3.6
JKCH 226 Bt	8.2	9.2	0.0	8.0	0.0	5.1
NCEH 2R Bt	8.4	15.0	0.0	8.0	0.0	6.3
NCEH 3R Bt	8.5	0.0	0.0	6.3	0.0	3.0
TULASI 4 Bt	8.4	5.0	0.0	8.0	0.0	4.3
TULASI 117 Bt	8.4	6.7	0.0	6.0	0.0	4.2
NPH 2171 Bt	8.4	15.0	0.0	8.0	0.0	6.3
BRAHMA Bt	9.0	14.2	0.0	5.8	0.0	5.8
KIRTIMAN Bt	7.9	4.2	0.0	6.6	0.0	3.7
KRISHNA Bt	8.0	5.8	0.0	7.6	0.0	4.3
GK 204 Bt	8.0	10.8	0.0	7.1	0.0	5.2
GK 205 Bt	8.0	10.0	0.0	10.7	0.0	5.7
ACH 33-1 Bt	8.3	22.5	1.1	7.3	0.0	7.9
ACH 155-1 Bt	8.1	22.5	0.0	7.0	0.0	7.5
ACH 11-2 Bt	8.4	10.8	0.0	9.2	0.0	5.7
KDCHH 9632 Bt	8.3	11.7	1.1	8.2	0.0	5.9
KDCHH 441 BG II	8.4	2.5	0.0	7.3	0.0	3.6
PRCH 102 BT	8.4	6.7	0.0	5.8	0.0	4.2
VCH 111 Bt.	8.1	15.0	0.0	9.8	0.0	6.6
NHH 44 (C.Hy)	8.2	38.3	5.6	10.6	3.3	13.2
RCH 2 Bt (Bt.C.hy)	8.7	15.8	0.0	5.1	0.0	5.9
RCH 118Bt (Bt.C.hy)	8.4	25.0	0.0	9.5	0.0	8.6

Open boll and locule damage

At harvest, the open boll and locule damage percentage were studied (Table 30).

Table 30. Open boll damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	9.2	3.8	0.0	10.3	2.8	5.2
MRC 6352 Bt	9.0	4.1	2.2	8.6	6.7	6.1
MRC 7226 BG II	8.3	1.7	3.3	6.2	1.6	4.2
MRC 7347 BG II	9.1	3.5	1.1	8.4	2.0	4.8
NCS 138 Bt	9.9	2.8	1.1	8.3	2.1	4.8
NCS 145 Bt	10.0	3.1	0.0	8.0	2.8	4.8
JKCH 555 Bt	9.7	2.7	2.2	7.1	2.6	4.9
JKCH 666 Bt	9.6	2.8	0.0	6.9	2.7	4.4
JKCH 226 Bt	9.5	2.9	0.0	7.4	4.2	4.8
NCEH 2R Bt	9.3	3.4	0.0	6.3	1.6	4.1
NCEH 3R Bt	10.0	2.9	2.2	6.6	4.2	5.2
TULASI 4 Bt	9.9	2.4	0.0	7.5	1.3	4.2
TULASI 117 Bt	9.7	2.2	0.0	6.5	2.4	4.2
NPH 2171 Bt	9.3	3.2	2.2	7.5	5.0	5.5
BRAHMA Bt	9.6	1.0	0.0	8.1	3.3	4.4
KIRTIMAN Bt	9.5	3.0	1.1	6.3	2.7	4.5
KRISHNA Bt	9.6	3.1	0.0	6.6	1.9	4.2
GK 204 Bt	9.5	5.1	0.0	6.3	2.1	4.6
GK 205 Bt	9.3	2.2	0.0	5.8	4.8	4.4
ACH 33-1 Bt	9.6	7.4	0.0	7.0	2.8	5.4
ACH 155-1 Bt	9.4	9.2	3.3	6.9	3.5	6.5
ACH 11-2 Bt	9.6	7.1	0.0	8.0	3.5	5.6
KDCHH 9632 Bt	8.9	8.1	0.0	6.0	3.5	5.3
KDCHH 441 BG II	9.5	2.7	0.0	6.5	1.9	4.1
PRCH 102 BT	9.5	2.0	0.0	6.5	2.9	4.2
VCH 111 Bt.	9.8	2.3	0.0	5.8	3.8	4.3
NHH 44 (C.Hy)	10.0	15.0	17.8	10.8	6.1	11.9
RCH 2 Bt (Bt.C.hy)	9.7	1.7	0.0	7.6	2.9	4.4
RCH 118 Bt (Bt.C.hy)	9.5	1.6	0.0	6.7	6.1	4.8

Mean open boll damage was the highest of 11.9 per cent on NHH 44, the non-Bt check. The Bt check hybrids RCH 2 Bt and RCH 118 Bt recorded 4.4 and 4.8 per cent boll damage respectively. Open boll damage in Bt test entries ranged from 4.1 to 6.5 per cent (Table 30).

The locule damage also showed the same trend with NHH 44 recording 7.6 per cent locule damage and Bt check hybrids recording 3.6 to 3.7 per cent locule damage. The locule damage in Bt test entries varied from 3.3 to 4.8 per cent (Table 31).

Table 31. Locule damage (%)

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	9.2	1.8	0.0	7.4	1.6	4.0
MRC 6352 Bt	9.0	1.8	1.0	6.4	2.5	4.1
MRC 7226 BG II	8.3	1.1	0.9	4.2	0.9	3.1
MRC 7347 BG II	9.1	2.1	0.5	6.5	1.3	3.9
NCS 138 Bt	9.9	1.5	0.5	6.4	1.4	3.9
NCS 145 Bt	9.9	1.8	0.0	6.0	2.1	3.9
JKCH 555 Bt	9.6	1.2	0.8	5.1	1.6	3.7
JKCH 666 Bt	9.6	1.2	0.0	4.4	1.6	3.4
JKCH 226 Bt	9.5	1.4	0.0	5.6	3.1	3.9
NCEH 2R Bt	8.9	2.0	0.0	4.8	0.9	3.3
NCEH 3R Bt	10.0	1.5	0.7	4.8	2.4	3.9
TULASI 4 Bt	9.9	1.3	0.0	5.8	0.7	3.5
TULASI 117 Bt	9.7	1.3	0.0	4.4	1.2	3.3
NPH 2171 Bt	9.3	1.8	0.5	6.0	3.1	4.1
BRAHMA Bt	9.6	0.4	0.0	5.8	2.1	3.6
KIRTIMAN Bt	9.5	1.7	0.2	4.1	1.8	3.5
KRISHNA Bt	9.6	2.3	0.0	5.3	0.7	3.6
GK 204 Bt	9.5	2.5	0.0	4.5	1.5	3.6
GK 205 Bt	9.3	1.4	0.0	4.6	3.7	3.8
ACH 33-1 Bt	9.6	3.7	0.0	5.4	1.6	4.1
ACH 155-1 Bt	9.4	6.6	0.7	5.0	2.2	4.8
ACH 11-2 Bt	9.6	2.7	0.0	6.6	1.7	4.1
KDCHH 9632 Bt	8.9	5.8	0.0	4.8	2.0	4.3
KDCHH 441 BG II	9.5	1.3	0.0	5.1	1.1	3.4
PRCH 102 BT	9.5	0.9	0.0	5.0	1.2	3.3
VCH 111 Bt.	9.8	0.8	0.0	4.3	1.6	3.3
NHH 44 (C.Hy)	10.0	11.0	4.9	8.1	4.1	7.6
RCH 2 Bt (Bt.C.hy)	9.7	0.7	0.0	5.6	2.2	3.6
RCH 118 Bt (Bt.C.hy)	9.5	0.6	0.0	4.8	3.5	3.7

Plant protection sprays

Jassids, aphids and thrips were the most predominant sucking pests recorded. All the entries tested including the check hybrids were found to be susceptible to the pests at

varying degrees and at different stages of crop growth at all locations, warranting chemical intervention to control the sucking pests. Maximum intervention was required at Surat followed by Khandwa (Table 32).

Table 32. Spray schedule for sucking pests

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	2	2	1	2	2	1.8
MRC 6352 Bt	3	3	2	2	2	2.4
MRC 7226 BG II	1	3	2	2	2	2.0
MRC 7347 BG II	1	4	1	2	2	2.0
NCS 138 Bt	2	3	2	2	2	2.2
NCS 145 Bt	2	3	1	2	2	2.0
JKCH 555 Bt	3	3	3	2	2	2.6
JKCH 666 Bt	3	3	2	2	2	2.4
JKCH 226 Bt	2	4	2	2	2	2.4
NCEH 2R Bt	2	4	2	2	2	2.4
NCEH 3R Bt	2	4	2	2	2	2.4
TULASI 4 Bt	2	4	2	2	2	2.4
TULASI 117 Bt	3	3	2	2	2	2.4
NPH 2171 Bt	3	4	3	2	2	2.8
BRAHMA Bt	3	4	2	2	2	2.6
KIRTIMAN Bt	3	2	2	2	2	2.2
KRISHNA Bt	2	4	2	2	2	2.4
GK 204 Bt	3	2	1	2	2	2.0
GK 205 Bt	2	3	0	2	2	1.8
ACH 33-1 Bt	2	3	0	2	2	1.8
ACH 155-1 Bt	2	3	0	2	2	1.8
ACH 11-2 Bt	2	3	1	2	2	2.0
KDCHH 9632 Bt	3	4	2	2	2	2.6
KDCHH 441 BG II	2	4	2	2	2	2.4
PRCH 102 BT	2	4	3	2	2	2.6
VCH 111 Bt.	3	4	3	2	2	2.8
NHH 44 (C.Hy)	2	4	2	2	2	2.4
RCH 2 Bt (Bt.C.hy)	3	3	3	2	2	2.6
RCH 118 Bt (Bt.C.hy)	3	4	3	2	2	2.8

Bollworm damage was moderate during the year. NHH 44, the non-Bt check hybrid, required one to four rounds of insecticidal spray at different locations to control bollworm damage. Bt check hybrid RCH 118 Bt and eight Bt test entries did not require

insecticidal application at any of the locations. ACH 155-1 Bt required 5 rounds of insecticidal application at Surat, two rounds at Akola and one at Nagpur. ACH 33-1 Bt required one to two rounds of insecticidal application to control bollworms. The other entries required a maximum of one round at certain locations (Table 33).

Table 33. Spray schedule for bollworms

Hybrid	Khandwa	Surat	Akola	Nanded	Nagpur	Mean
RCH 377 Bt	0	0	0	0	0	0.0
MRC 6352 Bt	1	0	0	1	1	0.6
MRC 7226 BG II	1	0	0	1	0	0.4
MRC 7347 BG II	0	0	0	0	0	0.0
NCS 138 Bt	0	0	1	0	1	0.4
NCS 145 Bt	0	0	0	0	1	0.2
JKCH 555 Bt	0	0	0	0	0	0.0
JKCH 666 Bt	0	0	0	0	0	0.0
JKCH 226 Bt	0	0	0	0	1	0.2
NCEH 2R Bt	0	0	0	0	1	0.2
NCEH 3R Bt	1	0	0	1	1	0.6
TULASI 4 Bt	0	1	1	0	0	0.4
TULASI 117 Bt	0	0	0	0	1	0.2
NPH 2171 Bt	1	0	0	1	0	0.4
BRAHMA Bt	0	0	0	0	1	0.2
KIRTIMAN Bt	0	0	0	0	0	0.0
KRISHNA Bt	0	0	0	0	1	0.2
GK 204 Bt	0	0	0	0	1	0.2
GK 205 Bt	0	0	1	0	0	0.2
ACH 33-1 Bt	1	2	2	1	1	1.4
ACH 155-1 Bt	0	5	2	0	1	1.6
ACH 11-2 Bt	0	1	0	0	1	0.4
KDCHH 9632 Bt	0	0	0	0	0	0.0
KDCHH 441 BG II	0	0	0	0	1	0.2
PRCH 102 BT	0	0	0	0	0	0.0
VCH 111 Bt.	0	0	0	0	0	0.0
NHH 44 (C.Hy)	2	4	4	2	1	2.6
RCH 2 Bt (Bt.C.hy)	1	0	0	1	0	0.4
RCH 118 Bt (Bt.C.hy)	0	0	0	0	0	0.0

2. EVALUATION UNDER UNPROTECTED CONDITIONS

All the twenty nine entries in the trial were also evaluated under unsprayed conditions for bollworms. However, they were protected against sucking pests based on their ETL values.

Germination

Germination was excellent in twenty six out of twenty nine entries with a mean germination of 89 to 97 per cent. Germination of JKCH 226 Bt at Surat (51 %), KDCHH 441 BG II at Surat (46 %) and PRCH 102 Bt at Khandwa (59 %) were low (Table 34).

Table 34. Germination percentage

Hybrid	Khandwa	Surat	Akola	Nanded	Mean
RCH 377 Bt	90	82	95	95	90
MRC 6352 Bt	91	86	99	97	93
MRC 7226 BG II	90	86	97	94	92
MRC 7347 BG II	91	97	99	100	97
NCS 138 Bt	92	96	98	96	95
NCS 145 Bt	94	89	97	96	94
JKCH 555 Bt	94	93	100	97	96
JKCH 666 Bt	92	91	98	96	94
JKCH 226 Bt	77	51	97	69	73
NCEH 2R Bt	87	91	99	100	94
NCEH 3R Bt	90	84	98	92	91
TULASI 4 Bt	93	95	99	92	95
TULASI 117 Bt	82	94	98	99	93
NPH 2171 Bt	77	84	99	95	89
BRAHMA Bt	85	91	99	96	93
KIRTIMAN Bt	89	94	99	96	94
KRISHNA Bt	77	92	100	97	91
GK 204 Bt	81	96	98	99	93
GK 205 Bt	92	99	100	99	97
ACH 33-1 Bt	84	93	100	95	93
ACH 155-1 Bt	84	89	100	94	92
ACH 11-2 Bt	85	81	99	96	90
KDCHH 9632 Bt	93	89	100	99	95
KDCHH 441 BG II	79	46	100	85	77
PRCH 102 BT	59	90	97	94	85
VCH 111 Bt.	84	93	99	94	93
NHH 44 Bt (C.Hy)	71	92	100	97	90
RCH 2 Bt (Bt.C.hy)	89	94	99	99	95
RCH 118 Bt (Bt.C.hy)	93	97	99	97	97

Open boll damage

The open boll damage and locule damage were assessed at harvest. The non-Bt hybrid check NHH 44 recorded the highest open boll damage of 17.5 per cent. The Bt check hybrids RCH 2 Bt and RCH 118 Bt recorded a mean open boll damage of 10.3 per cent. Only MRC 7226 BG II (9.7 %) recorded lower boll damage than the Bt check hybrids. The other Bt entries had higher open boll damage than the Bt check hybrids but lower than the non-Bt checks (Table 35).

Table 35. Open boll damage (%) (Under unprotected condition)

Hybrid	Khandwa		Surat		Nanded		Mean
	damage	TV	damage	TV	damage	TV	
RCH 377 Bt	11.5	19.8	3.6	10.37	22.7	28.5	12.6
MRC 6352 Bt	12.2	20.4	4.8	12.34	20.2	26.7	12.4
MRC 7226 BG II	11.5	19.9	2.0	8.05	15.5	23.1	9.7
MRC 7347 BG II	11.9	20.1	4.3	8.69	19.7	26.2	12.0
NCS 138 Bt	12.0	20.3	4.0	11.44	21.3	27.5	12.4
NCS 145 Bt	12.4	20.6	6.2	14.08	17.1	24.4	11.9
JKCH 555 Bt	12.5	20.7	4.9	12.49	16.0	23.5	11.1
JKCH 666 Bt	12.2	20.4	5.4	13.13	16.8	24.2	11.5
JKCH 226 Bt	12.2	20.4	4.3	11.90	19.1	25.8	11.9
NCEH 2R Bt	12.6	20.8	5.1	12.37	16.7	24.1	11.5
NCEH 3R Bt	12.5	20.7	7.2	15.48	16.6	24.0	12.1
TULASI 4 Bt	12.5	20.7	8.9	16.52	19.4	26.1	13.6
TULASI 117 Bt	12.4	20.6	4.7	11.98	17.9	25.1	11.7
NPH 2171 Bt	12.6	20.8	9.4	17.80	20.8	27.0	14.3
BRAHMA Bt	14.9	22.7	4.5	11.62	19.2	26.0	12.9
KIRTIMAN Bt	11.9	20.2	5.0	12.80	20.1	26.6	12.3
KRISHNA Bt	12.0	20.2	7.1	15.01	15.3	22.9	11.5
GK 204 Bt	12.1	20.3	5.8	13.83	14.8	22.6	10.9
GK 205 Bt	12.0	20.2	4.5	12.16	15.1	22.9	10.5
ACH 33-1 Bt	12.5	20.7	8.4	16.72	16.8	24.1	12.6
ACH 155-1 Bt	12.1	20.4	10.0	18.01	18.3	25.3	13.4
ACH 11-2 Bt	12.7	20.9	10.9	18.94	19.3	25.9	14.3
KDCHH 9632 Bt	12.6	20.8	8.3	16.70	14.8	22.6	11.9
KDCHH 441 BG II	12.5	20.7	6.1	14.21	14.1	22.0	10.9
PRCH 102 BT	12.6	20.8	4.2	11.58	17.2	24.5	11.3

VCH 111 Bt.	12.0	20.2	6.3	14.51	14.5	22.4	10.9
NHH 44 Bt (C.Hy)	12.1	20.4	13.9	21.45	26.5	31.0	17.5
RCH 2 Bt (Bt.C.hy)	12.9	21.0	0.9	4.07	17.2	24.4	10.3
RCH 118 Bt (Bt.C.hy)	12.6	20.8	2.2	8.43	16.0	23.5	10.3
CD at 5%		0.9		NS		1.2	
CV %				8.93		3.4	

TV=Transformed values

Locule damage

NHH 44 recorded the highest locule damage (14.7 %). RCH 2 Bt was the best check hybrid with 9.6 per cent locule damage. JKCH 555 Bt (8.8 %), Tulasi 117 Bt (8.8%), MRC 7226 BG II (9.2 %) and GK 205 Bt (9.5 %) recorded lower locule damage than RCH 2 Bt (Table 36).

Table 36. Locule damage (%) (Under unprotected condition)

Hybrid	Khandwa		Surat		Nanded		Mean
	damage	TV	damage	TV	damage	TV	
RCH 377 Bt	12.4	20.6	1.6	6.97	19.0	25.8	11.0
MRC 6352 Bt	13.1	21.2	3.4	10.18	15.9	23.4	10.8
MRC 7226 BG II	11.6	19.9	1.1	5.99	14.9	22.7	9.2
MRC 7347 BG II	12.8	20.9	2.5	6.71	16.7	24.1	10.7
NCS 138 Bt	11.8	20.0	2.0	8.44	16.5	23.9	10.1
NCS 145 Bt	13.3	21.4	3.7	10.55	16.9	24.2	11.3
JKCH 555 Bt	9.6	18.0	3.2	9.94	13.7	21.6	8.8
JKCH 666 Bt	13.1	21.2	3.8	10.96	15.2	22.8	10.7
JKCH 226 Bt	13.1	21.2	2.6	9.31	17.1	24.3	10.9
NCEH 2R Bt	13.5	21.6	3.1	9.40	14.6	22.5	10.4
NCEH 3R Bt	13.4	21.5	5.0	12.83	13.3	21.3	10.6
TULASI 4 Bt	13.4	21.4	6.1	13.27	18.7	25.6	12.7
TULASI 117 Bt	13.3	21.4	2.6	8.64	10.6	18.9	8.8
NPH 2171 Bt	13.5	21.5	4.9	12.72	16.7	24.0	11.7
BRAHMA Bt	15.8	23.4	2.7	9.37	16.1	23.6	11.5
KIRTIMAN Bt	12.8	21.0	2.9	9.55	13.8	21.7	9.8
KRISHNA Bt	12.9	21.0	4.9	7.25	14.6	22.5	10.8
GK 204 Bt	13.0	21.1	3.9	11.30	14.7	22.3	10.5
GK 205 Bt	12.9	21.0	2.3	8.57	13.5	21.5	9.5
ACH 33-1 Bt	13.4	21.5	5.8	13.78	14.9	22.6	11.4
ACH 155-1 Bt	13.0	21.1	6.6	14.27	14.5	22.3	11.4
ACH 11-2 Bt	13.6	21.6	6.5	14.5	16.9	24.2	12.3

KDCHH 9632 Bt	13.5	21.5	5.2	13.12	15.2	22.9	11.3
KDCHH 441 BG II	13.4	21.5	3.9	11.37	14.5	22.3	10.6
PRCH 102 BT	13.5	21.6	2.4	8.77	13.4	21.5	9.8
VCH 111 Bt.	12.9	21.0	3.8	11.15	12.8	20.9	9.8
NHH 44 Bt (C.Hy)	13.0	21.1	8.4	16.75	22.7	28.4	14.7
RCH 2 Bt (Bt.C.hy)	13.8	21.8	0.4	2.88	14.6	22.4	9.6
RCH 118 Bt (Bt.C.hy)	13.5	21.5	1.2	6.12	16.3	23.8	10.3
CD at 5%		1.1		NS		1.4	
CV %				12.54		3.8	

E). SEED COTTON YIELD UNDER UNPROTECTED CONDITION

i) Irrigated

The trial was conducted under irrigated conditions at Khandwa and Surat (Table 37). All the hybrids evaluated recorded higher seed cotton yield over the non-Bt check hybrid NHH 44. The yield increases were of the order of 3 to 113 per cent.

RCH 118 Bt was the best Bt check hybrid and recorded a mean seed cotton yield of 1777 Kg/ha. Nine test hybrids were superior to RCH 118 Bt in seed cotton yield by 2 to 20 percent. They are: RCH 377 Bt (2137 Kg/ha; 20% increase), GK 205 Bt (2081 Kg/ha; 17% increase), MRC 7226 BG II (2041 Kg/ha; 15% increase), MRC 7347 BG II (1946 Kg/ha; 10% increase), Tulasi 117 Bt (1934 Kg/ha; 9% increase), Tulasi 4 Bt (1891 Kg/ha; 6% increase), NCS 138 Bt (1891 Kg/ha; 6% increase), NCS 145 Bt (1808 Kg/ha; 2% increase) and NCEH 2R Bt(1768 kg/ha; less than 1 %)

(ii). Rainfed

The trial was conducted under rainfed conditions at Akola and Nanded(Table 37). All the hybrids evaluated were better than the non-Bt check hybrid NHH 44. The yield increases ranged from 8 to 51 per cent.

RCH 118 Bt was the best Bt check hybrid with a mean seed cotton yield of 2099 Kg/ha. Sixteen test hybrids were numerically superior to it in seed cotton yield. They are NCS 145 Bt (2451 Kg/ha; 17% increase), MRC 7226 BG II (2417 Kg/ha; 15% increase), Tulasi 4 Bt (2380 Kg/ha; 13% increase), GK 204 Bt (2336 Kg/ha; 11% increase), MRC 7347 BG II (2306 Kg/ha; 10% increase), MRC 6352 Bt (2259 Kg/ha; 8% increase), GK 205 Bt (2258 Kg/ha; 8% increase), Kirtiman Bt (2220 Kg/ha; 6% increase), NCS 138 Bt (2207 Kg/ha; 5% increase), Brahma Bt (2204 Kg/ha; 5% increase), ACH 155-1 Bt (2203 Kg/ha; 5% increase), JKCH 555 Bt (2146 Kg/ha; 2%

increase), RCH 377 Bt (2142 Kg/ha; 2% increase), KDCHH 441 BG II (2137 Kg/ha; 2% increase), ACH 11-2 Bt (2131 Kg/ha; 2% increase) and PRCH 102 Bt (2117 Kg/ha; 1% increase).

Table 37. Seed cotton yield (Kg/ha) (Under unprotected condition)

Hybrid	Irrigated			Rainfed		
	Khandwa	Surat	Mean	Akola	Nanded	Mean
RCH 377 Bt	1665	2609	2137	1583	2701	2142
MRC 6352 Bt	1343	1330	1337	2086	2431	2259
MRC 7226 BG II	1329	2753	2041	1849	2984	2417
MRC 7347 BG II	1424	2469	1947	1357	3254	2306
NCS 138 Bt	1545	2237	1891	1494	2919	2207
NCS 145 Bt	1514	2102	1808	2060	2842	2451
JKCH 555 Bt	1460	1553	1507	1926	2366	2146
JKCH 666 Bt	1380	1985	1683	1797	2392	2095
JKCH 226 Bt	1212	1214	1213	1764	2070	1917
NCEH 2R Bt	1464	2073	1769	1798	2379	2089
NCEH 3R Bt	1624	1912	1768	1307	2675	1991
TULASI 4 Bt	1515	2267	1891	1866	2894	2380
TULASI 117 Bt	1618	2249	1934	1595	2495	2045
NPH 2171 Bt	1225	1588	1407	1706	2238	1972
BRAHMA Bt	1562	2215	1889	1449	2958	2204
KIRTIMAN Bt	1299	2230	1765	1558	2881	2220
KRISHNA Bt	897	1934	1416	1758	2289	2024
GK 204 Bt	1086	1822	1454	1869	2803	2336
GK 205 Bt	1635	2527	2081	1867	2649	2258
ACH 33-1 Bt	1481	1936	1709	1391	2135	1763
ACH 155-1 Bt	1753	1691	1722	2155	2251	2203
ACH 11-2 Bt	1469	1654	1562	1780	2482	2131
KDCHH 9632 Bt	1323	1880	1602	1521	2443	1982
KDCHH 441 BG II	852	1205	1029	1521	2752	2137
PRCH 102 BT	1037	2114	1576	1405	2829	2117
VCH 111 Bt.	1477	1949	1713	1588	2405	1997
NHH 44 Bt (C.Hy)	926	1078	1002	1426	1825	1626
RCH 2 Bt (Bt.C.hy)	1419	2095	1757	1621	2276	1949
RCH 118 Bt (Bt.C.hy)	1189	2366	1778	1599	2598	2099
CD at 5%	477	440		405	449	
CV %	5	14		16	11	

F). PATHOLOGICAL EVALUATION

Twenty six Bt hybrids along with two Bt and one non-Bt checks were evaluated against various foliar diseases as well as parawilt.

Bacterial blight

This disease was noticed at Nagpur, Akola, Khandwa and Surat. Akola had very high incidence and at other places the incidence was either at low level or negligible. Under high disease intensity all entries were found susceptible to this disease with PDI varying from 28.89 to 57.78 (Table 38).

Table 38. Per cent Disease Incidence (PDI) of Bacterial blight on Bt hybrids

Hybrid	Nagpur	Akola	Khandwa	Surat
RCH 377 Bt	4.65	53.33	1.6	0.00
MRC 6352 Bt	-	50.00	1.3	0.00
MRC 7226 BG II	5.42	57.78	2.3	0.00
MRC 7347 BG II	1.46	55.56	1.6	0.67
NCS 138 Bt	2.71	52.22	1.6	0.00
NCS 145 Bt	3.31	51.11	2.3	0.00
JKCH 555 Bt	2.38	45.56	2.2	0.00
JKCH 666 Bt	2.57	44.45	2.9	0.00
JKCH 226 Bt	1.81	54.45	2.5	0.67
NCEH 2R Bt	2.88	53.33	2.7	0.00
NCEH 3R Bt	4.36	57.78	2.5	0.00
TULASI 4 Bt	2.24	53.34	1.8	0.00
TULASI 117 Bt	3.07	28.89	1.7	0.00
NPH 2171 Bt	3.18	50.00	2.8	0.50
BRAHMA Bt	0.94	54.45	2.8	0.00
KIRTIMAN Bt	1.90	34.45	2.9	0.33
KRISHNA Bt	0.41	46.66	1.5	0.00
GK 204 Bt	4.55	51.11	2.7	4.00
GK 205 Bt	6.84	51.11	2.6	1.67
ACH 33-1 Bt	1.42	41.11	1.3	0.00
ACH 155-1 Bt	4.69	37.78	1.8	0.00
ACH 11-2 Bt	4.22	57.78	1.5	0.00
KDCHH 9632 Bt	3.32	43.33	2.7	0.00
KDCHH 441 BG II	7.44	57.78	1.9	0.00
PRCH 102 BT	4.53	51.11	1.6	0.00
VCH 111 Bt.	0.6	47.78	1.6	0.00
NHH 44 (C.Hy)	1.46	15.56	1.6	0.00
RCH 2 Bt (Bt.C.hy)	8.97	31.11	3.0	0.00
RCH 118 Bt (Bt.C.hy)	3.7	50.00	2.7	0.83

Fungal foliar diseases

Overall, the fungal foliar diseases were at low level at the all centres. *Alternaria* leaf spot and grey mildew were observed only at Nagpur and Nanded. *Myrothecium* leaf spot was present at Nagpur and Khandwa. Higher incidence of grey mildew was observed at Nanded only. The hybrids GK 204 Bt and GK 205 Bt respectively had a PDI of 25.79 and 25.75 and the hybrids NCS 138 Bt, NCS 145 Bt and Kirtiman Bt showed incidences ranging from 15.0 to 15.45 PDI, while the others had PDI of below 10.00 per cent (Table 39).

Table 39. Fungal foliar disease incidences on Bt hybrids (PDI)

Hybrid	Alternaria leaf blight		Grey mildew		Myrothecium leaf spot	
	Nagpur	Nanded	Nagpur	Nanded	Nagpur	Khandwa
RCH 377 Bt	3.52	10.00	2.26	7.27	3.27	3.3
MRC 6352 Bt	6.53	10.00	7.66	7.27	2.25	3.8
MRC 7226 BG II	6.63	9.01	3.01	5.11	5.12	3.5
MRC 7347 BG II	3.4.	5.00	3.76	7.01	2.06	3.4
NCS 138 Bt	1.45	5.95	9.06	15.00	0.91	3.0
NCS 145 Bt	3.93	9.91	9.09	15.95	2.07	3.3
JKCH 555 Bt	9.8	10.55	9.86	7.00	1.02	3.4
JKCH 666 Bt	2.57	10.00	8.86	4.95	1.71	4.0
JKCH 226 Bt	3.43	5.00	5.65	5.75	4.23	3.4
NCEH 2R Bt	2.76	4.01	6.97	4.00	0.96	4.0
NCEH 3R Bt	2.98	7.91	3.78	5.45	3.1	3.2
TULASI 4 Bt	2.03	3.25	7.05	5.90	1.28	1.8
TULASI 117 Bt	1.68	10.00	8.38	5.00	0.7	3.4
NPH 2171 Bt	5.57	3.00	2.39	3.85	1.27	2.4
BRAHMA Bt	14.73	15.95	10.00	5.95	2.74	3.3
KIRTIMAN Bt	4.59	5.75	8.54	15.00	4.43	1.9
KRISHNA Bt	3.67	3.00	7.88	10.00	1.77	3.4
GK 204 Bt	3.84	5.75	3.55	25.79	4.4	3.3
GK 205 Bt	3.73	3.51	-	25.75	1.14	2.8
ACH 33-1 Bt	4.81	3.51	2.4	5.00	0.72	3.3
ACH 155-1 Bt	3.71	4.11	2.34	10.00	2.54	3.5
ACH 11-2 Bt	2.03	4.01	5.78	4.95	2.19	3.5
KDCHH 9632 Bt	3.1	4.11	14.6	5.71	2.88	3.1
KDCHH 441 BG II	3.72	10.00	8.21	5.15	0.77	3.5
PRCH 102 BT	6.68	5.00	4.53	5.00	-	3.3
VCH 111 Bt.	4.02	15.91	3.42	4.75	0.6	3.6
NHH 44 (C.Hy)	3.4	4.00	3.88	4.00	3.4	2.5
RCH 2 Bt (Bt.C.hy)	3.53	3.26	-	4.00	1.6	3.5
RCH 118 Bt (Bt.C.hy)	3.85	7.91	1.92	15.43	2.81	1.9

Parawilt

Parawilt was also observed on most of the hybrids at low level. The entries JKCH 555 Bt and GK 205 Bt recorded the highest percent of wilted plants (8.89%) (Table 40).

Table 40. Incidence of Parawilt on Bt hybrids (%)

Hybrid	Khandwa
RCH 377 Bt	4.45
MRC 6352 Bt	5.55
MRC 7226 BG II	0.00
MRC 7347 BG II	4.44
NCS 138 Bt	0.00
NCS 145 Bt	4.44
JKCH 555 Bt	8.89
JKCH 666 Bt	4.44
JKCH 226 Bt	0.00
NCEH 2R Bt	1.11
NCEH 3R Bt	5.56
TULASI 4 Bt	0.00
TULASI 117 Bt	3.33
NPH 2171 Bt	5.56
BRAHMA Bt	2.22
KIRTIMAN Bt	5.56
KRISHNA Bt	5.56
GK 204 Bt	3.33
GK 205 Bt	8.89
ACH 33-1 Bt	0.00
ACH 155-1 Bt	4.44
ACH 11-2 Bt	4.44
KDCHH 9632 Bt	2.22
KDCHH 441 BG II	5.56
PRCH 102 BT	6.67
VCH 111 Bt.	1.11
NHH 44 (C.Hy)	5.56
RCH 2 Bt (Bt.C.hy)	1.11
RCH 118 Bt (Bt.C.hy)	4.44

G). OVERALL ASSESSMENT

Twenty six Bt cotton hybrids were evaluated under protected and unprotected conditions along with NHH 44 (non-Bt check), RCH 2 Bt and RCH 118 Bt (Bt check hybrids). the trial was conducted at Khandwa and Surat under irrigated conditions and at Akola, Nanded and Nagpur under rainfed conditions.

The over all incidence of bollworm was low as indicated by low square damage and low bollworm population in both Bt and non-Bt hybrids. However, even under low bollworm pressure, differences could be seen between the non-Bt check hybrid and the Bt hybrids. Most of the Bt entries recorded comparatively low boll and locule damage as compared to NHH 44. Among the Bt entries, ACH 155-1 Bt recorded more larval population and boll damage.

Jassid was the main sucking pest noticed at all locations. Different entries crossed the ETL at different periods warranting chemical intervention. However, for bollworm most of the Bt hybrids required 0 to one round of insecticidal application only as against one to four rounds required for NHH 44.

All the 26 entries and also the three check hybrids have been found highly susceptible to bacterial blight at Akola. The hybrids GK 204 Bt, GK 205 Bt, NCS 138 Bt, NCS 145 Bt and Kirtiman Bt were susceptible to grey mildew at Nanded, while the entry Brahma Bt was found susceptible to alternaria leaf spot both at Nagpur and Nanded.

All the hybrids evaluated except KDCHH 441 BG II (under irrigated protected condition) recorded higher seed cotton yield over the non-Bt check hybrid NHH 44 under all the situations *viz.*, rainfed, irrigated, protected and unprotected, they were tested.

Under protected conditions in the irrigated trials RCH 118 was the best Bt check hybrid. Nine hybrids established numerical superiority of 1 to 24 per cent over it. Under rainfed situations, RCH 2 Bt was the best Bt check and five hybrids recorded higher seed cotton yield over RCH 2 Bt. The yield increases were of the order of 1 to 6 per cent.

Under unprotected conditions, RCH 118 Bt was the best check hybrid both under irrigated and rainfed situation. Under irrigated conditions nine test hybrids were superior to the best Bt check hybrid by 2 to 15 per cent and under rainfed conditions sixteen hybrids were superior by 1 to 17 per cent.

Ginning percentage showed wide variation. Three hybrids recorded more than 38 per cent ginning out turn. Six hybrids had more than 30 mm fibre length. But commensurate fibre strength was lacking.

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

Forty Bt cotton hybrids were evaluated during 2004-05 season in Central Zone. However, seeds of only twenty six hybrids were received from the respective seed companies for conducting the second year confirmatory trials.

The following are the twenty six Bt cotton hybrids evaluated for two consecutive years.

1. RCH 377 Bt from Rasi seeds
2. MRC 6352 Bt from MAHYCO seeds
3. MRC 7226 BG II from MAHYCO seeds
4. MRC 7347 BG II from MAHYCO seeds
5. NCS 138 Bt from Nuziveedu seeds
6. NCS 145 Bt from Nuziveedu seeds
7. JKCH 555 Bt from JK seeds
8. JKCH 666 Bt from JK seeds
9. JKCH 226 Bt from JK seeds
10. NCEH 2R Bt from Nath seeds
11. NCEH Bt from Nath seeds
12. Tulasi 4 Bt from Tulasi seeds
13. Tulasi 117 Bt from Tulasi seeds
14. NPH 2171 Bt from Prabhat seeds
15. Brahma Bt from Emergent Genetics
16. Kirtiman Bt from Emergent Genetics
17. Krishna Bt from Emergent Genetics
18. GK 204 Bt from Ganga Kaveri seeds
19. GK 205 Bt from Ganga Kaveri seeds
20. ACH 33-1 Bt from Ajeet seeds
21. ACH 155-1 Bt from Ajeet seeds
22. ACH 11-2 Bt from Ajeet seeds
23. KDCHH 9632 Bt from Krishidhan seeds
24. KDCHH 441 BG II from Krishidhan seeds
25. PRCH 102 Bt from Pravardhan seeds
26. VCH 111 Bt from Vikkis Agrotech.

NHH 44 was the common non-Bt check used in both the years. Similarly, RCH 2 Bt was the common Bt check hybrid used in the trial. In the combined report, results of the above twenty six hybrids have been discussed along with common check hybrids NHH 44 and RCH 2 Bt.

A. BIOMETRICAL EVALUATION

The year 2005-06 was more favourable for cotton cultivation, Boll number per plant, boll weight and seed cotton yield per hectare were more in 2005-06 than in 2004-05. Mean boll number per plant varied from 23.5 to 36.6. Boll weight varied from 3.6 to 5.2 g (Table 1).

Table 1. Combined analysis of bolls/plant and boll weight of two seasons (2004-05&2005-06)

Hybrids	Bolls/Plant			Boll Weight (g)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	27.6	41.2	34.4	4.1	4.7	4.4
MRC 6352 Bt	21.4	25.6	23.5	4.1	5.1	4.6
MRC 7226 BG II	24.0	29.7	26.9	4.4	5.1	4.8
MRC 7347 BG II	24.0	29.8	26.9	4.5	5.9	5.2
NCS 138 Bt	27.4	36.5	31.9	3.9	4.5	4.2
NCS 145 Bt	24.9	34.5	29.7	4.2	4.8	4.5
JKCH 555 Bt	26.9	36.9	31.9	3.5	3.8	3.6
JKCH 666 Bt	23.6	30.7	27.2	3.8	4.2	4.0
JKCH 226 Bt	25.8	29.7	27.8	3.8	4.0	3.9
NCEH 2R Bt	24.3	34.5	29.4	4.3	5.0	4.7
NCEH 3R Bt	33.3	35.0	34.2	3.7	4.9	4.3
TULASI 4 Bt	24.6	35.6	30.1	3.8	4.7	4.2
TULASI 117 Bt	30.4	39.7	35.0	3.7	4.7	4.2
NPH 2171 Bt	24.1	31.7	27.9	3.8	4.6	4.2
BRAHMA Bt	23.0	33.2	28.1	4.1	5.4	4.7
KIRTIMAN Bt	22.8	36.3	29.6	4.1	4.9	4.5
KRISHNA Bt	28.3	44.9	36.6	3.8	3.8	3.8
GK 204 Bt	26.8	34.1	30.5	3.7	4.2	3.9
GK 205 Bt	26.7	41.9	34.3	3.8	4.4	4.1
ACH 33-1 Bt	27.2	39.5	33.4	3.9	4.1	4.0
ACH 155-1 Bt	25.2	36.2	30.7	4.1	4.8	4.5
ACH 11-2 Bt	26.9	36.1	31.5	3.6	4.0	3.8
KDCHH 9632 Bt	22.5	30.2	26.4	3.9	4.9	4.4
KDCHH 441 BG II	24.0	33.5	28.8	4.5	5.2	4.8

PRCH 102 BT	24.4	31.8	28.1	4.6	4.7	4.6
VCH 111 Bt.	23.8	31.2	27.5	3.9	4.6	4.3
NHH 44 (C.Hy)	23.1	35.8	29.5	3.6	3.9	3.7
RCH 2 Bt (Bt.C.hy)	24.8	38.5	31.7	4.1	4.6	4.3

Ginning out turn showed consistency over the years. JKCH 555 Bt recorded the highest ginning out turn of 39.2 per cent. Several test hybrids showed better ginning out turn than the check hybrids (Table 2).

Table 2. Combined analysis of ginning percentage of two seasons (2004-05&2005-06)

Hybrids	Ginning %		
	2004-05	2005-06	Mean
RCH 377 Bt	34.0	34.5	34.3
MRC 6352 Bt	36.0	35.2	35.6
MRC 7226 BG II	33.1	31.8	32.5
MRC 7347 BG II	36.3	35.3	35.8
NCS 138 Bt	34.5	34.3	34.4
NCS 145 Bt	34.7	34.2	34.5
JKCH 555 Bt	40.1	38.3	39.2
JKCH 666 Bt	39.6	37.1	38.3
JKCH 226 Bt	35.1	38.4	36.7
NCEH 2R Bt	35.7	36.2	36.0
NCEH 3R Bt	35.3	34.6	34.9
TULASI 4 Bt	35.7	36.2	36.0
TULASI 117 Bt	35.5	34.1	34.8
NPH 2171 Bt	34.8	35.0	34.9
BRAHMA Bt	33.4	34.5	33.9
KIRTIMAN Bt	35.1	34.0	34.6
KRISHNA Bt	34.0	33.9	34.0
GK 204 Bt	35.5	34.0	34.8
GK 205 Bt	35.9	35.7	35.8
ACH 33-1 Bt	35.9	35.4	35.6
ACH 155-1 Bt	38.1	34.2	36.2
ACH 11-2 Bt	34.5	33.5	34.0
KDCHH 9632 Bt	34.4	35.8	35.1
KDCHH 441 BG II	35.4	35.8	35.6
PRCH 102 BT	37.8	38.0	37.9
VCH 111 Bt.	37.3	36.5	36.9
NHH 44 (C.Hy)	32.8	33.0	32.9
RCH 2 Bt (Bt.C.hy)	34.9	34.3	34.6

B). MEAN SEED COTTON YIELD UNDER PROTECTED CONDITIONS

i). Irrigated

Twenty six Bt hybrids along with NHH 44 (non-Bt check) and RCH 2 Bt (Bt check) were evaluated at Khandwa and Surat under irrigated conditions for two years (Table 3).

Except KDCHH 441 BG II and MRC 6352 Bt all the other Bt hybrids evaluated were superior to the non-Bt check hybrid NHH 44 by 3 to 47 per cent.

The Bt check hybrid RCH 2 Bt recorded a mean seed cotton yield of 2099 Kg/ha. Eleven hybrids were superior to RCH 2 Bt by 1 to 23 per cent. They are GK 205 Bt (2585 Kg/ha; 23% increase), RCH 377 Bt (2549 Kg/ha; 21 increase), MRC 7226 BG II (2307 Kg/ha; 10% increase), MRC 7347 BG II (2302 Kg/ha; 10% increase), Krishna Bt (2261 Kg/ha; 8% increase), ACH 155-1 Bt (2229 Kg/ha; 6% increase), NCS 145 Bt (2200 Kg/ha; 5% increase), ACH 33-1 Bt (2193 Kg/ha; 4% increase), Tulasi 4 Bt (2167 Kg/ha; 3% increase), Brahma Bt (2120 Kg/ha; 1% increase)

ii). Rainfed

The hybrids were evaluated under rainfed situations at Akola, Nanded and Nagpur.

All the hybrids evaluated were superior to the non-Bt check hybrid by 18 to 67 per cent.

RCH 2 Bt, the Bt check hybrid, recorded a mean seed cotton yield of 2112 Kg/ha. RCH 377 Bt (2217 Kg/ha; 5% increase) and GK 205 Bt (2114 Kg/ha) were numerically superior to it.

Table 3. Mean seed cotton yield under protected conditions (Kg/ha)

Hybrid	Irrigated			Rainfed		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	2778	2321	2549	1673	2762	2217
MRC 6352 Bt	1867	1543	1705	1078	2058	1568
MRC 7226 BG II	2500	2114	2307	1567	2526	2046
MRC 7347 BG II	2346	2258	2302	1401	2804	2102
NCS 138 Bt	2013	1987	2000	1265	2506	1886
NCS 145 Bt	2312	2088	2200	1437	2524	1980
JKCH 555 Bt	1998	2155	2076	1153	2064	1609
JKCH 666 Bt	2152	1599	1875	1148	2073	1610
JKCH 226 Bt	2706	1240	1973	1660	2030	1845

NCEH 2R Bt	1928	1698	1813	1463	2442	1952
NCEH 3R Bt	1892	2002	1947	1467	2428	1948
TULASI 4 Bt	2432	1903	2167	1247	2642	1945
TULASI 117 Bt	1704	1971	1838	1159	2611	1885
NPH 2171 Bt	2465	1376	1920	1219	2248	1734
BRAHMA Bt	2105	2134	2120	1321	2858	2090
KIRTIMAN Bt	2081	1976	2028	1093	2519	1806
KRISHNA Bt	2818	1705	2261	1227	2550	1889
GK 204 Bt	2079	1625	1852	1402	2445	1923
GK 205 Bt	2701	2470	2585	1512	2716	2114
ACH 33-1 Bt	2451	1936	2193	1474	2323	1898
ACH 155-1 Bt	2180	2278	2229	1447	2712	2079
ACH 11-2 Bt	2224	1673	1949	1458	2306	1882
KDCHH 9632 Bt	2189	1777	1983	1320	2222	1771
KDCHH 441 BG II	2364	1070	1717	1420	2702	2061
PRCH 102 BT	2490	1425	1957	1477	2577	2027
VCH 111 Bt.	2166	1823	1994	1368	2375	1872
NHH 44 Bt (C.Hy)	2385	1137	1761	889	1769	1329
RCH 2 Bt (Bt.C.hy)	2242	1957	2099	1526	2698	2112

C). FIBRE QUALITY EVALUATION

All the hybrids evaluated were found to be superior to NHH 44 in terms of fibre length and strength. RCH 377 Bt, NCS 145 Bt and Brahma Bt recorded over 30 mm in fibre length, with a fibre strength of 21.2 to 22.1 g/tex. Eventhough the hybrids evaluated did not fit in with the approved standards of fibre length and strength ratio, they were found to be on par with the Bt check RCH 2 Bt (Table 4).

Table 4. Overall fibre quality

Hybrid	Overall fibre quality		
	2.5% SL (mm)	Micronaire	Strength (g/tex)
RCH 377 Bt	30.8	4.3	22.1
MRC 6352 Bt	27.6	4.2	21.5
MRC 7226 BG II	29.0	4.4	21.2
MRC 7347 BG II	28.8	4.1	21.8
NCS 138 Bt	28.5	4.2	21.3
NCS 145 Bt	30.2	4.2	21.2
JKCH 555 Bt	28.6	4.5	20.1
JKCH 666 Bt	27.7	4.1	21.0
JKCH 226 Bt	26.9	4.3	21.0

NCEH 2R Bt	29.4	3.9	21.4
NCEH 3R Bt	29.9	3.8	21.2
TULASI 4 Bt	29.0	3.9	21.0
TULASI 117 Bt	29.3	4.0	20.5
NPH 2171 Bt	28.4	3.9	21.8
BRAHMA Bt	30.1	4.0	21.3
KIRTIMAN Bt	29.5	4.2	21.8
KRISHNA Bt	28.2	3.9	21.5
GK 204 Bt	27.0	3.8	20.5
GK 205 Bt	27.9	3.8	20.2
ACH 33-1 Bt	28.1	3.9	20.8
ACH 155-1 Bt	27.1	4.0	20.5
ACH 11-2 Bt	26.8	4.0	20.7
KDCHH 9632 Bt	28.3	3.9	21.3
KDCHH 441 BG II	27.5	4.2	21.0
PRCH 102 BT	28.4	4.4	21.3
VCH 111 Bt.	28.9	4.2	20.9
NHH 44 (C.Hy)	26.2	4.2	19.3
RCH 2 Bt (Bt.C.hy)	29.2	3.9	20.5

D). ENTOMOLOGICAL EVALUATIONS

1. EVALUATION UNDER PLANT PROTECTION (ETL BASED)

SUCKING PESTS

Jassids, Thrips and Aphids were the main sucking pests (Table 5 and 6). All the hybrids evaluated harboured these insects at varying intensities at different times and exhibited susceptible reaction of varying grades. Chemical intervention was required at varying intervals to control the sucking pests.

Table 5. Sucking pest reaction

Hybrid	Jassids			Aphids		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	1.6	2.6	2.1	6.7	5.6	6.2
MRC 6352 Bt	2.1	2.9	2.5	10.1	6.9	8.5
MRC 7226 BG II	1.8	3.2	2.5	9.1	6.4	7.7
MRC 7347 BG II	1.6	2.5	2.0	8.5	7.6	8.0
NCS 138 Bt	1.5	2.8	2.2	13.9	9.3	11.6
NCS 145 Bt	1.6	2.9	2.3	13.6	8.8	11.2
JKCH 555 Bt	2.9	3.7	3.3	12.9	7.9	10.4
JKCH 666 Bt	2.0	3.3	2.6	9.1	8.4	8.7

JKCH 226 Bt	2.1	2.9	2.5	9.0	8.2	8.6
NCEH 2R Bt	1.6	2.7	2.1	9.2	8.2	8.7
NCEH 3R Bt	1.7	2.6	2.1	8.7	9.1	8.9
TULASI 4 Bt	2.1	2.7	2.4	12.5	8.0	10.3
TULASI 117 Bt	1.9	3.0	2.4	7.0	8.2	7.6
NPH 2171 Bt	2.0	3.3	2.6	10.2	8.4	9.3
BRAHMA Bt	1.6	3.0	2.3	9.2	9.6	9.4
KIRTIMAN Bt	2.0	2.9	2.5	6.4	7.2	6.8
KRISHNA Bt	1.8	2.8	2.3	9.7	8.5	9.1
GK 204 Bt	1.9	3.4	2.6	8.2	6.2	7.2
GK 205 Bt	1.6	2.6	2.1	6.9	5.8	6.3
ACH 33-1 Bt	1.6	2.8	2.2	8.9	7.2	8.0
ACH 155-1 Bt	2.1	2.6	2.4	9.4	8.5	8.9
ACH 11-2 Bt	1.6	2.5	2.1	10.5	8.4	9.5
KDCHH 9632 Bt	1.6	3.0	2.3	11.3	9.6	10.4
KDCHH 441 BG II	1.8	3.0	2.4	7.4	7.1	7.3
PRCH 102 BT	2.1	3.2	2.6	8.6	8.6	8.6
VCH 111 Bt.	2.1	3.1	2.6	9.6	8.6	9.1
NHH 44 (C.Hy)	2.5	2.7	2.6	10.4	8.8	9.6
RCH 2 Bt (Bt.C.hy)	2.3	3.6	3.0	10.3	5.4	7.9

Table 6. Thrips/Plant & Whitefly/Plant

Hybrid	Thrips/Plant			Whitefly/Plant		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	18.7	7.9	13.3	9.2	1.9	5.6
MRC 6352 Bt	18.2	10.9	14.5	10.8	2.1	6.4
MRC 7226 BG II	16.7	9.1	12.9	11.2	2.4	6.8
MRC 7347 BG II	17.8	9.6	13.7	8.9	2.6	5.7
NCS 138 Bt	16.2	9.3	12.8	11.8	2.4	7.1
NCS 145 Bt	15.0	11.8	13.4	8.5	2.0	5.3
JKCH 555 Bt	15.7	7.1	11.4	9.7	2.2	5.9
JKCH 666 Bt	15.8	8.3	12.1	9.2	1.4	5.3
JKCH 226 Bt	14.2	8.6	11.4	11.5	2.1	6.8
NCEH 2R Bt	17.8	9.0	13.4	11.8	2.0	6.9
NCEH 3R Bt	15.7	9.2	12.5	11.7	2.2	7.0
TULASI 4 Bt	14.5	9.4	11.9	9.4	2.2	5.8
TULASI 117 Bt	16.3	6.1	11.2	8.9	1.8	5.4
NPH 2171 Bt	18.3	9.5	13.9	11.1	2.3	6.7
BRAHMA Bt	15.9	8.7	12.3	9.1	2.1	5.6
KIRTIMAN Bt	15.1	8.0	11.6	9.8	2.4	6.1

KRISHNA Bt	15.3	9.8	12.5	10.4	3.0	6.7
GK 204 Bt	15.1	7.6	11.3	12.1	2.2	7.1
GK 205 Bt	17.8	7.8	12.8	8.6	2.1	5.3
ACH 33-1 Bt	17.3	10.2	13.8	10.0	2.2	6.1
ACH 155-1 Bt	16.9	10.3	13.6	8.9	2.2	5.6
ACH 11-2 Bt	16.4	9.3	12.9	10.1	2.4	6.3
KDCHH 9632 Bt	16.6	8.2	12.4	10.0	2.7	6.4
KDCHH 441 BG II	13.6	7.9	10.8	9.5	2.5	6.0
PRCH 102 BT	16.2	7.3	11.7	8.4	2.0	5.2
VCH 111 Bt.	15.7	7.4	11.6	9.4	2.1	5.7
NHH 44 (C.Hy)	16.0	8.4	12.2	9.3	2.6	6.0
RCH 2 Bt (Bt.C.hy)	14.9	5.6	10.2	10.0	1.9	6.0

Bollworms

The larval population of *Earias* spp. and *Helicoverpa armigera* was very minimum during both the years (Table 7). Even under low pressure situations the non-Bt checks harboured two to four times more population.

Table 7. Bollworm reaction under ETL based plant protection

Hybrid	<i>Earias</i> larvae/Plant			<i>H. armigera</i> larvae/Plant		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH.377	0.3	0.0	0.2	0.3	0.0	0.2
MRC.6352	0.3	0.0	0.2	0.2	0.0	0.1
MRC.7226X	0.4	0.1	0.2	0.0	0.0	0.0
MRC.7347X	0.0	0.0	0.0	0.3	0.1	0.2
NCS.138	0.4	0.0	0.2	0.1	0.1	0.1
NCS.145	0.2	0.0	0.1	0.5	0.1	0.3
VARUN	0.4	0.0	0.2	0.1	0.0	0.1
JKCH.666	0.3	0.0	0.2	0.3	0.1	0.2
JKCH.226	0.3	0.0	0.2	0.6	0.0	0.3
NECH.2R	0.4	0.0	0.2	0.5	0.0	0.3
NECH.3R	0.3	0.0	0.2	0.2	0.0	0.1
Tulasi.4	0.2	0.0	0.1	0.2	0.1	0.1
Tulasi.117	0.8	0.0	0.4	0.8	0.1	0.4
NPH.2171	0.1	0.0	0.1	0.0	0.1	0.0
BRAHMA	0.0	0.0	0.0	0.0	0.1	0.0
KIRTIMAN	0.1	0.0	0.1	0.4	0.0	0.2
KRISHNA	0.2	0.0	0.1	0.2	0.1	0.1
GK.204	0.4	0.0	0.2	0.3	0.0	0.1

GK.205	0.7	0.0	0.4	0.4	0.1	0.2
ACH-33-1	0.0	0.2	0.1	0.2	0.2	0.2
ACH-155-1	0.0	0.2	0.1	0.1	0.3	0.2
ACH-11-2x	0.0	0.0	0.0	0.2	0.2	0.2
KDCHH.9632	0.5	0.0	0.3	0.3	0.1	0.2
KDCHH.441X	0.2	0.0	0.1	0.2	0.1	0.1
PRCH.102	0.0	0.0	0.0	0.2	0.0	0.1
VCH.111	0.3	0.0	0.2	0.3	0.1	0.2
NHH.44 (ZC)	1.3	0.3	0.8	2.8	0.4	1.6
RCH.2Bt (CC)	0.2	0.0	0.1	0.2	0.0	0.1

Square damage

The mean square damage in the non-Bt check NHH 44 was 5 per cent (Table 8). However, on the Bt hybrids it varied from 1.4 to 3.6. The Bt check RCH 2 Bt recorded 2.1 per cent square damage. Among the Bt entries ACH 155-1 Bt recorded the highest square damage of 3.6 per cent.

Pink bollworm damage

The pink bollworm damage was studied in green bolls by destructive sampling. The non-Bt check hybrid recorded the highest damage of 12.5 per cent. The Bt check RCH 2 Bt recorded a mean damage of 4.7 per cent. All the Bt hybrids evaluated showed boll damage levels ranging from 2.8 to 5.8 per cent (Table 8).

Table 8. Square damage (%) and Pink bollworm damage (%)

Hybrid	Square damage (%)			Pink bollworm damage(%)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	0.7	3.0	1.8	2.5	5.7	4.1
MRC 6352 Bt	0.6	3.9	2.2	3.9	6.4	5.2
MRC 7226 BG II	1.7	3.4	2.6	3.9	4.4	4.2
MRC 7347 BG II	0.8	3.6	2.2	3.2	4.6	3.9
NCS 138 Bt	0.0	3.0	1.5	3.1	4.7	3.9
NCS 145 Bt	0.2	5.7	3.0	4.1	4.0	4.0
JKCH 555 Bt	0.0	3.1	1.5	2.2	3.6	2.9
JKCH 666 Bt	0.3	3.7	2.0	4.2	3.6	3.9
JKCH 226 Bt	0.7	3.2	1.9	4.4	5.1	4.7
NCEH 2R Bt	0.7	3.8	2.3	3.5	6.3	4.9
NCEH 3R Bt	0.0	4.6	2.3	2.7	3.0	2.8
TULASI 4 Bt	0.0	2.8	1.4	3.6	4.3	3.9
TULASI 117 Bt	3.9	2.8	3.3	6.9	4.2	5.6

NPH 2171 Bt	0.0	4.5	2.3	2.8	6.3	4.5
BRAHMA Bt	0.0	2.8	1.4	3.8	5.8	4.8
KIRTIMAN Bt	0.0	3.1	1.5	3.2	3.7	3.5
KRISHNA Bt	0.2	2.5	1.3	2.5	4.3	3.4
GK 204 Bt	0.3	3.3	1.8	4.5	5.2	4.8
GK 205 Bt	0.7	3.4	2.1	4.3	5.7	5.0
ACH 33-1 Bt	0.3	5.6	2.9	3.8	7.9	5.8
ACH 155-1 Bt	0.7	6.6	3.6	2.6	7.5	5.1
ACH 11-2 Bt	0.1	3.5	1.8	3.6	5.7	4.6
KDCHH 9632 Bt	0.1	3.5	1.8	4.1	5.9	5.0
KDCHH 441 BG II	1.2	3.4	2.3	2.7	3.6	3.2
PRCH 102 BT	1.2	2.7	1.9	4.0	4.2	4.1
VCH 111 Bt.	0.4	2.8	1.6	4.8	6.6	5.7
NHH 44 (C.Hy)	0.0	10.0	5.0	11.8	13.2	12.5
RCH 2 Bt (Bt.C.hy)	0.3	3.8	2.1	3.4	5.9	4.7

Open boll and locule damage

The open boll and locule damage was also high in non-Bt check NHH 44 (15.1 and 10.5, respectively) (Table 9). The Bt check hybrid RCH 2 Bt recorded a mean open boll damage of 5.5 per cent and locule damage of 3.9 per cent. The open boll damage in Bt test entries varied from 4.4 to 8.4 and the locule damage from 3.2 to 6.7 per cent.

Table 9. Open boll damage (%) and Locule damage %

Hybrid	Open boll damage (%)			Locule damage %		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	6.5	5.2	5.9	4.3	4.0	4.2
MRC 6352 Bt	6.8	6.1	6.5	4.1	4.1	4.1
MRC 7226 BG II	10.0	4.2	7.1	6.9	3.1	5.0
MRC 7347 BG II	8.5	4.8	6.7	5.0	3.9	4.5
NCS 138 Bt	5.7	4.8	5.3	3.2	3.9	3.6
NCS 145 Bt	12.1	4.8	8.4	9.4	3.9	6.7
JKCH 555 Bt	4.5	4.9	4.7	2.8	3.7	3.2
JKCH 666 Bt	5.6	4.4	5.0	5.5	3.4	4.4
JKCH 226 Bt	5.1	4.8	5.0	3.6	3.9	3.8
NCEH 2R Bt	10.9	4.1	7.5	7.4	3.3	5.4
NCEH 3R Bt	6.2	5.2	5.7	3.9	3.9	3.9
TULASI 4 Bt	9.0	4.2	6.6	6.4	3.5	5.0
TULASI 117 Bt	9.7	4.2	6.9	7.0	3.3	5.2
NPH 2171 Bt	4.8	5.5	5.1	3.3	4.1	3.7
BRAHMA Bt	8.1	4.4	6.2	5.9	3.6	4.7

KIRTIMAN Bt	5.5	4.5	5.0	3.5	3.5	3.5
KRISHNA Bt	4.5	4.2	4.4	3.6	3.6	3.6
GK 204 Bt	6.6	4.6	5.6	3.8	3.6	3.7
GK 205 Bt	9.7	4.4	7.1	5.1	3.8	4.5
ACH 33-1 Bt	7.5	5.4	6.4	4.1	4.1	4.1
ACH 155-1 Bt	8.4	6.5	7.4	5.8	4.8	5.3
ACH 11-2 Bt	8.8	5.6	7.2	5.2	4.1	4.7
KDCHH 9632 Bt	6.3	5.3	5.8	4.3	4.3	4.3
KDCHH 441 BG II	7.9	4.1	6.0	4.7	3.4	4.1
PRCH 102 BT	7.3	4.2	5.7	5.2	3.3	4.2
VCH 111 Bt.	6.7	4.3	5.5	4.4	3.3	3.9
NHH 44 (C.Hy)	18.3	11.9	15.1	13.5	7.6	10.5
RCH 2 Bt (Bt.C.hy)	6.6	4.4	5.5	4.2	3.6	3.9

Plant protection

Two to three rounds of systemic insecticides were required to control the sucking pests. However, very few sprayings were required to control the bollworms. NHH 44 the non-Bt check required on an average 2.3 rounds of sprayings to control the bollworms effectively. On the other hand, the Bt entries required 0 to 0.5 rounds of application. ACH 155-1 Bt required 1 to 3 rounds of chemical sprays to control the pests (Table 10).

Table 10. Spray schedule for sucking pests and Bollworms

Hybrid	For sucking pests			For Bollworms		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	2.7	1.8	2.2	0.0	0.0	0.0
MRC 6352 Bt	2.7	2.4	2.5	0.0	0.6	0.3
MRC 7226 BG II	2.7	2.0	2.3	0.0	0.4	0.2
MRC 7347 BG II	2.7	2.0	2.3	0.3	0.0	0.2
NCS 138 Bt	3.0	2.2	2.6	0.3	0.4	0.4
NCS 145 Bt	2.3	2.0	2.2	0.3	0.2	0.3
JKCH 555 Bt	2.3	2.6	2.5	0.3	0.0	0.2
JKCH 666 Bt	2.7	2.4	2.5	0.0	0.0	0.0
JKCH 226 Bt	2.7	2.4	2.5	0.3	0.2	0.3
NCEH 2R Bt	2.7	2.4	2.5	0.7	0.2	0.4
NCEH 3R Bt	2.7	2.4	2.5	0.0	0.6	0.3
TULASI 4 Bt	2.7	2.4	2.5	0.3	0.4	0.4
TULASI 117 Bt	2.7	2.4	2.5	0.0	0.2	0.1
NPH 2171 Bt	2.7	2.8	2.7	0.0	0.4	0.2
BRAHMA Bt	2.7	2.6	2.6	0.0	0.2	0.1

KIRTIMAN Bt	3.0	2.2	2.6	1.0	0.0	0.5
KRISHNA Bt	2.7	2.4	2.5	0.0	0.2	0.1
GK 204 Bt	2.7	2.0	2.3	0.0	0.2	0.1
GK 205 Bt	3.0	1.8	2.4	0.3	0.2	0.3
ACH 33-1 Bt	2.7	1.8	2.2	0.7	1.4	1.0
ACH 155-1 Bt	2.7	1.8	2.2	1.0	1.6	1.3
ACH 11-2 Bt	2.7	2.0	2.3	0.7	0.4	0.5
KDCHH 9632 Bt	3.0	2.6	2.8	0.0	0.0	0.0
KDCHH 441 BG II	2.7	2.4	2.5	0.0	0.2	0.1
PRCH 102 BT	2.7	2.6	2.6	0.0	0.0	0.0
VCH 111 Bt.	2.7	2.8	2.7	0.0	0.0	0.0
NHH 44 (C.Hy)	2.7	2.4	2.5	2.0	2.6	2.3
RCH 2 Bt (Bt.C.hy)	2.7	2.6	2.6	0.0	0.4	0.2

2). EVALUATION UNDER UNPROTECTED CONDITION

Under unprotected conditions the non-Bt check hybrid NHH 44 showed higher open boll (28.6 %) and locule (16.5 %) damage. RCH 2 Bt, the check hybrid showed 7 per cent open boll damage and 5.8 per cent locule damage. The open boll damage in test hybrids varied from 8.7 per cent to 12.0 per cent and the locule damage from 6.5 to 9.4 per cent (Table 11).

Table 11. Boll damage under unprotected condition

Hybrid	Open boll damage (%)			Locule damage (%)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	4.8	12.6	8.7	2.8	11.0	6.9
MRC 6352 Bt	5.1	12.4	8.7	2.9	10.8	6.8
MRC 7226 BG II	6.2	9.7	7.9	3.8	9.2	6.5
MRC 7347 BG II	6.4	12.0	9.2	3.3	10.7	7.0
NCS 138 Bt	6.0	12.4	9.2	4.6	10.1	7.4
NCS 145 Bt	10.3	11.9	11.1	7.2	11.3	9.2
JKCH 555 Bt	7.9	11.1	9.5	4.8	8.8	6.8
JKCH 666 Bt	6.3	11.5	8.9	4.0	10.7	7.4
JKCH 226 Bt	8.9	11.9	10.4	5.5	10.9	8.2
NCEH 2R Bt	11.6	11.5	11.5	7.8	10.4	9.1
NCEH 3R Bt	11.4	12.1	11.7	7.4	10.6	9.0
TULASI 4 Bt	3.9	13.6	8.7	2.7	12.7	7.7
TULASI 117 Bt	4.1	11.7	7.9	2.6	8.8	5.7
NPH 2171 Bt	7.1	14.3	10.7	4.3	11.7	8.0
BRAHMA Bt	6.0	12.9	9.4	4.3	11.5	7.9

KIRTIMAN Bt	6.5	12.3	9.4	4.4	9.8	7.1
KRISHNA Bt	8.4	11.5	9.9	5.1	10.8	8.0
GK 204 Bt	6.0	10.9	8.4	4.0	10.5	7.3
GK 205 Bt	6.0	10.5	8.3	3.3	9.5	6.4
ACH 33-1 Bt	6.7	12.6	9.6	3.6	11.4	7.5
ACH 155-1 Bt	10.7	13.4	12.1	6.1	11.4	8.7
ACH 11-2 Bt	9.6	14.3	12.0	6.4	12.3	9.4
KDCHH 9632 Bt	6.2	11.9	9.0	4.0	11.3	7.6
KDCHH 441 BG II	5.5	10.9	8.2	3.5	10.6	7.1
PRCH 102 BT	6.7	11.3	9.0	4.4	9.8	7.1
VCH 111 Bt.	5.0	10.9	8.0	3.2	9.8	6.5
NHH 44 (C.Hy)	39.8	17.5	28.6	18.4	14.7	16.5
RCH 2 Bt (Bt.C.hy)	3.6	10.3	7.0	2.0	9.6	5.8

E). MEAN SEED COTTON YIELD UNDER UNPROTECTED CONDITIONS

i). Irrigated

Under unprotected conditions, in the irrigated trial as many as sixteen test hybrids were found to be superior to NHH 44.

RCH 2 Bt, the Bt check hybrid recorded a mean seed cotton yield of 1507 Kg/ha. Twelve hybrids recorded higher seed cotton yield over the Bt check hybrid. The yield increases were of the order of 1 to 29 per cent. They are GK 205 Bt (1950 Kg/ha; 29% increase), RCH 377 Bt (1766 Kg/ha; 17% increase), ACH 155-1 Bt (1728 Kg/ha; 15% increase), MRC 7347 BG II (1717 Kg/ha; 14% increase), Brahma Bt (1649 Kg/ha; 9% increase), MRC 7226 BG II (1627 Kg/ha; 8% increase), NCEH 3R Bt (1611 Kg/ha; 7% increase), NCS 145 Bt (1611 Kg/ha; 7% increase), NCS 138 Bt (1581 Kg/ha; 5% increase), Tulasi 4 Bt (1534 Kg/ha; 2% increase), VCH 111 Bt (1525 Kg/ha; 1% increase), ACH 33-1 Bt (1510 Kg/ha; less than 1% increase).

ii). Rainfed

In the rainfed trials, NHH 44, the non-Bt check recorded the lowest yield.

RCH 2 Bt, the Bt check hybrids recorded a mean seed cotton yield of 1656 kg/ha. As many as 18 hybrids were superior to it by 2 to 25 per cent. They are MRC 7226 BG II (2066 Kg/ha; 25% increase), NCS 145 Bt (1942 Kg/ha; 17% increase), GK 205 Bt (1896 Kg/ha; 14% increase), RCH 377 Bt (1894 Kg/ha; 14% increase), GK 204 Bt (1837 Kg/ha; 11% increase), KDCHH 441 BG II (1817 Kg/ha; 10% increase), NCS 138 Bt (1801 Kg/ha; 9% increase), ACH 155-1 Bt (1787 Kg/ha; 8% increase), Brahma Bt (1784

Kg/ha; 8% increase), MRC 7347 BG II (1772 Kg/ha; 7% increase), Tulasi 4 Bt (1768 Kg/ha; 7% increase), ACH 11-2 Bt (1745 Kg/ha; 5% increase), NCEH 2R Bt (1731 Kg/ha; 5% increase), PRCH 102 Bt (1731 Kg/ha; 5% increase), Kirtiman Bt (1726 Kg/ha; 4% increase), MRC 6352 Bt (1703 Kg/ha; 3% increase), JKCH 226 Bt (1693 Kg/ha; 2% increase), NCEH 3R Bt (1681 Kg/ha; 2% increase) (Table 12).

Table 12 : Mean Seed Cotton Yield under Unprotected conditions

Hybrid	Irrigated			Rainfed		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
RCH 377 Bt	1396	2137	1766	1647	2142	1894
MRC 6352 Bt	1272	1337	1304	1148	2259	1703
MRC 7226 BG II	1213	2041	1627	1715	2417	2066
MRC 7347 BG II	1488	1946	1717	1239	2306	1772
NCS 138 Bt	1271	1891	1581	1395	2207	1801
NCS 145 Bt	1413	1808	1611	1433	2451	1942
JKCH 555 Bt	1072	1506	1289	1166	2146	1656
JKCH 666 Bt	1310	1682	1496	1196	2095	1645
JKCH 226 Bt	1492	1213	1352	1469	1917	1693
NCEH 2R Bt	1195	1768	1481	1374	2089	1731
NCEH 3R Bt	1455	1768	1611	1372	1991	1681
TULASI 4 Bt	1177	1891	1534	1156	2380	1768
TULASI 117 Bt	837	1934	1385	1193	2045	1619
NPH 2171 Bt	1225	1407	1316	1250	1972	1611
BRAHMA Bt	1409	1889	1649	1365	2204	1784
KIRTIMAN Bt	1200	1764	1482	1233	2220	1726
KRISHNA Bt	1523	1416	1469	1222	2024	1623
GK 204 Bt	1311	1454	1382	1337	2336	1837
GK 205 Bt	1819	2081	1950	1533	2258	1896
ACH 33-1 Bt	1311	1709	1510	1484	1763	1623
ACH 155-1 Bt	1735	1722	1728	1371	2203	1787
ACH 11-2 Bt	1214	1561	1387	1358	2131	1745
KDCHH 9632 Bt	1055	1602	1328	1130	1982	1556
KDCHH 441 BG II	1343	1028	1185	1497	2137	1817
PRCH 102 BT	1194	1575	1384	1345	2117	1731
VCH 111 Bt.	1336	1713	1525	1283	1997	1640
NHH 44 (C.Hy)	1803	1002	1402	862	1626	1244
RCH 2 Bt (Bt.C.hy)	1258	1757	1507	1364	1949	1656

F). PATHOLOGICAL EVALUATION

Among the foliar diseases bacterial blight, grey mildew and alternaria leaf spots are the important diseases in this zone. Parawilt occurs regularly at Khandwa, Myrothecium leaf spot is a very minor one and occurs at very low intensity.

Bacterial blight

Bacterial blight was observed at all the five locations, where these hybrids were tested. However, for combined evaluation, the data from Akola and Surat were alone taken because of higher incidence during 2004-05. During 2005-06, all the hybrid entries have been found highly susceptible at Akola including the check hybrids. However, during 2004-05 only Tulasi 4 Bt, had low incidence of the disease (5.79 to 11.73 per cent) and the rest had higher incidences (Table 13).

Table 13. Per cent Disease Incidence (PDI) of Bacterial blight on Bt hybrids

Hybrid	Akola		Surat	
	2004-05	2005-06	2004-05	2005-06
RCH 377 Bt	28.70	53.33	25.87	0.00
MRC 6352 Bt	27.16	50.00	19.95	0.00
MRC 7226 BG II	18.21	57.78	22.26	0.00
MRC 7347 BG II	20.37	55.56	0.57	0.67
NCS 138 Bt	31.97	52.22	5.04	0.00
NCS 145 Bt	27.78	51.11	13.35	0.00
JKCH 555 Bt	33.64	45.56	0.57	0.00
JKCH 666 Bt	22.84	44.45	17.42	0.00
JKCH 226 Bt	35.81	54.45	32.75	0.67
NCEH 2R Bt	-	53.33	15.04	0.00
NCEH 3R Bt	22.84	57.78	22.04	0.00
TULASI 4 Bt	11.73	53.34	5.79	0.00
TULASI 117 Bt	14.82	28.89	15.47	0.00
NPH 2171 Bt	14.20	50.00	7.33	0.50
BRAHMA Bt	24.71	54.45	0.57	0.00
KIRTIMAN Bt	31.48	34.45	19.92	0.33
KRISHNA Bt	23.15	46.66	21.98	0.00
GK 204 Bt	28.02	51.11	30.23	4.00
GK 205 Bt	13.27	51.11	20.01	1.67
ACH 33-1 Bt	40.12	41.11	0.57	0.00
ACH 155-1 Bt	28.70	37.78	6.71	0.00
ACH 11-2 Bt	33.95	57.78	7.79	0.00
KDCHH 9632 Bt	26.85	43.33	10.97	0.00
KDCHH 441 BG II	28.09	57.78	13.74	0.00
PRCH 102 BT	21.67	51.11	7.61	0.00
VCH 111 Bt.	21.61	47.78	0.57	0.00
NHH 44 (C.Hy)	12.04	15.56	8.65	0.00
RCH 2 Bt (Bt.C.hy)	11.97	31.11	16.92	0.00

Alternaria leaf spot

From the two years data of Nagpur and Nanded, it was found that, the hybrid entries MRC 7226 BG II, NCS 138 Bt, JKCH 666 Bt, Brahma Bt, Krishna Bt, GK 205 Bt, ACH 11-2 Bt and KDCHH 441 BG II were found susceptible to alternaria leaf spot having a disease incidence ranging from 12.0 to 15 per cent. Other entries had below 10.00 PDI (Table 14).

Grey mildew

Since grey mildew has been observed for two years only at Nanded and the incidence at Nagpur during 2005-06 was low, the data from Nanded were taken into consideration for the assessment of the hybrids against this disease. The hybrid entries RCH 377 Bt, JKCH 555 Bt, JKCH 226 Bt, Tulasi 117 Bt, NPH 2171 Bt, VCH 111 Bt and the check hybrid RCH 2 Bt had disease incidence below 10.0 per cent. The rest of the entries have been found highly susceptible to this disease (Table 14).

Table 14. Alternaria leaf spot and Grey mildew incidences on Bt hybrids (PDI)

Hybrid	Alternaria leaf spot				Grey mildew	
	Nagpur		Nanded		Nanded	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
RCH 377 Bt	0.00	3.52	5.70	10.00	10.00	7.27
MRC 6352 Bt	0.30	6.53	10.75	10.00	20.32	7.27
MRC 7226 BG II	2.24	6.63	15.00	9.01	25.09	5.11
MRC 7347 BG II	1.91	3.4.	10.54	5.00	23.21	7.01
NCS 138 Bt	1.15	1.45	15.00	5.95	35.07	15.00
NCS 145 Bt	0.91	3.93	9.34	9.91	35.00	15.95
JKCH 555 Bt	1.52	9.8	5.95	10.55	10.00	7.00
JKCH 666 Bt	0.40	2.57	12.00	10.00	15.00	4.95
JKCH 226 Bt	1.63	3.43	5.50	5.00	10.00	5.75
NCEH 2R Bt	0.58	2.76	5.00	4.01	15.00	4.00
NCEH 3R Bt	0.88	2.98	10.00	7.91	30.00	5.45
TULASI 4 Bt	-	2.03	2.00	3.25	15.21	5.90
TULASI 117 Bt	0.25	1.68	5.00	10.00	10.00	5.00
NPH 2171 Bt	0.00	5.57	9.00	3.00	10.00	3.85
BRAHMA Bt	0.28	14.73	12.95	15.95	35.93	5.95
KIRTIMAN Bt	1.00	4.59	9.09	5.75	10.00	15.00
KRISHNA Bt	1.01	3.67	15.00	3.00	15.00	10.00
GK 204 Bt	0.42	3.84	10.00	5.75	5.00	25.79
GK 205 Bt	-	3.73	15.00	3.51	5.00	25.75
ACH 33-1 Bt	0.73	4.81	10.00	3.51	25.00	5.00
ACH 155-1 Bt	0.10	3.71	7.90	4.11	15.00	10.09
ACH 11-2 Bt	1.33	2.03	15.00	4.01	15.35	4.95
KDCHH 9632 Bt	1.23	3.1	9.09	4.11	30.00	5.71

KDCHH 441 BG II	1.16	3.72	15.87	10.00	30.07	5.15
PRCH 102 BT	0.83	6.68	5.00	5.00	10.53	5.00
VCH 111 Bt.	1.18	4.02	8.95	15.91	1.23	4.75
NHH 44 (C.Hy)	0.85	3.4	10.00	4.00	21.25	4.00
RCH 2 Bt (Bt.C.hy)	1.31	3.53	5.95	3.26	5.00	4.00

Parawilt

Only at Khandwa centre, the parawilt symptoms were noticed during the two years of evaluation. The Bt entries MRC 7347 BG II, JKCH 226 Bt, Tulasi 4 Bt, GK 204 Bt and KDCHH 441 BG II had more than 10 per cent of the plants wilted. Rest of the hybrids had less than 10 per cent and none was free (Table 15).

Table 15. Incidence of Parawilt on Bt hybrids (%)

Hybrid	Khandwa	
	2004-05	2005-06
RCH 377 Bt	1.11	4.45
MRC 6352 Bt	0.00	5.55
MRC 7226 BG II	7.77	0.00
MRC 7347 BG II	11.11	4.44
NCS 138 Bt	0.00	0.00
NCS 145 Bt	1.11	4.44
JKCH 555 Bt	0.00	8.89
JKCH 666 Bt	2.22	4.44
JKCH 226 Bt	10.00	0.00
NCEH 2R Bt	2.22	1.11
NCEH 3R Bt	0.00	5.56
TULASI 4 Bt	10.00	0.00
TULASI 117 Bt	5.55	3.33
NPH 2171 Bt	8.88	5.56
BRAHMA Bt	8.86	2.22
KIRTIMAN Bt	0.00	5.56
KRISHNA Bt	1.11	5.56
GK 204 Bt	14.44	3.33
GK 205 Bt	5.55	8.89
ACH 33-1 Bt	7.77	0.00
ACH 155-1 Bt	1.11	4.44
ACH 11-2 Bt	0.00	4.44
KDCHH 9632 Bt	4.44	2.22
KDCHH 441 BG II	12.24	5.56
PRCH 102 BT	4.44	6.67
VCH 111 Bt.	0.00	1.11
NHH 44 (C.Hy)	0.00	5.56
RCH 2 Bt (Bt.C.hy)	0.00	1.11

G). OVERALL ASSESSMENT AND CONCLUSION

Results of the evaluation of twenty six Bt cotton hybrids along with NHH 44 (non-Bt check) and RCH 2 Bt (Bt check) at five locations for two years are discussed. Twenty six Bt hybrid entries were evaluated under irrigated conditions at Khandwa and Surat and under rainfed situation in Akola, Nanded and Nagpur for two years.

All the hybrids evaluated including the check hybrids were found to be susceptible to sucking pests especially jassids at varying levels during both the years. However, they could be easily kept under check through ETL based plant protection measures.

Bollworms infestation was moderate during both the years as indicated by low larval populations of *Earias* spp. and *Helicoverpa armigera* and square damage. Even under low infestation levels, the non-Bt check hybrid recorded more bollworm damage as compared to the Bt hybrids, indicating the good resistance provided by the Bt hybrids to bollworms. The bollworm reaction in respect of test entries were on par with the Bt check hybrid. The non-Bt check hybrid required 2.3 rounds of chemical sprayings to control bollworms. On the other hand Bt hybrids required nil to 0.5 rounds of sprayings.

The two years assessment of the Bt hybrids showed that all of them are susceptible to bacterial blight under high disease pressure in Akola. Against alternaria leaf spot MRC 7226 BG II, NCS 138 Bt, JKCH 666 Bt, Brahma Bt, Krishna Bt, GK 205 Bt, ACH 11-2 Bt and KDCHH 441 BG II were susceptible. The test entries RCH 377 Bt, JKCH 555 Bt, JKCH 226 Bt, Tulasi 117 Bt, NPH 2171 Bt and VCH 111 Bt had less than 10.0 per cent grey mildew incidence while others have been found susceptible.

An overall assessment of 26 Bt cotton hybrids under both Irrigated and Rainfed situations indicated that under **Irrigated Protected Conditions** only seven hybrids viz., GK 205 Bt, RCH 377 Bt, MRC 7226 BG II, MRC 7347 BG II, Krishna Bt, ACH 155-1 Bt and NCS 145 Bt recorded 5% or more seed cotton yield over the common Bt check hybrid RCH 2 Bt. The performance of these hybrids except Krishna Bt under unprotected condition also showed a yield increase ranging from 7 to 29 per cent. Krishna Bt recorded less seed cotton yield than the RCH 2 Bt check hybrid.

Under **Rainfed protected condition**, only two hybrids GK 205 Bt and RCH 377 Bt were found to be superior than the RCH 2 Bt check. They were also better than the common check hybrid RCH 2 Bt under unprotected conditions.

All the seven test hybrids were on par with the check hybrid RCH 2 Bt in fibre quality parameters.

The overall performance of these hybrids is furnished below.

Mean Seed Cotton Yield (kg/ha)

Hybrids	Irrigated				Rainfed			
	Protected conditions		Unprotected Conditions		Protected conditions		Unprotected Conditions	
	Seed Cotton Yield (kg/ha)	% increase over check	Seed Cotton Yield (kg/ha)	% increase over check	Seed Cotton Yield (kg/ha)	% increase over check	Seed Cotton Yield (kg/ha)	% increase over check
GK 205 Bt	2585	23	1950	29	2114	-	1896	14
RCH 377 Bt	2549	21	1766	17	2217	5	1894	14
MRC 7226 BG II	2307	10	1627	8				
MRC 7347 BG II	2302	10	1717	14				
Krishna Bt	2261	8	1469	-				
ACH 155-1 Bt	2229	6	1728	15				
NCS 145 Bt	2200	5	1611	7				
RCH 2 Bt (Check)	2099	-	1507	-	2112	-	1656	-

Hybrids	Ginning Percent	Fibre Quality		
		2.5% span length (mm)	Micronaire	Strength (g/tex)
GK 205 Bt	35.8	27.9	3.8	20.2
RCH 377 Bt	34.3	30.8	4.3	22.1
MRC 7226 BG II	32.5	29.0	4.4	21.2
MRC 7347 BG II	35.8	28.8	4.1	21.8
Krishna Bt	34.0	28.2	3.9	21.5
ACH 155-1-Bt	36.2	27.1	4.0	20.5
NCS 145 Bt	34.5	30.2	4.2	21.2
RCH 2 Bt (Check)	34.6	29.2	3.9	20.5

Pest Reaction

All the entries required plant protection against sucking pests. Boll worm damage was on par with RCH 2 Bt check hybrid.

Disease reaction

As regards disease reaction, they are susceptible to bacterial blight and moderately susceptible to both alternaria leaf spot and grey mildew. These entries require timely plant protection measures to manage the diseases.