

**Bt COTTON
EVALUATION REPORT
Second Year
(9 Bollgard - I Bt hybrids)**

CENTRAL ZONE

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Executive Summary

- The nine Bt hybrids, viz., ANKUR.09Bt, ANKUR.651Bt, ANKUR.2534Bt, MRC.6301Bt, MRC.6304Bt, MRC.6160Bt, RCH.118Bt, RCH.335Bt and RCH.359Bt were evaluated with MECH.162Bt and RCH.2Bt as check hybrids and NHH.44 as zonal hybrid check. These entries were evaluated at Central Institute for Cotton Research Institute, Nagpur, Dr.Punjabrao Deshmukh Krishi Vidyapeeth, Akola, Cotton Research Station of Marathwada Agricultural University, Nanded, Cotton Research Station, Khandwa of Jawaharlal Nehru Krishi Vishwa Vidyalaya, and Cotton Research Station, Surat of Navsari Agricultural University for the second year in succession with the same protocol observed during 2003 *kharif* season.
- The breeding evaluation concentrated on various observations on plant biometric characters such as number of monopodia per plant, number of sympodia per plant, nodes per plant, mean length of sympodia, number of fruiting points per sympodium, number of green bolls per plant at harvest, number of burst bolls per plant at harvest, mean boll weight, seed index, Lint index, seed cotton yield per hectare in addition to the fibre length, strength and micronaire of the entries tested.
- The percentage Ginning outturn (GOT) was ranging between 35 to 38 in Bt test entries, as seen in the following table. The highest GOT in this zone was seen in RCH.359Bt (38.4%). In general, non-Bt counterparts recorded lower GOT over their Bt counterparts in this zone. The lint index was the highest in MRC.6160Bt (5.26), RCH.359Bt (5.21), RCH.118Bt (5.15), MRC.6301 Bt (5.08).
- These nine hybrids were tested under unprotected conditions for studying their response to bollworms and other lepidopterous insects to assess the action of the Cry 1 A(c) gene in them in Central zone. In general, bollworm pressure was low in this zone during this season. Spotted bollworms were low in population in the central zone centres. However, the Bt hybrids were infested with lower number of bollworms, in comparison to their non-Bt counterparts. Observations on the incidence of the American bollworm in various test hybrids showed that their population was low in Bt hybrids over their non-Bt counterparts. This observation was reinforced with the data on the percent square damage in the zone. Significant reduction in damage was noticed in all centres in Bt test hybrids. The NHH.44, the conventional check hybrid, had over 10% square damage. Some non-Bt hybrids such as MRC.6160 recorded 12.8% square damage.

- The observation on the number of Pink bollworms (PBW) in green bolls after destructive sampling showed that the Bt test hybrids harboured lower number of PBW. Khandwa centre showed the maximum infestation of this pest. The percent locule damage was seen to be significantly low in Bt test hybrids in all centres. The zone's mean damage also showed that the Bt test hybrids did exhibit strong reduction in bollworm damage. The percent open boll damage data showed that the reduction in this damage in Bt hybrids was significantly low. However, the reduction in RCH.118 Bt hybrid was less than that in other hybrids. The non-Bt check hybrid recorded 22.1% damage and some non-Bt hybrids recorded more than this under protected conditions. The Check hybrid, NHH.44 had 7.5 PBW per boll and in some non-Bt counterpart hybrids, it was up to 18.9/boll. The Bt hybrids showed locule damage between 4.9 to 7.2 per cent in comparison to 16.8 to 21.9 per cent in NHH.44 as well as the non-Bt counterpart hybrids. The open boll damage also showed that Bt hybrids recorded very low values in comparison to non-Bt hybrids. RCH.359Bt, all Ankur hybrids as well as MRC.6301Bt had the lowest open boll damage. Damage in open bolls was up to a maximum of 35.6 per cent.
- The observation on the mean jassid numbers per plant showed that under protected conditions, the genotypes did not vary much to their reaction to this insect. Khandwa recorded the highest infestation in this zone and in spite of protection with insecticides, most of the hybrids had high population of this insect as well as damage level. The incidence of thrips was the highest in Akola and Nanded, where early season drought was prevalent. All the test hybrids and check hybrids had similar infestation in spite of protection with insecticides. The jassid infestation was more at Akola and Khandwa. All genotypes were susceptible to this insect also in this zone. Hence, it is imperative that the suitable strategy to reduce their build up is taken up at instances when they cross the threshold level. Under protected condition, the whitefly population in all entries was quite high in Nanded in this zone. The other centres showed low population.
- When the number of sprayings in central zone was considered, MRC.6302Bt, MRC.6304Bt, RCH.118Bt and RCH.335Bt did not receive any insecticide spraying to suppress bollworms, since they did not cross economic threshold levels. In the case of other Bt hybrids, this was below 1.5 in comparison to 2 and above in non-Bt hybrids. The number of sprayings for sap sucking pest in Unprotected test hybrids was ranging from 2 and 3. The maximum number of 4 to 5 was done in Akola centre in this zone in almost all hybrids.

- Foliar diseases viz., Bacterial leaf blight (BLB), Grey mildew, Alternaria leaf spot and Myrothecium leaf spot and also Parawilt appeared in central zone and the test Bt hybrids could be evaluated for their reaction during this year. Among these diseases, significant incidence of Bacterial leaf blight at Surat and Akola, Grey mildew at Nanded and Parawilt at Khandwa as well as at Akola have been noticed. RCH.118Bt, Ankur.651Bt and MRC.6160Bt were found to be highly susceptible at Akola where as at Surat, RCH.118Bt, MRC 6301Bt and MRC.6160 Bt showed higher susceptibility to BLB. There were no differences between Bt and non-Bt hybrids in their susceptibility. Some entries such as RCH.335, Ankur.2534Bt and MRC.6160Bt and non-Bt hybrids showed high incidence of the disease in unprotected plots, warranting recommended control measures. Both Bt and non-Bt hybrids are equally susceptible to this disease. There was no correlation between disease incidence and seed cotton yield in this trial. Since overall seed cotton yield was low, the correlation between yield and disease incidence could not be arrived at.
- Parawilt was noticed at Khandwa ranging from 0.00% (RCH.118 Bt) to 8.33% (MRC.6160 Bt) under protected conditions and 0.00% (RCH.118 Bt) to 5.83 % (Ankur.09 Bt) under unprotected conditions where as at Akola the incidences of parawilt was from 0.00 % to 4.00%. There was variation in the incidence of wilt at these two centres. The seed cotton yield was not seen to be affected during this year due to this syndrome. This may be due to the late occurrence of parawilt in the season. As seen in this evaluation result, there was no relationship with seed cotton yield and Parawilt incidence in most of the entries.
- In the zone, the non-Bt entries had 2.0 to 2.7 sprayings against sap sucking pests and 1.3 to 2.7 number of sprays against bollworms on non-Bt entries during 2004 season, as seen from the following table. However, in their Bt counterparts, the number of insecticide spraying against bollworms ranged from nil to 1.3. Since the threshold levels for bollworms never exceeded the prescribed limit to warrant any insecticide spray.
- The average seed cotton yield, during 2004 season, under protected condition in central zone shows that RCH.118Bt and RCH.335Bt have yielded 1679 and 1616 kg/ha seed cotton respectively. MRC.6160Bt yielded 1428 kg/ha while Ankur.651Bt and MRC.6301Bt yielded 1419 kg/ha. There is clear superiority over the non-Bt counterpart hybrids as well as over check hybrids.
- Under unprotected conditions, however, the average seed cotton yield harvested, during 2004 season, in RCH.335BT with 1512.2 kg/ha, RCH.359 with

1506.4 kg/ha, MRC.6301Bt with 1459.4 kg/ha and MRC.6160Bt with 1460.6 kg/ha and these were the top entries. Other Bt hybrids yielded between 1160.8 to 1389.6 kg/ha. RCH. 335Bt, RCH.359Bt, MRC.6301Bt and MRC.6160Bt were statistically at par. Ankur.651Bt and Ankur.09Bt, that are released for central zone, yielded 1321 kg/ha and 1160.8 kg/ha respectively in this evaluation. This data shows clearly the gene action to provide protection from bollworms over the non-Bt checks and over the counterparts of the test hybrids.

Combined results of two years' (2003 & 2004 seasons) evaluations:

- The seed cotton yield superiority, under protected conditions of RCH.118Bt (mean yield of two years under protected condition was 1365 kg/ha) and RCH.335Bt (mean yield of two years under protected condition was 1389 kg/ha) is seen. In both protected and unprotected conditions, MRC.6360Bt performed well in terms of mean seed cotton yield for two years (1347 & 1288 kg/ha respectively in protected and unprotected plots) in rainfed evaluation of central zone.
- The fibre tenacity values of the test hybrids were not, however, commensurate with span length recorded in the Bt test hybrids for the desirable yarn quality and yield, as stipulated by CIRCOT and SITRA (South India Textile Research Association, Textile Ministry) norms. Fibre samples from large plots shall only provide clear picture about the goodness of these entries under rainfed conditions.
- The susceptibility of all Bt hybrids and their non-Bt counterparts to sap sucking insects such as jassids in certain endemic centres of this zone shall indicate that the cultivation of these hybrids in this zone warrant recommended plan protection measures to prevent their excess build up. The data of 2004-05 indicate that suitable recommendation for protecting the test hybrids from excess build up and damage by jassids and thrips shall be warranted in this zone. The data on number Pink bollworm in the test hybrids of 2004-05 indicate that there is some measure of reduction in Bt test hybrids. However, their natural build up has to be cautiously watched in order to suitably protect the crop from severe damage.
- During 2003 - 04, there was very little disease incidence in the test Bt hybrids and hence the hybrids could not be evaluated for their reaction to various diseases. However, during 2004 *kharif* season, Parawilt was noticed at Khandwa ranging from 0.00% (RCH.118 Bt) to 8.33% (MRC.6160 Bt) under protected conditions and 0.00% (RCH.118 Bt) to 5.83 % (Ankur.09 Bt) under unprotected conditions

where as at Akola the incidences of parawilt was from 0.00 % to 4.00%. There was variation in the incidence of wilt at these two centres. The seed cotton yield was not affected. This may be due to the late occurrence of parawilt in the season. There was no relationship with seed cotton yield and Parawilt incidence in most of the entries. The trials at Khandwa and Akola centres showed Parawilt syndrome and hence this observation was specially considered at these centres in the various test entries. However, their relationship with seed cotton yield was not established from data during 2004-05.

- The Central zone is prone to Grey mildew disease under favourable climatic conditions. Although some of the test entries were susceptible during this year, this disease could be managed with prophylactic recommendation of suitable fungicide, as is recommended for all other cotton hybrids and varieties and shall be a pre-requisite for extensive cultivation of the Bt hybrids in this zone.
- In the zone, the non-Bt entries had 2.0 to 2.7 sprayings against sap sucking pests and 1.3 to 2.7 number of sprays against bollworms on non-Bt entries during 2004 season, as seen from the following table. However, in their Bt counterparts, the number of insecticide spraying against bollworms ranged from nil to 1.3. Since the threshold levels for bollworms never exceeded the prescribed limit to warrant any insecticide spray. During 2003 season also, similar number of sprayings were given to these test genotypes for preventing high build up of sap sucking pests and the status of bollworm population was also similar as in 2004 season.

EVALUATION REPORT FOR SECOND YEAR (2004 season)

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Introduction

The All India Coordinated Cotton Improvement Project (AICCIP) undertook the evaluation of **nine cotton hybrids** possessing the Cry 1 A(c) gene expressing delta-endotoxin in five central Zone centres, viz., Central Institute for Cotton Research Institute, Nagpur, Dr.Punjabrao Deshmukh Krishi Vidyapeeth, Akola, Cotton Research Station of Marathwada Agricultural University, Nanded, Cotton Research Station, Khandwa of Jawaharlal Nehru Krishi Vishwa Vidyalaya, and Cotton Research Station, Surat of Navsari Agricultural University for the second year in succession (vide ICAR letter No.2(8)/2003-C.C.I. dated 25.4.2003). The trials were laid out in accordance with standard package of practices of cotton cultivation, followed at respective centers, where the evaluations were undertaken. The untreated, acid de-linted seeds of the relevant test hybrids and their non-Bt counterparts were provided by the above seed companies. The relevant Bt check, local checks were included for comparison and results are furnished below:

Test hybrid entries:

The nine Bt hybrids, viz., ANKUR-651Bt, ANKUR-09Bt, ANKUR-2534Bt, MRC.6301Bt, MRC.6304Bt, MRC.6160Bt RCH.118Bt, RCH.335Bt and RCH.359Bt were evaluated with MECH.162Bt and RCH2Bt as check hybrids and NHH.44 as zonal hybrid check. These entries were evaluated at these centres with the same protocol observed during 2003 *kharif* season

Date of sowing and final harvest

Dates	Nagpur	Akola	Nanded	Surat	Khandwa
Date of sowing	17.06.04	9.7.04	05.07.04	15.6.2004	26.06.04
Date of final harvesting	31.01.05	29.01.05	02.02.05	11.01.05	25.01.05

BREEDING TRIAL

DESIGN: Randomised Block Design 3 Replications – 6 Row X 6 metre rows with plant protection, based on recommended package of practices of the respective centres with plant protection against all pests and diseases at the prescribed economic threshold levels for each of those biotic stresses in the concerned entries from time to time, based on close monitoring for their incidence and damage.

PLANT PROTECTION TRIAL

DESIGN: Randomised Block design 3 Replications – 6 ROWS X 6 metre rows with no plant protection measures against prevalent bollworms and diseases. However, protection against sap sucking pests in respective entries, based on the recommended practices of respective centres was made.

BREEDING EVALUATION

The breeding evaluation concentrated on various observations on plant biometric characters such as number of monopodia per plant, number of sympodia per plant, nodes per plant, mean length of sympodia, number of fruiting points per sympodium, number of green bolls per plant at harvest, number of burst bolls per plant at harvest, mean boll weight, seed index, Lint index, mean seed cotton yield per plant and per plot and final yield (calculated) of seed cotton yield per hectare in addition to the fibre length, strength and micronaire of the entries tested.

The Germination data of the Breeding evaluations are given below. The general plant stand of all entries was quite good, as seen from the following tables.

Percent germination in Breeding Evaluation

Entry	Nagpur	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	100	98	100	99	100	99
Ankur.09	100	98	100	100	95	99
Ankur.651Bt	100	99	99	99	100	99
Ankur.651	100	100	99	99	100	100
Ankur.2534Bt	100	100	98	97	100	99
Ankur.2534	100	98	99	99	100	99
MRC.6301Bt	100	98	100	99	100	99
MRC.6301	100	98	100	98	95	98
MRC.6304Bt	100	94	99	99	100	98
MRC.6304	100	98	100	98	100	99
MRC.6160Bt	100	98	100	99	95	98
MRC.6160	100	98	99	98	100	99
RCH.118Bt	100	98	99	100	98	99
RCH.118	100	98	99	97	90	97
RCH.335Bt	100	98	99	100	100	99
RCH.335	100	99	97	100	95	98
RCH.359Bt	100	98	99	99	100	99
RCH.359	100	100	99	99	100	100
NHH.44(ZC)	100	99	98	100	100	99
RCH.2Bt (CC)	100	98	97	99	100	99
MECH.162.Bt (CC)	100	98	99	100	95	98

Mean Length of First Sympodium (cm):

The mean length of the first sympodium in test Bt hybrids ranged between 35 to 40 which was, however, higher in the non-Bt hybrids, as given below.

Entry	Nagpur	Akola	Nanded	Surat	Mean
Ankur.09Bt	41.9	18.9	27.2	66.0	38.5
Ankur.09	52.3	21.5	30.4	64.0	42.1
Ankur.651Bt	46.3	20.4	29.4	64.0	40.0
Ankur.651	49.2	22.6	29.2	67.0	42.0
Ankur.2534Bt	34.7	23.7	27.7	55.0	35.3
Ankur.2534	46.0	22.6	23.9	67.0	39.9
MRC.6301Bt	40.5	20.3	28.4	55.0	36.1
MRC.6301	53.3	19.3	28.2	75.0	44.0
MRC.6304Bt	41.9	20.8	24.5	64.0	37.8
MRC.6304	40.3	17.9	31.9	84.0	43.5
MRC.6160Bt	46.8	19.9	28.2	60.0	38.7
MRC.6160	48.7	19.8	30.1	64.0	40.7
RCH.118Bt	39.2	17.3	28.3	68.0	38.2
RCH.118	53.6	21.7	31.7	73.0	45.0
RCH.335Bt	37.1	21.0	32.0	70.0	40.0
RCH.335	44.6	21.3	31.2	74.0	42.8
RCH.359Bt	45.2	23.2	28.9	64.0	40.3
RCH.359	45.3	22.0	30.6	65.0	40.7
NHH.44(ZC)	62.4	22.9	28.5	76.0	47.5
RCH.2Bt (CC)	34.8	21.1	27.8	68.0	37.9
MECH.162.Bt (CC)	59.8	21.5	36.4	72.0	47.4
CD (0.05)	13.7				
CV%	14.3				

Number of Sympodia

The mean number of sympodia per entry varied between 15 to 20 in Bt entries and was comparable as in non-Bt entries, as given in the following table.

Entry	Nagpur	Surat	Khandwa	Mean
Ankur.09Bt	17.4	18.0	10.6	15
Ankur.09	19.9	25.0	13.7	20
Ankur.651Bt	17.8	24.0	13.2	18
Ankur.651	18.9	19.0	14.0	17
Ankur.2534Bt	18.1	19.0	14.0	17
Ankur.2534	18.2	18.0	14.0	17
MRC.6301Bt	17.4	25.0	16.0	19
MRC.6301	18.0	20.0	13.5	17
MRC.6304Bt	17.4	21.0	11.5	17
MRC.6304	15.5	18.0	9.7	14
MRC.6160Bt	17.2	25.0	14.0	19
MRC.6160	17.6	19.0	14.2	17
RCH.118Bt	18.9	19.0	13.7	17
RCH.118	19.3	19.0	12.0	17
RCH.335Bt	19.4	17.0	14.6	17
RCH.335	18.8	16.0	15.2	17
RCH.359Bt	19.4	21.0	8.5	16
RCH.359	18.7	19.0	10.2	16
NHH.44(ZC)	24.5	22.0	15.2	21
RCH.2Bt (CC)	17.9	20.0	15.0	18
MECH.162.Bt (CC)	20.8	24.0	13.0	19
CD (0.05)	4.6	5.7	3.7	
CV%	11.9	13.7	13.6	

Total Number of Bolls/plant

The total bolls of test hybrids were similar in the zone in Bt hybrids. Bt hybrids had more number of bolls over their non-Bt counterparts. RCH.118, RCH.359, Ankur.651 and Ankur.2534 Bt hybrids recorded more number of bolls and the rest of the entries.

Entry	Nagpur	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	28.7	10.3	16.9	31.0	20.2	21.4
Ankur.09	25.8	10.5	7.9	42.0	21.3	21.5
Ankur.651Bt	24.9	14.6	20.2	44.0	26.2	26.0
Ankur.651	22.4	11.3	6.4	30.0	18.8	17.8
Ankur.2534Bt	27.9	19.1	15.0	58.0	19.0	27.8
Ankur.2534	15.7	12.6	7.6	42.0	18.3	19.3
MRC.6301Bt	24.5	15.3	16.1	52.0	18.2	25.2
MRC.6301	19.0	10.1	6.8	37.0	23.5	19.3
MRC.6304Bt	29.2	16.5	13.0	33.0	21.5	22.6
MRC.6304	20.2	7.5	4.2	36.0	21.3	17.8
MRC.6160Bt	19.9	15.9	17.8	41.0	16.7	22.3
MRC.6160	11.7	6.6	6.4	41.0	15.8	16.3
RCH.118	11.8	8.9	9.9	53.0	21.2	21.0
RCH.335Bt	19.8	16.1	9.6	56.0	22.0	24.7
RCH.335	10.1	12.8	8.2	42.0	20.0	18.6
RCH.359Bt	25.6	19.1	17.8	43.0	27.2	26.5
RCH.359	17.9	16.5	10.9	59.0	27.0	26.3
NHH.44(ZC)	20.2	13.5	7.6	53.0	18.7	22.6
RCH.2Bt (CC)	20.9	16.8	12.5	40.0	13.5	20.7
MECH.162.Bt (CC)	23.1	17.3	12.2	48.0	18.0	23.7
CD (0.05)	4.8	6.8	4.1	10.5	1.9	
CV%	10.9	23.5	16.9	11.2	20.4	

Boll Weight (g)

The mean boll weight was ranging from 3.5 to 4.0 in test Bt hybrids. The non-Bt hybrids and check hybrids also had similar boll weight. The zonal average was 4.0 in MRC.6304Bt and Ankur.651Bt.

Entry	Nagpur	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	4.5	3.5	2.8	3.9	3.2	3.6
Ankur.09	5.2	4.7	3.0	3.1	4.2	4.0
Ankur.651Bt	4.9	3.3	3.2	4.0	4.7	4.0
Ankur.651	4.4	3.3	3.0	3.3	4.8	3.7
Ankur.2534Bt	3.7	3.2	2.9	3.3	3.6	3.3
Ankur.2534	4.1	3.4	3.2	3.6	3.2	3.5
MRC.6301Bt	5.4	3.3	3.1	3.6	3.0	3.7
MRC.6301	3.8	3.4	3.1	3.4	3.5	3.4
MRC.6304Bt	5.0	4.4	3.2	4.1	3.5	4.0
MRC.6304	4.7	2.4	3.1	4.0	4.2	3.7
MRC.6160Bt	4.5	3.6	3.0	3.6	4.7	3.9
MRC.6160	4.4	3.5	3.2	3.7	3.9	3.7
RCH.118Bt	5.0	3.8	3.0	3.8	3.6	3.8
RCH.118	4.8	3.9	3.2	3.6	3.8	3.9
RCH.335Bt	4.2	3.1	3.1	3.6	3.5	3.5
RCH.335	3.9	2.3	3.0	3.4	3.9	3.3
RCH.359Bt	4.3	3.9	3.1	3.6	3.6	3.7
RCH.359	3.6	3.3	2.9	3.2	3.7	3.3
NHH.44(ZC)	3.3	2.7	3.0	2.6	3.6	3.0
RCH.2Bt (CC)	4.0	4.1	3.3	4.3	3.5	3.8
MECH.162.Bt (CC)	3.8	3.1	3.2	3.3	3.6	3.4
CD (0.05)	1.3	0.9	0.7	0.9	0.3	
CV%	14.2	12.6	5.4	10.3	7.8	

Ginning Out Turn (%)

The percentage Ginning out turn (GOT) was ranging between 35 to 38 in Bt test entries, as seen in the following table. The highest GOT in this zone was seen in RCH.359Bt (38.4%). In general non-Bt counterparts recorded lower GOT over their Bt counterparts in this zone.

Entry	Nagpur	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	36.1	35.7	38.4	34.2	36.1
Ankur.09	34.1	39.5	36.8	34.3	36.2
Ankur.651Bt	33.6	35.9	36.6	33.8	35.0
Ankur.651	33.8	35.6	36.3	33.0	34.7
Ankur.2534Bt	29.4	37.1	37.8	32.7	34.3
Ankur.2534	34.5	36.2	36.5	34.7	35.5
MRC.6301Bt	37.2	37.3	37.5	35.4	36.9
MRC.6301	32.7	39.3	38.4	30.9	35.3
MRC.6304Bt	33.0	36.1	35.6	32.3	34.2
MRC.6304	31.7	38.2	34.9	31.5	34.1
MRC.6160Bt	34.7	38.4	36.7	34.1	36.0
MRC.6160	31.5	35.4	35.6	32.8	33.8
RCH.118Bt	31.5	37.3	35.3	34.3	34.6
RCH.118	32.6	36.4	34.6	34.3	34.5
RCH.335Bt	36.4	36.4	36.0	30.7	34.9
RCH.335	34.0	35.2	36.2	33.3	34.7
RCH.359Bt	38.6	39.8	39.7	35.6	38.4
RCH.359	37.0	40.5	39.2	36.0	38.2
NHH.44(ZC)	33.5	37.2	34.1	32.6	34.3
RCH.2Bt (CC)	33.4	37.6	34.5	33.2	34.7
MECH.162.Bt (CC)	34.9	39.5	36.8	34.8	36.5
CD (0.05)	2.1	2.8	2.0	1.0	
CV%	3.0	8.5	2.5	1.4	

Mean Lint Index (g)

The lint index was the highest in MRC.6160Bt (5.26), RCH.359Bt (5.21), RCH.118Bt (5.15) and MRC.6301 Bt (5.08).

Entry	Nagpur	Akola	Nanded	Surat	Mean
Ankur.09Bt	4.45	3.95	4.49	4.68	4.39
Ankur.09	4.42	4.02	4.96	4.51	4.48
Ankur.651Bt	4.27	4.25	4.20	4.46	4.30
Ankur.651	4.57	4.88	4.61	4.56	4.66
Ankur.2534Bt	4.02	4.73	5.01	4.23	4.50
Ankur.2534	4.15	4.34	4.31	4.45	4.31
MRC.6301Bt	5.44	4.83	5.41	4.65	5.08
MRC.6301	4.04	4.44	5.24	4.67	4.60
MRC.6304Bt	4.81	5.37	4.63	5.15	4.99
MRC.6304	4.44	5.74	4.88	4.56	4.91
MRC.6160Bt	4.96	4.75	5.54	5.77	5.26
MRC.6160	5.09	4.47	4.92	4.43	4.73
RCH.118Bt	4.75	5.39	5.25	5.19	5.15
RCH.118	4.87	4.95	5.06	4.89	4.94
RCH.335Bt	5.33	5.27	5.26	4.21	5.02
RCH.335	5.79	4.62	4.99	4.83	5.06
RCH.359Bt	5.40	5.20	4.95	5.27	5.21

RCH.359	5.29	4.13	5.20	4.82	4.86
NHH.44(ZC)	4.02	3.52	4.32	3.49	3.84
RCH.2Bt (CC)	5.06	4.47	5.42	5.01	4.99
MECH.162.Bt (CC)	4.28	3.84	5.38	4.66	4.54
CD (0.05)	0.78	0.69	0.87	0.79	
CV%	7.88	7.20	5.49	8.10	

Mean Seed Index (g)

The seed index ranged from 8.2 to 9.4g in test hybrids. The check Bt hybrids recorded more than 9 g, as given in the table below. Some of the test entries have a good combination of high lint index and good seed index as in RCH.134Bt hybrid.

Entry	Nagpur	Akola	Nanded	Surat	Mean
Ankur.09Bt	7.88	6.90	8.10	7.50	7.60
Ankur.09	8.52	6.55	7.60	7.80	7.62
Ankur.651Bt	8.90	7.50	7.50	7.80	7.93
Ankur.651	8.95	7.45	8.30	8.00	8.18
Ankur.2534Bt	8.56	7.05	8.50	7.00	7.78
Ankur.2534	8.54	6.90	7.60	7.80	7.71
MRC.6301Bt	9.75	8.20	9.10	7.80	8.71
MRC.6301	8.95	6.90	8.10	7.50	7.86
MRC.6304Bt	9.75	8.45	8.20	9.30	8.93
MRC.6304	9.56	8.10	7.90	8.50	8.52
MRC.6160Bt	9.33	8.65	8.90	8.30	8.80
MRC.6160	11.05	8.80	9.00	8.00	9.21
RCH.118Bt	10.29	8.50	8.80	9.50	9.27
RCH.118	10.31	8.10	8.80	9.30	9.13
RCH.335Bt	9.32	8.65	9.20	7.50	8.67
RCH.335	11.25	8.55	9.20	8.50	9.38
RCH.359Bt	9.12	8.10	7.50	8.00	8.18
RCH.359	9.02	6.55	7.60	7.50	7.67
NHH.44(ZC)	8.00	6.85	7.30	6.80	7.24
RCH.2Bt (CC)	10.07	8.75	9.00	9.50	9.33
MECH.162.Bt (CC)	7.99	7.70	8.20	8.00	7.97
CD (0.05)	1.15	0.94	0.59	0.90	
CV%	5.96	5.79	5.13	5.20	

Seed Cotton Yield (Protected condition)

The average seed cotton yield under protected condition in central zone shows that RCH.118Bt and RCH.335Bt have yielded 1679 and 1616 kg/ha seed cotton respectively and tops the nine hybrids in this regard. MRC.6160Bt yielded 1428 kg/ha while Ankur.651Bt and MRC.6301Bt yielded 1419 kg/ha, as given below. There is clear superiority over the non-Bt counterpart hybrids as well as over check hybrids.

Seed cotton yield (Kg/ha) in Protected condition

Entry	Nagpur	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	1375	669	807	1546	1364	1152
Ankur.09	1178	458	351	2042	928	991
Ankur.651Bt	1350	694	950	2667	1435	1419
Ankur.651	1101	813	430	1317	1051	942
Ankur.2534Bt	976	866	712	3079	1231	1373
Ankur.2534	1171	488	347	2250	1026	1056
MRC.6301Bt	1231	793	1029	2942	1102	1419
MRC.6301	1149	435	321	1760	981	929
MRC.6304Bt	1154	848	495	1912	1062	1094
MRC.6304	1289	316	273	2088	949	983
MRC.6160Bt	1404	1289	764	2500	1185	1428
MRC.6160	778	405	286	2232	884	917
RCH.118Bt	1615	1042	1176	3458	1106	1679
RCH.118	1072	304	512	3033	889	1162
RCH.335Bt	1682	1102	812	3264	1221	1616
RCH.335	1003	362	347	2195	1025	986
RCH.359Bt	1627	714	916	2306	1009	1314
RCH.359	907	486	503	3005	1111	1202
NHH.44(ZC)	1449	360	482	2218	1009	1104
RCH.2Bt (CC)	1358	756	508	2565	1034	1244
MECH.162.Bt (CC)	1450	615	742	2380	1116	1261
CD (0.05)	80	107.74	182.29	721	115.6	
CV%	27.17	7.85	14.46	14.3	6.93	

Fibre quality

The fibre quality, viz., 2.5% Span length (mm), Bundle strength (g/tex), Strength/length ratio and Micronaire (10^{-6} g/in) in the following tables show that the test Bt hybrids shall be providing medium long to long staple fibre. However, as per CIRCOT and SITRA (South India Textile Research Association, Textile Ministry) norms, the fibre tenacity values were less than desirable for the fibre length recorded in the test Bt hybrid genotypes.

2.5% span length (mm)

Genotypes	Nagpur	Akola	Surat	Khandwa	mean
RCH. 118	29.1	23.9	30.2	29.6	28
RCH. 335	28.2	26.8	29.7	28.0	28
RCH. 359	25.5	24.8	26.6	27.4	26
Ankur – 651	28.6	28.2	29.0	29.5	29
Ankur – 09	27.5	26.7	28.5	28.5	28
Ankur – 2534	27.7	27.5	28.6	29.0	28
MRC. 6301	26.2	26.4	27.4	28.5	27
MRC. 6304	30.0	27.9	30.7	30.9	30
MRC. 6160	26.2	28.7	26.9	27.9	27
RCH. 118 Bt	28.2	28.9	30.1	29.4	29
RCH. 335 Bt	25.8	27.5	28.4	28.7	28
RCH. 359 Bt	26.4	26.9	27.6	28.8	27
Ankur – 651 Bt	27.2	28.3	29.6	27.9	28
Ankur – 09 Bt	26.5	25.9	26.8	28.5	27
Ankur – 2534 Bt	27.3	28.2	27.8	29.2	28
MRC. 6301 Bt	26.9	27.0	27.5	28.0	27
MRC. 6304 Bt	29.3	30.7	30.2	30.5	30
MRC. 6160 Bt	25.7	27.8	26.3	27.8	27
NHH.44 (ZC)	24.7	22.9	25.7	26.1	25
RCH.2 Bt (CC)	29.8	32.0	32.2	32.2	32
MECH.162 Bt (CC)	25.1	26.3	24.5	26.7	26

Bundle strength (g/tex)

Genotypes	Nagpur	Akola	Surat	Khandwa	mean
RCH. 118	20.3	19.0	19.5	20.8	20
RCH. 335	20.6	21.9	19.6	20.6	21
RCH. 359	19.0	20.4	19.2	21.3	20
Ankur – 651	20.0	22.0	19.3	21.4	21
Ankur – 09	20.6	22.8	18.9	19.1	20
Ankur – 2534	20.1	21.9	18.8	20.6	20
MRC. 6301	19.9	20.4	18.9	21.1	20
MRC. 6304	20.7	22.1	22.7	23.3	22
MRC. 6160	19.3	21.2	19.1	20.1	20
RCH. 118 Bt	19.6	17.4	19.5	20.6	19
RCH. 335 Bt	20.6	19.3	19.8	21.0	20
RCH. 359 Bt	19.9	18.9	18.9	21.2	20
Ankur – 651 Bt	20.7	17.3	19.1	20.2	19
Ankur – 09 Bt	20.0	15.6	18.4	19.6	18
Ankur – 2534 Bt	20.4	18.9	19.0	21.8	20
MRC. 6301 Bt	20.9	16.3	19.0	21.2	19
MRC. 6304 Bt	22.0	18.0	22.1	23.5	21
MRC. 6160 Bt	19.2	16.8	18.5	19.1	18
NHH.44 (ZC)	19.7	19.1	17.7	18.5	19
RCH.2 Bt (CC)	19.6	18.5	20.0	21.0	20
MECH.162 Bt (CC)	19.1	17.0	17.7	20.0	18

Micronaire (10^{-6} g/in)

Genotypes	Nagpur	Akola	Surat	Khandwa	mean
RCH. 118	3.4	3.4	4.7	4.2	3.93
RCH. 335	3.8	3.6	4.8	3.9	4.03
RCH. 359	4.2	3.4	5.4	4.8	4.45
Ankur – 651	3.8	3.5	4.7	4.2	4.05
Ankur – 09	3.8	2.9	4.9	4.8	4.10
Ankur – 2534	3.1	2.9	4.5	3.8	3.58
MRC. 6301	3.7	3.1	4.7	4.2	3.93
MRC. 6304	3.2	3.7	4.4	3.6	3.73
MRC. 6160	4.4	3.4	5.0	4.4	4.30
NHH.44 (ZC)	3.6	3.6	4.4	4.5	4.03
RCH.2 Bt (CC)	3.5	3.2	4.3	4.2	3.80
MECH.162 Bt (CC)	3.6	3.2	5.1	4.0	3.98
RCH. 118 Bt	3.7	2.8	4.9	3.6	3.75
RCH. 335 Bt	3.8	3.3	4.9	3.7	3.93
RCH. 359 Bt	4.6	3.5	5.5	4.5	4.53
Ankur – 651 Bt	3.4	2.8	4.6	3.5	3.58
Ankur – 09 Bt	3.8	2.9	4.8	4.2	3.93
Ankur – 2534 Bt	3.1	2.6	3.9	3.2	3.20
MRC. 6301 Bt	3.9	3.1	4.9	4.1	4.00
MRC. 6304 Bt	3.4	3.3	4.4	3.5	3.65
MRC. 6160 Bt	3.9	3.6	4.7	4.1	4.08

Mean fibre property data of the Zone

Genotypes	2.5% Span length (mm)	Bundle strength (g/tex)	Micronaire
RCH. 118	28	20	3.93
RCH. 335	28	21	4.03
RCH. 359	26	20	4.45
Ankur – 651	29	21	4.05
Ankur – 09	28	20	4.10
Ankur – 2534	28	20	3.58
MRC. 6301	27	20	3.93
MRC. 6304	30	22	3.73
MRC. 6160	27	20	4.30
RCH. 118 Bt	29	19	3.75
RCH. 335 Bt	28	20	3.93
RCH. 359 Bt	27	20	4.53
Ankur – 651 Bt	28	19	3.58
Ankur – 09 Bt	27	18	3.93
Ankur – 2534 Bt	28	20	3.20
MRC. 6301 Bt	27	19	4.00
MRC. 6304 Bt	30	21	3.65
MRC. 6160 Bt	27	18	4.08
NHH.44 (ZC)	25	19	4.03
RCH.2 Bt (CC)	32	20	3.80
MECH.162 Bt (CC)	26	18	3.98

PLANT PROTECTION EVALUATION

In this evaluation, the nine test Bt hybrids (ANKUR-651Bt, ANKUR-09Bt, ANKUR-2534Bt, MRC.6301Bt, MRC.6304Bt, MRC.6160Bt RCH.118Bt, RCH.335Bt and RCH.359Bt were evaluated with MECH.162Bt and RCH2Bt as check hybrids and NHH.44 as zonal hybrid check) were tested under **unprotected conditions for bollworms and other lepidopterous insects** so as to find out the performance of the Cry 1 A(c) gene action in them during 2004-05 season in Central zone. In general, bollworm pressure was low in this zone during this season.

Entomology Evaluation

The Entomology evaluation was targeted primarily to test the action of Cry IA (c) gene in eight Bt hybrids, viz., against the following bollworms.

SPOTTED BOLLWORM- *Earias vittella* Fabricius

SPINY BOLLWORM – *Earias insulana* Boisduval

AMERICAN BOLLWORM – *Helicoverpa armigera* Hubner

PINK BOLLWORM – *Pectinophora gossypiella* (Saunders)

Observations on the incidence of pests and diseases in plots protected against sap sucking pests was done in addition to the data generation on their incidence in unprotected conditions. The data on these observations are explained in the following tables.

Pest infestation in PROTECTED CONDITIONS

Moderate levels of aphid infestation was observed in all entries. There was no difference in their infestation between entries.

Aphids (average of 3 leaves/plant)

Entry	Akola	Nanded		Surat		Mean
	Number	*TV	Number	TV	Number	
Ankur.09Bt	15.2	3.6	12.8	2.2	4.5	10.9
Ankur.09	17.6	4.0	15.9	2.0	3.5	12.3
Ankur.651Bt	15.7	3.6	12.2	1.9	3.2	10.4
Ankur.651	20.7	4.1	16.2	2.3	4.8	13.9
Ankur.2534Bt	13.8	3.4	11.2	1.9	3.2	9.4
Ankur.2534	15.9	2.4	8.1	1.8	2.9	8.9
MRC.6301Bt	10.8	5.1	26.2	2.4	5.2	14.1
MRC.6301	13.8	4.6	20.3	1.4	1.4	11.8
MRC.6304Bt	13.1	5.1	30.0	2.0	3.4	15.5
MRC.6304	14.4	3.9	15.1	1.7	2.3	10.6
MRC.6160Bt	13.4	2.6	6.2	2.6	6.1	8.6
MRC.6160	13.8	2.8	7.7	1.6	1.9	7.8
RCH.118Bt	12.7	3.7	12.9	1.4	1.4	9.0
RCH.118	8.5	3.6	12.4	1.2	0.9	7.3
RCH.335Bt	12.9	3.1	9.3	2.3	4.9	9.0
RCH.335	15.6	6.2	38.4	1.3	1.2	18.4
RCH.359Bt	11.7	7.2	51.9	2.6	6.2	23.3
RCH.359	12.5	4.3	17.8	1.3	1.3	10.5

NHH.44(ZC)	21.3	4.7	21.8	1.5	1.6	14.9
RCH.2Bt (CC)	11.3	2.8	7.3	1.6	2.2	6.9
MECH.162.Bt (CC)	14.3	5.5	29.9	1.9	3.0	15.7
	CD (0.05)	2.1		0.9		
	CV%	24.5		22.8		

The observation on the mean jassid numbers per plant showed that under protected conditions, the genotypes did not vary much to their reaction to this insect. Khandwa recorded the highest infestation in this zone and in spite of protection with insecticides; most of the hybrids had high population of this insect as well as damage level.

Jassids (average of 3 leaves/plant)

Entry	Akola	Nanded		Surat		Khandwa		Mean
	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	2.2	1.8	2.6	1.4	1.3	2.7	6.9	3.3
Ankur.09	2.0	1.7	2.4	1.3	1.1	1.9	3.7	2.3
Ankur.651Bt	2.0	1.8	2.6	1.3	1.2	2.6	6.9	3.2
Ankur.651	2.4	1.7	2.4	1.5	1.7	3.4	11.5	4.5
Ankur.2534Bt	1.5	1.7	3.3	1.2	1.0	2.5	7.4	3.3
Ankur.2534	2.3	1.7	2.3	1.3	1.1	3.8	14.3	5.0
MRC.6301Bt	1.9	1.9	3.3	1.4	1.3	2.5	6.0	3.1
MRC.6301	1.5	1.6	2.0	1.4	1.4	3.1	9.8	3.7
MRC.6304Bt	1.8	1.8	2.7	1.4	1.4	2.7	6.4	3.1
MRC.6304	2.3	1.6	2.2	1.4	1.5	4.0	16.3	5.6
RCH.118Bt	3.2	1.6	2.2	1.7	2.3	4.2	17.9	6.4
RCH.118	3.9	2.0	3.5	1.6	2.0	3.4	11.5	5.2
RCH.335Bt	1.7	1.7	2.4	1.4	1.4	2.7	7.4	3.2
RCH.335	1.7	1.7	2.3	1.4	1.6	3.2	10.1	3.9
RCH.359Bt	2.9	1.5	1.7	1.5	1.8	3.0	8.8	3.8
RCH.359	1.7	1.5	1.8	1.3	1.2	1.6	2.5	1.8
NHH.44(ZC)	2.4	1.8	2.9	1.3	1.2	1.8	3.2	2.4
RCH.2Bt (CC)	4.5	1.7	2.4	1.4	1.4	4.2	17.9	6.6
MECH.162.Bt (CC)	2.8	1.8	2.7	1.2	1.0	2.9	8.6	3.8
	CD (0.05)		0.2		NS		1.71	
	CV%		5.69		11.59		18.31	

*TV - transformed values

The incidence of thrips was the highest in Akola and Nanded, where early season drought was prevalent. All the test hybrids and check hybrids had similar infestation in spite of protection with insecticides.

Thrips (average of three leaves per plant)

Entry	Akola	Nanded		Surat		Khandwa		Mean
	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	24.8	6.2	37.7	2.8	7.5	0.2	0.1	17.5
Ankur.09	24.3	5.5	29.5	2.4	5.2	0.2	0.0	14.8
Ankur.651Bt	23.8	6.2	38.1	3.0	8.3	0.2	0.0	17.6
Ankur.651	22.8	5.8	33.6	2.6	6.5	0.2	0.0	15.7
Ankur.2534Bt	27.0	6.0	35.7	2.7	6.7	0.2	0.1	17.3
Ankur.2534	20.1	5.5	29.3	2.4	5.1	0.2	0.1	13.6
MRC.6301Bt	27.3	6.2	38.2	3.3	10.2	0.3	0.1	18.9
MRC.6301	20.0	6.5	30.3	3.4	5.2	0.2	0.1	13.9
MRC.6304Bt	22.0	6.2	38.4	2.2	4.3	0.2	0.0	16.2
MRC.6304	21.0	5.5	29.3	2.9	8.1	0.3	0.1	14.6
MRC.6160Bt	18.5	6.1	37.2	2.7	6.8	0.3	0.1	15.6
MRC.6160	17.8	6.0	35.3	2.6	6.0	0.2	0.0	14.8

RCH.118Bt	16.0	6.1	37.2	2.0	3.6	0.3	0.1	14.2
RCH.118	14.4	5.5	29.7	2.2	4.5	0.3	0.1	12.2
RCH.335Bt	25.3	5.9	34.7	2.7	6.8	0.3	0.1	16.7
RCH.335	20.3	5.4	29.2	2.6	6.1	0.3	0.1	13.9
RCH.359Bt	23.2	6.3	39.3	3.2	9.7	0.2	0.0	18.1
RCH.359	20.6	5.3	27.3	2.8	7.4	0.3	0.1	13.8
NHH.44(ZC)	18.3	5.6	31.3	3.1	8.9	0.2	0.1	14.6
RCH.2Bt (CC)	22.4	6.2	38.2	2.4	5.2	0.2	0.0	16.5
MECH.162.Bt (CC)	22.4	6.3	39.3	3.0	8.6	0.3	0.1	17.6
CD (0.05)				0.89		0.013		
CV%				15.8		12.45		

*TV - transformed values

Under protected condition, the whitefly population in all entries was quite high in Nanded in this zone. The other centres showed low population.

Whitefly (average of 3 leaves/plant)

Entry	Akola	Nanded		Surat		Khandwa		Mean
	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	1.8	5.1	25.1	1.0	0.6	0.7	0.4	7.0
Ankur.09	1.8	5.1	25.8	1.0	0.6	0.8	0.7	7.2
Ankur.651Bt	2.1	6.0	35.4	1.2	1.0	0.4	0.2	9.7
Ankur.651	1.8	5.3	27.2	1.3	1.1	0.7	0.5	7.6
Ankur.2534Bt	1.9	5.1	26.0	1.1	0.8	0.8	0.7	7.3
Ankur.2534	2.1	5.3	27.4	1.0	0.6	0.7	0.5	7.6
MRC.6301Bt	1.4	6.0	35.3	1.1	0.7	0.8	0.6	9.5
MRC.6301	1.5	5.2	26.5	1.3	1.1	0.8	0.7	7.4
MRC.6304Bt	1.8	5.9	34.9	1.2	0.9	0.7	0.4	9.5
MRC.6304	2.0	5.8	32.6	1.0	0.5	0.5	0.3	8.9
MRC.6160Bt	2.9	5.3	27.7	1.5	1.7	0.7	0.5	8.2
MRC.6160	2.8	5.5	29.9	1.4	1.4	0.6	0.3	8.6
RCH.118Bt	1.1	6.0	35.3	1.2	0.8	0.5	0.2	9.4
RCH.118	0.9	5.2	26.1	1.2	0.9	0.6	0.4	7.1
RCH.335Bt	2.0	5.5	29.7	1.1	0.8	0.6	0.4	8.2
RCH.335	2.0	5.8	33.1	1.1	0.8	0.6	0.4	9.1
RCH.359Bt	1.4	6.0	35.7	1.0	0.5	0.7	0.4	9.5
RCH.359	1.8	5.3	27.8	0.9	0.3	0.7	0.5	7.6
NHH.44(ZC)	1.5	5.1	25.7	1.2	0.9	0.7	0.4	7.1
RCH.2Bt (CC)	1.2	5.7	31.5	1.1	0.8	0.8	0.7	8.5
MECH.162.Bt (CC)	1.7	5.1	25.8	1.2	0.9	0.6	0.4	7.2
CD (0.05)				NS		0.014		
CV%				18.13		15.63		

*TV - transformed values

Spotted bollworms were low in population in the central zone centres. However, the Bt hybrids had lower numbers in comparison to their non-Bt counterparts. Khandwa centre recorded the highest number of this pest in various entries.

Spotted bollworms

Entry	Nagpur	Nanded		Surat		Khandwa		Mean
	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	0.0	0.7	0.0	0.7	0.0	1.8	3.3	0.8
Ankur.09	0.0	1.6	3.0	0.7	0.0	1.8	3.3	1.6
Ankur.651Bt	0.0	0.7	0.0	0.7	0.0	1.9	3.4	0.9
Ankur.651	0.1	1.7	2.5	0.7	0.0	1.8	3.1	1.4
Ankur.2534Bt	0.0	0.7	0.0	0.8	0.2	1.8	3.3	0.9
Ankur.2534	0.2	1.3	1.5	0.9	0.5	1.8	3.3	1.4
MRC.6301Bt	0.0	0.7	0.0	0.7	0.0	1.5	2.2	0.5
MRC.6301	0.0	1.9	3.0	0.9	0.3	1.5	2.3	1.4
MRC.6304Bt	0.0	0.7	0.0	0.7	0.0	1.8	3.1	0.8
MRC.6304	0.1	1.4	1.5	0.9	0.5	1.9	3.4	1.4
MRC.6160Bt	0.0	0.7	0.0	0.7	0.0	1.8	3.3	0.8
MRC.6160	0.0	1.7	2.5	0.7	0.0	1.8	3.3	1.5
RCH.118Bt	0.0	0.7	0.0	0.7	0.0	1.8	3.3	0.8
RCH.118	0.0	1.9	3.0	0.8	0.2	1.8	3.3	1.6
RCH.335Bt	0.0	0.7	0.0	0.7	0.0	1.8	3.3	0.8
RCH.335	0.0	1.4	1.5	0.9	0.3	1.8	3.3	1.3
RCH.359Bt	0.0	0.7	0.0	0.7	0.0	1.5	2.3	0.6
RCH.359	0.1	1.5	2.0	0.7	0.0	1.5	2.2	1.1
NHH.44(ZC)	0.0	1.7	2.5	0.7	0.0	1.8	3.3	1.4
RCH.2Bt (CC)	0.0	0.7	0.0	0.7	0.0	1.5	2.2	0.5
MECH.162.Bt (CC)	0.0	0.7	0.0	0.7	0.0	1.8	3.1	0.8
CD (0.05)			0.89	0.24		0.39		
CV%			27.88	15.03		14.98		

*TV - transformed values

Observations on the incidence of the American bollworm in various test hybrids showed that its population was low in Bt hybrids over their non-Bt counterparts. Nanded centre showed maximum population and the Bt entries had less number of this bollworm in comparison to their non-Bt counterparts. The gene action seems to be in operation in the Bt entries.

American bollworms

Entry	Nagpur	Nanded		Surat		Khandwa		Mean
	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	0.2	2.2	4.5	0.7	0.0	2.3	5.3	2.5
Ankur.09	0.6	2.9	8.0	0.8	0.3	2.3	5.1	3.5
Ankur.651Bt	0.0	1.7	2.5	0.7	0.0	2.0	3.9	1.6
Ankur.651	1.0	5.9	8.0	0.8	0.3	2.2	4.7	3.5
Ankur.2534Bt	0.1	2.0	4.0	0.7	0.0	2.2	4.7	2.2
Ankur.2534	0.5	2.9	8.0	0.7	0.0	2.0	4.1	3.2
MRC.6301Bt	0.1	2.0	3.5	0.7	0.0	2.3	5.1	2.2
MRC.6301	0.7	2.5	6.0	0.8	0.1	2.3	5.2	3.0
MRC.6304Bt	0.3	1.9	3.0	0.7	0.0	1.5	2.2	1.4
MRC.6304	0.3	2.6	6.5	0.8	0.1	2.0	3.9	2.7
MRC.6160Bt	0.1	2.2	4.5	0.7	0.0	1.0	1.0	1.4
MRC.6160	1.4	2.1	4.0	0.9	0.5	2.3	5.3	2.8
RCH.118Bt	0.2	1.7	2.5	0.7	0.0	1.0	1.0	0.9
RCH.118	0.3	2.7	7.0	0.7	0.0	2.3	5.2	3.1
RCH.335Bt	0.0	1.9	3.0	0.7	0.0	2.0	4.1	1.8
RCH.335	0.3	2.5	6.0	0.9	0.4	2.0	3.9	2.6
RCH.359Bt	0.0	2.0	3.5	0.7	0.0	2.3	5.2	2.2
RCH.359	1.0	2.5	6.0	0.7	0.0	2.3	5.3	3.1
NHH.44(ZC)	0.5	2.7	7.0	0.7	0.0	2.2	4.7	3.1
RCH.2Bt (CC)	0.1	2.2	4.5	0.7	0.0	2.3	5.1	2.4
MECH.162.Bt (CC)	0.3	2.4	5.5	0.7	0.0	1.5	2.2	2.0
CD (0.05)				0.16		0.13		
CV%				10.78		12.95		

The above observation was reinforced with the data on the percent square damage in the three centres. Significant reduction in damage was noticed in all centres in Bt test hybrids. Nagpur recorded the maximum damage.

American bollworms - Percent square damage

Entry	Nagpur	Nanded		Surat		Mean
	Number	*TV	Number	TV	Number	
Ankur.651Bt	2.4	0.7	0.2	3.7	0.4	1.0
Ankur.651	11.7	6.3	3.4	2.9	0.0	5.0
Ankur.09Bt	2.9	0.0	0.0	2.9	0.0	1.0
Ankur.09	10.3	5.4	2.4	5.0	0.7	4.5
Ankur.2534Bt	1.7	1.1	0.2	4.8	0.7	0.9
Ankur.2534	14.8	5.1	1.6	6.2	1.2	5.9
MRC.6301Bt	5.3	2.3	0.6	4.1	0.5	2.1
MRC.6301	8.1	7.7	3.0	6.0	1.1	4.1
MRC.6304Bt	3.6	0.6	0.1	5.1	0.8	1.5
MRC.6304	10.1	6.9	2.4	8.7	2.3	4.9
MRC.6160Bt	3.9	1.2	0.3	4.7	0.7	1.6
MRC.6160	14.4	7.2	2.8	9.3	2.6	6.6
RCH.118Bt	2.6	1.9	0.4	3.9	0.5	1.1
RCH.118	8.7	6.4	2.1	4.5	0.6	3.8
RCH.335Bt	3.4	1.8	0.4	3.9	0.5	1.4
RCH.335	8.7	5.7	2.0	9.1	2.5	4.4
RCH.359Bt	2.9	1.9	0.6	6.0	1.1	1.5
RCH.359	12.7	4.8	2.5	6.6	1.3	5.5
NHH.44(ZC)	8.6	5.0	1.9	4.3	0.6	3.7
RCH.2Bt (CC)	3.8	1.7	0.5	2.9	0.0	1.4
MECH.162.Bt (CC)	5.8	2.7	0.8	3.8	0.4	2.3
CD (0.05)		7.86		3.89		
CV%						

*TV - transformed values

The observation on the number of Pink bollworms (PBW) in green bolls after destructive sampling showed that the Bt test hybrids harboured lower number of PBW. Khandwa centre showed the maximum infestation of this pest.

Number of Pink boll worm in green bolls

Entry	Nagpur		Nanded		Surat		Khandwa		Mean
	TV	Number	*TV	Number	TV	Number	TV	Number	
Ankur.09Bt	0.7	0.0	1.2	1.3	0.7	0.0	2.1	4.2	1.4
Ankur.09	1.6	2.5	2.8	7.3	0.7	0.0	1.9	3.6	3.3
Ankur.651Bt	0.7	0.0	1.4	1.8	0.7	0.0	1.9	3.7	1.4
Ankur.651	1.6	2.3	2.5	6.3	0.7	0.0	1.9	0.1	2.1
Ankur.2534Bt	1.0	0.5	1.4	1.5	1.0	0.5	1.6	2.7	1.3
Ankur.2534	2.2	4.3	2.4	5.5	1.7	2.5	1.9	3.7	4.0
MRC.6301Bt	1.0	0.5	1.8	2.8	0.7	0.0	1.8	3.1	1.6
MRC.6301	1.6	2.3	2.2	4.3	0.7	0.0	2.1	4.2	2.7
MRC.6304Bt	1.1	0.8	1.5	2.0	0.7	0.0	1.8	3.2	1.5
MRC.6304	2.3	4.8	1.7	2.5	0.7	0.0	1.6	2.7	2.5
MRC.6160Bt	1.1	0.8	1.7	2.5	0.7	0.0	1.9	3.5	1.7
MRC.6160	2.0	3.5	2.1	4.0	1.5	2.0	1.8	3.1	3.2
RCH.118Bt	0.7	0.0	1.1	0.8	0.7	0.0	1.9	3.4	1.0
RCH.118	2.4	5.3	2.4	5.5	1.2	1.0	1.9	3.5	3.8
RCH.335Bt	1.2	1.0	1.3	1.3	0.7	0.0	1.9	3.7	1.5
RCH.335	2.5	5.8	2.5	5.8	0.7	0.0	1.9	3.7	3.8
RCH.359Bt	1.1	0.8	1.1	1.0	0.7	0.0	1.9	3.6	1.3
RCH.359	1.7	2.3	2.5	6.3	1.4	1.5	1.9	3.4	3.4
NHH.44(ZC)	1.6	2.0	2.7	6.8	0.7	0.0	1.8	3.2	3.0
RCH.2Bt (CC)	1.0	0.5	1.2	1.3	0.7	0.0	1.9	3.5	1.3
MECH.162.Bt ©	1.6	2.0	1.8	3.0	0.7	0.0	1.9	3.7	2.2
CD (0.05)	0.75		0.97		0.31		0.09		
CV%	24.95		22.8		17.17		15.85		

*TV - transformed values

The percent locule damage was seen to be significantly low in Bt test hybrids in all centres. The zone's mean damage also showed that the Bt test hybrids did exhibit strong reduction in bollworm damage.

Locule damage (%)

Entry	Nagpur		Nanded		Surat		Khandwa		Mean %
	TV	%	*TV	%	TV	%	TV	%	
Ankur.09Bt	16.9	9.3	12.5	4.7	7.6	1.7	9.1	2.5	4.5
Ankur.09	25.2	18.9	27.0	20.6	23.2	15.6	9.5	2.7	14.5
Ankur.651Bt	13.7	5.6	10.1	3.3	11.5	4.0	9.5	2.7	3.9
Ankur.651	24.4	17.6	20.3	12.2	17.8	9.4	19.9	11.4	12.6
Ankur.2534Bt	13.5	5.7	10.6	3.4	10.0	3.0	8.9	2.4	3.6
Ankur.2534	23.1	15.7	30.0	25.0	17.8	9.3	9.3	2.7	13.2
MRC.6301Bt	12.1	5.0	10.4	3.3	11.5	4.1	9.1	2.6	3.7
MRC.6301	26.3	20.1	25.7	19.4	23.2	15.5	20.5	12.3	16.8
MRC.6304Bt	13.6	5.7	8.2	2.1	12.9	5.0	20.3	12.1	6.2
MRC.6304	25.3	19.0	22.1	14.2	22.1	14.2	20.8	12.7	15.0
MRC.6160Bt	17.0	9.2	9.2	2.6	7.5	1.9	22.1	14.3	7.0
MRC.6160	34.4	31.9	23.1	15.5	23.6	16.1	21.1	12.9	19.1
RCH.118Bt	12.9	5.2	11.4	4.0	17.2	8.8	20.7	12.6	7.6
RCH.118	24.4	17.4	19.6	11.4	28.0	22.1	9.1	2.6	13.4
RCH.335Bt	10.8	3.8	13.0	5.1	11.1	3.7	8.5	2.3	3.7
RCH.335	30.5	27.1	25.3	18.4	25.0	17.1	9.5	2.7	16.3
RCH.359Bt	14.6	6.6	8.2	2.1	16.8	8.4	9.3	2.7	4.9
RCH.359	21.7	15.0	22.6	14.8	21.3	13.2	8.9	2.4	11.4
NHH.44(ZC)	24.4	17.7	26.6	20.1	27.1	20.8	8.9	2.4	15.2
RCH.2Bt (CC)	12.7	5.0	11.9	4.3	8.2	2.1	10.1	3.1	3.6
MECH.162.Bt (CC)	16.1	8.5	9.5	2.8	14.5	6.3	8.9	2.4	5.0
CD (0.05)	6.28		4.29		3.68		0.35		
CV%	27.85		12.11		10.35		7.21		

*TV - transformed values

The percent open boll damage data showed that the reduction in this damage in Bt hybrids was significantly low. However, the reduction in RCH.118 Bt hybrid was less than that in other hybrids. The non-Bt check hybrid recorded 22.1% damage and some non-Bt hybrids recorded more than this under protected conditions.

Open boll damage (%)

Entry	Nagpur		Nanded		Surat		Khandwa		Mean %
	TV	%	*TV	%	TV	%	TV	%	
RCH.118Bt	19.0	11.0	18.4	10.0	20.2	12.1	19.9	11.7	11.2
RCH.118	34.1	31.8	23.3	15.7	34.7	32.4	7.9	1.9	20.5
RCH.335Bt	19.4	11.7	19.3	11.0	15.4	7.1	7.3	1.6	7.8
RCH.335	45.3	47.5	28.7	23.0	31.2	26.9	7.4	1.7	24.8
RCH.359Bt	21.9	14.4	15.9	7.5	22.7	15.0	6.6	1.3	9.6
RCH.359	33.1	30.9	25.1	18.0	27.7	21.7	8.3	2.1	18.2
Ankur.651Bt	20.8	12.9	12.8	4.9	15.5	7.1	7.5	1.8	6.6
Ankur.651	32.0	28.7	27.0	20.7	22.5	14.7	18.9	10.5	18.6
Ankur.09Bt	24.1	18.3	15.2	6.9	10.0	3.0	6.6	1.3	7.4
Ankur.09	34.3	32.7	27.5	21.3	26.7	20.3	6.8	1.5	18.9
Ankur.2534Bt	18.9	10.7	13.4	5.4	12.7	4.9	6.0	1.2	5.5

Ankur.2534	33.0	29.9	36.6	35.5	23.1	15.4	6.6	1.4	20.5
MRC.6301Bt	16.2	9.0	11.8	4.2	15.9	7.6	7.5	1.8	5.6
MRC.6301	40.2	42.0	36.5	35.4	27.2	20.9	21.8	13.9	28.0
MRC.6304Bt	21.8	14.1	12.7	4.9	16.3	7.9	19.1	10.7	9.4
MRC.6304	33.7	31.8	25.5	18.6	26.8	20.4	20.9	11.9	20.7
MRC.6160Bt	23.9	17.2	12.2	4.5	9.5	2.8	19.5	11.1	8.9
MRC.6160	44.7	49.5	29.6	24.4	30.6	26.0	20.6	12.5	28.1
NHH.44(ZC)	32.8	30.5	31.7	27.6	32.4	28.8	7.3	1.6	22.1
RCH.2Bt (CC)	19.1	11.0	15.6	7.2	11.1	3.8	8.9	2.4	6.1
MECH.162.Bt (CC)	23.7	17.3	13.2	5.3	20.2	12.0	7.5	1.7	9.1
CD (0.05)	9.72		3.06		4.20		0.39		
CV%	30.09		6.84		9.34		8.92		

*TV - transformed values

When the number of sprayings in central zone was considered, MRC.6302Bt, MRC.6304Bt, RCH.118Bt and RCH.335Bt did not receive any insecticide spraying to suppress bollworms, since they did not cross economic threshold levels. In the case of other Bt hybrids, this was below 1.5 in comparison to 2 and above in non-Bt hybrids.

Pest infestation in UNPROTECTED CONDITIONS

Aphid (average on 3 leaves/plant)

Entry	Nagpur	Nanded		Surat		Mean Number
	Number	*TV	Number	TV	Number	
Ankur.09Bt	9.3	3.2	9.9	2.3	4.8	8
Ankur.09	6.7	3.5	12.3	1.2	1	6.7
Ankur.651Bt	8.4	3.4	10.9	2.4	5.4	8.2
Ankur.651	6.8	3.7	12.9	1.2	1	6.9
Ankur.2534Bt	10.7	3.9	14.4	2.2	4.2	9.8
Ankur.2534	7.7	2.8	7.8	1.6	2	5.8
MRC.6301Bt	12.9	3.3	10.3	1.6	1.9	8.4
MRC.6301	9.9	3.8	14.1	1.5	1.6	8.5
MRC.6304Bt	10.8	4.1	16.5	2.2	4.2	10.5
MRC.6304	7	3.4	11.5	1.1	0.8	6.4
MRC.6160Bt	5.8	3.5	12	2.6	6.1	8
MRC.6160	6.1	3.2	10.3	1.4	1.5	6
RCH.118Bt	3.2	3.2	9.7	1.1	0.7	4.5
RCH.118	12.5	3.4	11.5	0.9	0.4	8.1
RCH.335Bt	8.9	2.7	6.9	1.2	1	5.6
RCH.335	11.8	3.8	13.7	0.9	0.4	8.6
RCH.359Bt	7.1	4.3	18	1.4	1.5	8.9
RCH.359	7.5	3.2	9.5	1.3	1.2	6.1
NHH.44(ZC)	9.3	3.7	13	1.1	0.8	7.7
RCH.2Bt (CC)	4.2	2.4	5.4	1.1	0.6	3.4
MECH.162.Bt (CC)	6.7	5.1	25.4	2.2	4.3	12.1
CD (0.05)		0.9		0.67		
CV%		12.38		26.76		

*TV - transformed values

Severe jassid incidence was noticed at Akola and Khandwa. All the entries were showing varying degrees of susceptibility. The following data shows that this pest was uniformly affecting all the genotypes in the zone.

Jassids (average on 3 leaves/plant) – Unprotected Condition

Entry	Nagpur	Akola		Nanded		Surat		Khandwa		Mean Number
	Number	*TV	Number	TV	Number	TV	Number	TV	Number	
Ankur.09Bt	1.6	3.0	9.3	1.5	1.9	1.4	1.4	3.9	15.5	6.0
Ankur.09	1.6	2.4	6.7	1.7	2.3	1.4	1.6	3.3	10.6	4.5
Ankur.651Bt	1.6	2.5	6.8	1.8	2.9	1.4	1.4	2.4	5.9	3.7
Ankur.651	1.4	3.2	10.5	1.8	2.9	1.4	1.5	2.5	6.1	4.5
Ankur.2534Bt	0.6	2.5	6.0	1.8	2.7	1.4	1.5	3.2	10.5	4.3
Ankur.2534	1.3	3.0	9.0	1.6	2.1	1.4	1.3	3.1	9.8	4.7
MRC.6301Bt	1.4	3.3	11.0	2.0	3.4	1.4	1.6	3.3	11.1	5.7
MRC.6301	1.7	2.0	4.0	1.6	2.0	1.5	1.6	3.4	11.4	4.1
MRC.6304Bt	1.5	2.7	7.5	1.3	1.4	1.6	2.0	4.1	16.5	5.8
MRC.6304	2.1	3.1	9.5	1.8	2.8	1.5	1.6	3.4	11.6	5.5
MRC.6160Bt	1.7	2.2	5.2	1.8	2.6	1.4	1.4	2.2	4.9	3.1
MRC.6160	1.7	2.5	6.3	1.7	2.3	1.5	1.7	3.3	10.9	4.6
RCH.118Bt	2.4	3.4	11.7	1.8	2.8	1.8	2.6	3.4	11.3	6.2
RCH.118	2.7	3.5	13.0	1.6	2.2	1.7	2.3	3.8	14.7	7.0
RCH.335Bt	1.3	2.6	6.8	1.7	2.5	1.4	1.4	3.3	10.9	4.6
RCH.335	1.4	2.6	7.2	1.7	2.4	1.5	1.7	2.2	4.8	3.5
RCH.359Bt	1.5	3.0	9.2	1.5	1.9	1.6	2.0	2.5	6.1	4.1
RCH.359	1.0	2.2	5.5	1.9	3.2	1.5	1.8	2.3	5.2	3.3
NHH.44(ZC)	0.9	3.2	10.2	1.8	2.8	1.4	1.3	3.4	11.2	5.3
RCH.2Bt (CC)	1.9	3.8	14.7	1.7	2.3	1.7	1.5	4.1	16.5	7.4
MECH.162.Bt (CC)	1.5	3.5	12.1	1.8	2.8	1.5	1.9	3.3	10.8	5.8
CD (0.05)		1.36		0.42	NS	0.23		1.19		
CV%		22.6		12.01	12.01	10.36		16.42		

*TV - transformed values

In the case of thrips infestation in the test hybrids, as given below, the similar observations showing no variation in tolerance in any hybrid was recorded. It shows that these hybrids need special care to be protected against these pests in this zone.

Thrips – Unprotected Condition

Entry	Nagpur	Akola		Nanded		Surat		Khandwa		Mean Number
	Number	*TV	Number	TV	Number	TV	Number	TV	Number	
Ankur.09Bt	5.9	10.4	107.3	5.5	30.1	3.0	8.2	0.7	0.4	30.4
Ankur.09	5.9	11.3	127.0	5.1	25.9	3.5	11.5	0.7	0.5	34.2
Ankur.651Bt	9.8	10.8	117.5	4.5	20.4	3.4	10.9	0.6	0.4	31.8
Ankur.651	8.5	10.5	111.0	4.9	24.0	3.3	10.6	0.6	0.4	30.9
Ankur.2534Bt	6.4	11.6	134.2	5.7	32.6	3.1	9.2	0.4	0.2	36.5
Ankur.2534	5.1	10.3	106.0	4.7	21.5	2.8	7.2	0.7	0.5	28.1
MRC.6301Bt	8.4	12.2	149.0	6.3	38.6	3.6	12.3	0.7	0.4	41.7
MRC.6301	6.5	10.2	105.8	4.6	21.0	3.2	9.5	0.8	0.7	28.7
MRC.6304Bt	6.9	10.8	116.7	5.5	29.8	2.9	8.0	0.8	0.7	32.4
MRC.6304	6.0	9.9	100.4	5.6	30.4	3.1	8.9	0.7	0.5	29.2
MRC.6160Bt	3.9	9.1	84.2	5.8	33.4	3.1	9.2	0.8	0.6	26.3
MRC.6160	4.3	9.7	95.3	4.8	23.0	2.8	7.3	0.8	0.7	26.1
RCH.118Bt	3.6	9.0	81.7	4.2	17.5	2.5	5.6	0.8	0.7	21.8
RCH.118	5.4	8.9	78.3	3.6	13.2	2.0	3.7	0.5	0.2	20.2
RCH.335Bt	7.0	11.6	134.5	5.5	30.0	3.2	9.5	0.6	0.4	36.3
RCH.335	6.2	10.7	115.3	4.7	21.8	3.2	9.6	0.7	0.5	30.7
RCH.359Bt	6.5	11.4	130.2	5.2	26.5	3.4	11.1	0.5	0.2	34.9
RCH.359	6.8	10.4	107.8	4.6	20.9	3.1	9.4	0.6	0.4	29.1
NHH.44(ZC)	8.3	9.4	89.2	4.3	17.9	3.5	11.7	0.5	0.3	25.5
RCH.2Bt (CC)	4.9	10.6	111.7	5.7	31.8	2.9	2.9	0.6	0.3	30.3
MECH.162.Bt (CC)	7.0	11.2	126.0	5.2	27.0	3.1	9.0	0.7	0.4	33.9
CD (0.05)		2.18		1.15		0.61		0.025		
CV%		9.99		10.99		13.63		15.35		

There was no difference between entries in terms of whitefly infestation and as the data given below, indicates the central zone centres such as Nanded showed the highest whitefly population during this year.

Whitefly – Unprotected Condition

Entry	Nagpur		Akola		Nanded		Surat		Khandwa		Mean number
	Number	*TV	Number	TV	Number	TV	Number	TV	Number		
Ankur.09Bt	3.3	1.9	3.3	5.3	28.2	1.1	0.7	0.6	0.4	7.2	
Ankur.09	2.4	2.0	3.3	5.4	29.0	1.1	0.7	0.7	0.5	7.2	
Ankur.651Bt	2.8	2.2	4.3	5.6	31.4	1.0	0.6	0.8	0.7	7.9	
Ankur.651	1.8	1.5	1.8	5.2	26.2	1.0	0.6	0.6	0.4	6.2	
Ankur.2534Bt	2.2	2.2	4.2	5.1	25.3	1.3	1.1	0.5	0.2	6.6	
Ankur.2534	2.3	2.5	5.7	5.4	29.1	1.2	1.0	0.5	0.2	7.7	
MRC.6301Bt	2.2	1.8	2.8	5.3	28.5	1.1	0.8	0.6	0.4	6.9	
MRC.6301	2.6	1.3	1.3	5.8	33.7	1.1	0.6	0.7	0.5	7.8	
MRC.6304Bt	3.9	2.0	3.7	5.2	26.9	1.2	0.9	0.7	0.4	7.2	
MRC.6304	1.8	2.1	4.3	5.4	30.2	1.1	0.8	0.6	0.4	7.5	
MRC.6160Bt	3.1	2.3	4.7	5.3	27.8	1.3	1.3	0.6	0.3	7.4	
MRC.6160	2.5	1.5	1.7	5.4	28.5	1.3	1.2	0.6	0.4	6.8	
RCH.118Bt	1.9	1.5	2.2	5.9	34.7	1.1	0.8	0.5	0.3	8.0	
RCH.118	2.0	0.9	0.3	5.2	26.1	1.0	0.6	0.8	0.6	5.9	
RCH.335Bt	2.2	1.9	3.3	5.8	23.3	1.2	0.8	0.6	0.3	6.0	
RCH.335	2.3	2.2	4.3	5.3	27.3	1.1	0.7	0.7	0.4	7.0	
RCH.359Bt	2.7	2.1	3.8	4.9	23.2	1.2	0.9	0.7	0.4	6.2	
RCH.359	2.4	1.3	1.3	5.3	27.4	1.0	0.5	0.7	0.5	6.4	
NHH.44(ZC)	3.2	1.7	2.7	5.3	27.8	1.1	0.7	0.8	0.7	7.0	
RCH.2Bt (CC)	2.3	1.8	2.7	5.6	30.7	1.0	0.5	0.7	0.5	7.3	
MECH.162.Bt (CC)	2.8	2.0	3.5	5.5	29.8	1.2	1.0	0.8	0.7	7.6	
CD (0.05)		1.00		0.82		NS		0.02			
CV%		26.18		7.29		15.89		14.25			

*TV - transformed values

The Spotted bollworm incidence was negligible in the five test centres, although the maximum population was seen in Khandwa centre. There was clear-cut difference in incidence of this pest between Bt and non-Bt hybrids. All the Bt hybrids provided protection against this pest. The data is given below.

Spotted bollworms (mean of counts/5 plants) – Unprotected Condition

Entry	Nagpur		Akola		Nanded		Surat		Khandwa		Mean Number
		*TV	Number	TV	Number	TV	Number	TV	Number		
Ankur.09Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	1.8	3.4	0.7	
Ankur.09	0.1	2.1	4.5	1.4	1.5	0.9	0.4	1.6	2.6	1.8	
Ankur.651Bt	0.0	0.7	0.0	0.7	0.0	0.8	0.2	1.3	1.8	0.4	
Ankur.651	0.1	1.4	2.0	1.5	2.0	0.8	0.1	1.4	1.9	1.2	
Ankur.2534Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	1.6	2.6	0.5	
Ankur.2534	0.1	2.4	5.0	1.0	0.5	0.7	0.0	1.7	3.0	1.7	
MRC.6301Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	1.4	1.9	0.4	
MRC.6301	0.0	1.2	1.0	1.2	1.0	1.0	0.6	1.5	2.3	1.0	
MRC.6304Bt	0.0	0.7	0.0	0.7	0.0	0.8	0.2	1.9	3.7	0.8	
MRC.6304	0.3	2.0	3.5	1.4	1.5	1.0	0.6	1.4	1.9	1.6	
MRC.6160Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	1.5	2.4	0.5	
MRC.6160	0.1	2.0	3.5	1.7	2.5	1.0	1.1	1.6	2.6	2.0	
RCH.118Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	1.9	3.5	0.7	
RCH.118	0.0	1.4	2.0	1.4	1.5	0.7	0.0	1.8	3.4	1.4	

RCH.335Bt	0.0	0.7	0.0	0.7	0.0	0.7	0.0	0.7	0.5	0.1
RCH.335	0.0	1.6	2.0	1.4	1.5	0.7	0.0	1.6	2.7	1.2
RCH.359Bt	0.2	0.7	0.0	0.7	0.0	0.7	0.0	1.8	3.2	0.7
RCH.359	0.1	1.2	1.0	1.7	2.5	0.8	0.1	1.7	3.0	1.3
NHH.44(ZC)	0.0	1.9	3.0	2.1	4.0	1.0	0.2	1.5	2.2	1.9
RCH.2Bt (CC)	0.1	0.7	0.0	0.7	0.0	0.8	0.2	0.8	0.7	0.2
MECH.162.Bt (CC)	0.1	0.7	0.0	0.7	0.0	0.7	0.0	1.9	3.5	0.7
CD (0.05)		1.0		0.44		1.20		0.30		
CV%		40.4		19.6		11.8		8.5		

*TV - transformed values

The American bollworm incidence, in this zone, was low to moderate during this season. Khandwa and Nanded recorded maximum levels of their population. The zone's mean incidence shows, as given below, that there is reduction in their numbers in Bt hybrids over their non-Bt counterparts.

American bollworms (mean number/5 plants) – Unprotected Condition

Entry	Nagpur	Akola		Nanded		Surat	Khandwa		Mean Number
		*TV	Number	TV	Number		TV	Number	
Ankur.09Bt	0.1	1.0	0.5	2.0	3.5	0.0	2.2	5.0	1.8
Ankur.09	0.6	1.6	2.0	3.1	9.5	0.1	2.2	5.0	3.4
Ankur.651Bt	0.1	0.7	0.0	2.0	3.5	0.0	20.9	4.4	1.6
Ankur.651	0.7	1.4	1.5	2.8	7.5	0.7	3.5	11.9	4.5
Ankur.2534Bt	0.1	0.7	0.0	1.9	3.0	0.0	2.3	5.1	1.6
Ankur.2534	0.6	1.6	2.0	2.4	5.5	0.3	2.2	4.8	2.6
MRC.6301Bt	0.1	0.7	0.0	1.7	2.5	0.0	2.2	4.9	1.5
MRC.6301	0.6	1.6	2.0	6.4	6.5	0.2	3.5	12.2	4.3
MRC.6304Bt	0.3	0.7	0.0	1.5	2.0	0.0	3.5	12.0	2.8
MRC.6304	0.3	1.3	1.5	2.6	6.5	1.4	3.5	12.4	4.4
MRC.6160Bt	0.3	0.7	0.0	2.1	4.0	0.0	3.3	11.0	3.0
MRC.6160	0.9	1.7	2.5	2.2	4.5	1.0	3.4	11.8	4.1
RCH.118Bt	0.1	0.7	0.0	2.1	4.0	0.0	3.4	11.6	3.1
RCH.118	0.3	1.0	0.5	2.4	5.5	0.6	2.3	5.3	2.4
RCH.335Bt	0.0	0.7	0.0	2.0	3.5	0.0	2.1	4.6	1.6
RCH.335	0.6	1.0	0.5	2.5	6.0	0.4	2.2	5.0	2.5
RCH.359Bt	0.1	0.7	0.0	2.0	3.5	0.0	2.2	4.9	1.7
RCH.359	0.5	1.0	0.5	2.7	7.0	0.5	2.3	5.1	2.7
NHH.44(ZC)	0.6	1.6	2.0	2.6	6.5	0.7	2.2	5.0	3.0
RCH.2Bt (CC)	0.2	0.7	0.0	2.1	4.0	0.3	2.2	4.9	1.9
MECH.162.Bt (CC)	0.3	1.2	1.0	2.3	5.0	0.0	2.3	5.1	2.3
CD (0.05)		0.62		0.6			0.46		
CV%		28.4		13			8.3		

*TV - transformed values

The square damage due to American bollworm was quite low in Bt hybrids, showing the action of Bt gene in them, in comparison to their non-Bt counterparts. The NHH.44, conventional check hybrid had over 10% square damage. Some non-Bt hybrids such as MRC.6160 recorded 12.8% square damage.

American bollworms square damage (%)– Unprotected Condition

Entry	Nagpur	Akola	Surat		Mean %
			TV	%	
Ankur.09Bt	5.2	0.3	3.0	0.3	1.9
Ankur.09	15.5	10.2	2.7	4.8	10.2
Ankur.651Bt	4.8	0.9	4.1	0.5	2.1
Ankur.651	11.7	4.9	2.8	4.9	7.2
Ankur.2534Bt	6.0	1.5	3.7	0.4	2.6
Ankur.2534	12.9	8.0	6.3	1.2	7.4

MRC.6301Bt	4.5	0.1	5.2	0.8	1.8
MRC.6301	10.0	7.6	9.3	2.6	6.7
MRC.6304Bt	4.2	0.1	5.2	0.8	1.7
MRC.6304	11.3	12.7	8.5	2.2	8.7
MRC.6160Bt	6.4	0.5	3.9	0.5	2.5
MRC.6160	13.6	22.4	8.9	2.4	12.8
RCH.118Bt	4.3	0.5	4.6	0.6	1.8
RCH.118	10.8	6.1	9.4	2.7	6.5
RCH.335Bt	3.6	0.9	5.0	0.8	1.8
RCH.335	10.6	12.6	1.3	3.9	9.0
RCH.359Bt	6.5	0.3	3.4	0.4	2.4
RCH.359	14.8	11.3	0.0	3.0	9.7
NHH.44(ZC)	13.5	13.2	1.3	3.8	10.2
RCH.2Bt (CC)	2.6	0.4	4.3	0.6	1.2
MECH.162.Bt (CC)	8.5	1.0	7.6	1.8	3.7
CD (0.05)			3.81		
CV%			36.92		

*TV - transformed values

During this season, special efforts to look into the Pink bollworm (PBW) infestation were done in this zone. The green boll sampling revealed, as given below, that there is appreciable reduction in the number of PBW in green bolls of Bt hybrids. The Check hybrid, NHH.44 had 7.5 PBW per boll and in some non-Bt counterpart hybrids, it was seen up to 18.9/boll.

Pink bollworm (mean of counts/20 green bolls) – Unprotected Condition

Entry	Nagpur		Akola		Nanded		Surat		Mean number
	*TV	Number	TV	Number	TV	Number	TV	Number	
Ankur.09Bt	1.4	1.5	0.7	0.0	2.1	4.0	0.7	0.0	1.4
Ankur.09	1.4	1.8	4.8	22.5	3.3	10.5	0.7	0.0	8.7
Ankur.651Bt	1.0	0.5	1.4	1.5	2.2	4.5	0.7	0.0	1.6
Ankur.651	1.4	2.0	6.2	38.0	2.2	4.5	0.7	0.0	11.1
Ankur.2534Bt	0.7	0.0	0.7	0.0	1.7	2.5	0.7	0.0	0.6
Ankur.2534	1.5	1.8	5.3	29.0	2.2	4.5	0.7	0.0	8.8
MRC.6301Bt	0.7	0.0	0.7	0.0	1.7	2.5	0.7	0.0	0.6
MRC.6301	1.2	1.0	6.0	35.5	2.8	7.5	0.7	0.0	11.0
MRC.6304Bt	0.9	0.3	1.0	0.5	1.7	2.5	0.7	0.0	0.8
MRC.6304	1.5	1.8	6.8	45.0	1.6	3.0	1.4	1.5	12.8
MRC.6160Bt	0.7	0.0	1.8	3.0	1.1	1.0	0.7	0.0	1.0
MRC.6160	1.5	1.8	8.0	66.0	2.8	7.5	1.0	0.5	18.9
RCH.118Bt	0.7	0.0	1.6	3.0	1.3	1.5	0.7	0.0	1.1
RCH.118	1.6	2.0	6.1	36.5	3.0	8.5	1.2	1.0	12.0
RCH.335Bt	1.1	0.8	0.7	0.0	1.7	2.5	0.7	0.0	0.8
RCH.335	0.9	0.3	5.9	34.0	3.0	8.5	1.0	5.0	11.9
RCH.359Bt	0.9	0.3	0.7	0.0	2.1	4.0	0.7	0.0	1.1
RCH.359	1.0	0.5	3.7	14.0	2.4	5.5	0.7	0.0	5.0
NHH.44(ZC)	1.0	0.5	4.7	22.5	2.7	7.0	0.7	0.0	7.5
RCH.2Bt (CC)	1.0	0.5	0.7	0.0	2.2	4.5	0.7	0.0	1.3
MECH.162.Bt (CC)	1.3	1.3	3.1	9.0	1.4	2.0	0.7	0.0	3.1
CD (0.05)			1.9		1.1		0.2		
CV%	29		27		25		15		

*TV - transformed values

The percentage Locule damage in this zone, an indicator of PBW damage, also closely followed the above data of PBW incidence in green bolls. The Bt hybrids

showed Locule damage between 4.9 to 7.2 per cent in comparison to 16.8 to 21.9 per cent in NHH.44 as well as the non-Bt counterpart hybrids, as given below.

Locule damage (%) – Unprotected Condition

Entry	Nagpur		Akola		Nanded		Surat		Khandwa		Mean %
	*TV	%	TV	%	TV	%	TV	%	TV	%	
Ankur.09Bt	19.7	12.5	8.8	9.2	10.0	2.9	0.0	20.8	9.1	2.5	5.4
Ankur.09	17.9	10.0	68.8	33.8	30.0	5.7	7.5	21.2	9.5	2.7	17.6
Ankur.651Bt	12.9	5.0	22.5	13.5	12.5	7.9	2.5	20.8	9.5	2.7	4.9
Ankur.651	17.0	12.5	76.3	23.9	10.0	7.9	2.5	27.8	19.8	11.4	17.6
Ankur.2534Bt	4.1	0.0	10.0	13.5	12.5	5.7	7.5	20.9	8.9	2.4	5.4
Ankur.2534	24.7	17.5	67.5	16.9	17.5	2.9	0.0	20.8	9.3	2.7	20.6
MRC.6301Bt	4.1	0.0	12.5	18.1	7.5	2.9	0.0	21.2	9.1	2.6	5.1
MRC.6301	18.4	10.0	90.0	31.5	22.5	0.6	5.0	29.1	20.5	12.3	20.5
MRC.6304Bt	8.5	2.5	3.8	17.1	10.0	2.9	0.0	26.2	20.3	12.1	7.2
MRC.6304	25.8	20.0	82.5	23.2	15.0	2.8	7.5	28.8	20.8	12.7	21.2
MRC.6160Bt	4.1	0.0	8.8	3.2	2.5	2.9	0.0	27.1	22.1	14.3	9.2
MRC.6160	24.7	17.5	72.5	14.1	22.5	7.9	2.5	28.9	21.1	12.9	21.9
RCH.118Bt	8.5	2.5	15.0	7.8	5.0	2.9	0.0	26.8	20.7	12.6	7.4
RCH.118	22.5	15.0	72.5	31.5	22.5	2.9	5.0	20.7	9.1	2.6	19.2
RCH.335Bt	17.9	10.0	6.3	14.4	10.0	2.9	0.0	21.4	8.5	2.3	6.5
RCH.335	8.5	2.5	77.5	26.1	27.5	0.7	5.0	20.4	9.5	2.7	21.7
RCH.359Bt	17.9	10.0	7.5	19.5	12.5	2.9	0.0	21.5	9.3	2.7	4.9
RCH.359	12.9	5.0	61.3	26.5	20.0	5.7	7.5	20.1	8.9	2.4	13.6
NHH.44(ZC)	11.2	5.0	65.0	28.9	25.0	2.9	0.0	20.5	8.9	2.4	16.8
RCH.2Bt (CC)	12.9	5.0	15.0	10.3	12.5	2.9	0.0	21.3	10.1	3.1	5.8
MECH.162.Bt (CC)	20.6	12.5	21.3	15.6	7.5	2.9	0.0	21.4	8.9	2.4	7.8
CD (0.05)	-			13.2		9.5		0.5	0.4		
CV%	46.2			35.8		63		5.8	7.2		

*TV - transformed values

The Open boll damage in the Central zone also showed that Bt hybrids recorded very low values in comparison to non-Bt hybrids. RCH.359Bt, all Ankur hybrids as well as MRC.6301Bt had the lowest open boll damage, as seen from the following table. Damage in open bolls was up to a maximum of 35.6 per cent.

Open boll damage (%) – Unprotected Condition

Entry	Nagpur		Akola		Nanded		Surat		Khandwa		Mean %
	*TV	%	TV	%	TV	%	TV	%	TV	%	
Ankur.09Bt	22.1	15.3	0.0	0.0	16.6	8.2	25.6	18.9	6.6	1.3	8.7
Ankur.09	32.7	29.8	26.7	30.9	38.8	39.3	44.6	49.3	6.8	1.5	30.2
Ankur.651Bt	21.3	14.1	6.7	10.7	12.8	5.4	23.1	15.7	7.5	1.8	9.5
Ankur.651	38.2	38.6	43.3	41.2	29.9	25.0	39.6	40.7	18.9	10.5	31.2
Ankur.2534Bt	21.6	15.3	0.0	0.0	15.5	7.2	24.4	18.6	6.0	1.2	8.5
Ankur.2534	34.7	33.4	46.7	43.1	36.7	35.8	45.2	50.4	6.6	1.4	32.8
MRC.6301Bt	18.2	11.1	0.0	0.0	13.8	5.7	26.8	20.3	7.5	1.8	7.8
MRC.6301	33.3	30.5	70.0	56.8	35.7	34.1	39.4	40.9	21.8	13.9	35.2
MRC.6304Bt	16.0	9.8	0.0	0.0	13.8	5.7	33.0	29.6	19.1	10.7	11.2
MRC.6304	32.9	30.1	66.7	54.7	27.7	21.7	42.2	45.2	20.1	11.9	32.7
MRC.6160Bt	20.3	12.8	0.0	0.0	13.7	5.6	35.2	33.2	19.5	11.1	12.6
MRC.6160	44.1	48.6	70.0	57.1	31.6	27.6	38.8	39.7	20.6	12.5	37.1
RCH.118Bt	13.9	7.3	0.0	0.0	19.3	11.0	28.7	24.4	19.9	11.7	10.9
RCH.118	38.2	38.5	63.3	52.8	29.6	24.5	43.8	48.0	7.9	1.9	33.1
RCH.335Bt	12.9	6.0	6.7	10.7	17.8	9.4	32.6	29.4	7.3	1.6	11.4
RCH.335	33.9	31.4	83.3	67.0	33.7	30.9	43.4	47.3	7.4	1.7	35.6
RCH.359Bt	20.5	12.7	0.0	0.0	17.3	8.9	27.8	22.3	6.6	1.3	9.0
RCH.359	28.7	23.4	53.3	47.0	28.4	22.7	35.0	33.5	8.3	2.1	25.7
NHH.44(ZC)	30.9	27.3	43.3	41.2	32.4	28.8	41.5	43.9	7.3	1.6	28.6
RCH.2Bt (CC)	17.7	10.6	0.0	0.0	16.8	8.4	26.1	20.5	8.9	2.4	8.4
MECH.162.Bt (CC)	23.2	16.2	3.3	7.5	14.1	6.0	37.6	37.4	7.5	1.7	13.8
CD (0.05)	8.44		14.5		5.47		NS		0.39		
CV%	27.88		28.0		11.12		21.00		8.92		

*TV - transformed values

The number of sprayings for sap sucking pest in Unprotected test hybrids was ranging from 2 and 3. The maximum number of 4 to 5 was done in Akola centre in this zone in almost all hybrids.

Number of sprays for sap sucking pests

Entry	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	5	2	2	3	3
Ankur.09	5	2	3	2	3
Ankur.651Bt	5	2	2	1	3
Ankur.651	4	2	3	1	3
Ankur.2534Bt	5	2	2	2	3
Ankur.2534	5	2	2	2	3
MRC.6301Bt	5	2	3	2	3
MRC.6301	4	2	3	2	3
MRC.6304Bt	4	2	2	3	3
MRC.6304	5	2	3	2	3
MRC.6160Bt	5	2	2	1	3
MRC.6160	3	2	2	2	2
RCH.118Bt	3	2	3	2	3
RCH.118	3	2	1	3	2
RCH.335Bt	4	2	3	2	3
RCH.335	4	2	3	1	3
RCH.359Bt	4	2	3	1	3
RCH.359	5	2	3	1	3
NHH.44(ZC)	5	2	4	2	3
RCH.2Bt (CC)	4	2	3	3	3
MECH.162.Bt (CC)	4	2	2	2	3

In the zone, the non-Bt entries had 2.0 to 2.7 sprayings against sap sucking pests and 1.3 to 2.7 number of sprays against bollworms on non-Bt entries during 2004 season, as seen from the following table. However, in their Bt counterparts, the number of insecticide spraying against bollworms ranged from nil to 1.3. Since the threshold levels for bollworms never exceeded the prescribed limit to warrant any insecticide spray.

Mean number of sprayings

Entry name	Mean number of sprayings	
	Sucking Pests	Boll worms
RCH.118	2.5	2.3
RCH.335	2.0	2.3
RCH.359	2.7	2.7
Ankur.651	2.3	2.5
Ankur.09	2.7	3.0
Ankur.2534	2.5	1.3
MRC.6301	2.0	2.3
MRC.6304	2.5	2.3
MRC.6160	2.7	2.3
RCH.118Bt	2.5	0.0

RCH.335Bt	2.3	0.0
RCH.359Bt	2.3	1.0
Ankur.651Bt	2.3	2.0
Ankur.09Bt	2.3	1.0
Ankur.2534Bt	2.3	1.3
MRC.6301Bt	2.5	0.0
MRC.6304Bt	2.5	0.0
MRC.6160Bt	2.3	1.0
NHH.44(ZC)	2.7	2.0
RCH.2Bt (CC)	2.5	1.0
MECH.162.Bt (CC)	2.3	1.5

Seed cotton yield (Kg/ha) – Unprotected Condition

Under unprotected conditions, however, the average seed cotton yield harvested in the central zone is given below. It is found that RCH. 335Bt with 1512 kg/ha, RCH.359 with 1506 kg/ha, MRC.6301Bt with 1459 kg/ha and MRC.6160Bt with 1459 kg/ha were the top entries in respect of seed cotton yield. Other Bt hybrids yielded between 1160 to 1389 kg/ha. RCH. 335BT, RCH.359, MRC.6301Bt and MRC.6160Bt are superior over others and statistically, being at par. Ankur.651 and Ankur.09, that are released for central zone, yielded 1321 kg/ha and 1160 kg/ha respectively. This data shows clearly the gene action to provide the higher yield over the non-Bt checks and over the counterparts of the test hybrids.

Seed cotton yield (Kg/ha) – Unprotected Condition

Entry	Nagpur	Akola	Nanded	Surat	Khandwa	Mean
Ankur.09Bt	732	648	1053	1984	1387	1161
Ankur.09	739	369	612	1275	779	755
Ankur.651Bt	845	1101	1493	1800	1366	1321
Ankur.651	695	440	332	1477	681	725
Ankur.2534Bt	579	998	1306	2065	1105	1211
Ankur.2534	677	436	406	1514	1167	840
MRC.6301Bt	804	995	1272	2766	1460	1459
MRC.6301	796	558	595	1951	610	902
MRC.6304Bt	839	842	729	2623	782	1163
MRC.6304	748	394	362	1935	858	859
MRC.6160Bt	1308	1042	1237	2363	1353	1461
MRC.6160	1012	243	278	1403	1108	809
RCH.118Bt	1030	1063	1315	2398	1142	1390
RCH.118	1023	488	352	1481	683	805
RCH.335Bt	966	1107	712	3449	1327	1512
RCH.335	926	273	462	1377	1120	832
RCH.359Bt	787	826	1033	3719	1167	1506
RCH.359	737	354	610	1942	995	928
RCH.2Bt (CC)	736	877	1102	1914	943	1114
MECH.162.Bt (CC)	840	848	929	1954	923	1099
NHH.44(ZC)	857	240	464	951	888	680
CD (0.05)	61	393	145	525	273	
CV %	22.03	20.8	7.66	12.48	18.68	

PLANT PATHOLOGY EVALUATION

During 2004 – 05 season, foliar diseases viz., Bacterial leaf blight (BLB), Grey mildew, Alternaria leaf spot and Myrothecium leaf spot and also Parawilt appeared in central zone and the test Bt hybrids could be evaluated for their reaction during this year. Among these diseases, significant incidence of Bacterial leaf blight at Surat and Akola, Grey mildew at Nanded and Parawilt at Khandwa as well as Akola have been noticed.

Bacterial leaf blight.

BLB has been observed at all the five centres, where the Bt hybrids were tested, but the incidences Nagpur, Nanded and Khandwa were negligible. At Akola and to certain extent at Surat, significant disease incidence was noticed. RCH 118Bt, Ankur 651Bt and MRC 6160Bt were found to be highly susceptible at Akola where as at Surat, RCH 118Bt, MRC 6301Bt and MRC 6160 Bt showed higher susceptibility to BLB. There were no differences between Bt and non Bt hybrids in their susceptibility, as seen from the following table.

Percent disease incidence of Bacterial leaf Blight

Entry	Nagpur	Akola	Surat	Nanded		Khandwa	
				Protected	Unprotected	Protected	Unprotected
Ankur.09Bt	0.16	21.3	3.99	0.00	0.00	2.90	2.5
Ankur.09	0.49	3.71	9.21	0.00	2.40	2.30	2.3
Ankur.651Bt	0.00	35.19	2.70	4.90	4.10	2.20	3.2
Ankur.651	0.75	12.96	10.04	2.20	5.70	2.20	2.0
Ankur.2534Bt	1.24	17.59	0.57	0.00	0.00	1.90	3.1
Ankur.2534	0.00	5.09	8.23	0.00	0.00	2.40	3.1
MRC.6301Bt	0.00	16.21	15.84	3.00	3.75	2.50	3.2
MRC.6301	0.59	6.02	16.83	4.00	5.90	2.40	2.2
MRC.6304Bt	0.59	24.08	17.57	5.00	5.90	2.60	2.3
MRC.6304	1.41	16.67	15.98	0.00	0.00	2.40	2.2
MRC.6160Bt	0.60	12.5	7.54	0.00	0.00	2.40	3.3
MRC.6160	0.08	8.8	7.37	0.00	3.15	2.00	3.2
RCH.118Bt	0.00	27.78	28.87	3.00	5.75	2.30	1.9
RCH.118	0.00	33.8	18.22	8.50	9.00	2.90	2.1
RCH.335Bt	1.25	14.81	10.70	3.00	5.75	2.90	3.1
RCH.335	0.00	23.6	23.88	0.00	2.15	2.10	3.1
RCH.359Bt	0.77	19.9	6.61	0.00	0.00	2.00	2.1
RCH.359	1.03	20.83	2.46	0.00	2.20	2.10	3.3
NHH.44(ZC)	0.00	14.82	7.39	0.00	0.00	2.00	1.9
RCH.2Bt (CC)	0.32	27.78	8.88	3.15	3.15	3.10	2.0
MECH.162.Bt (CC)	0.44	25.93	14.12	0.00	2.00	2.30	2.3
C.D (0.05)		7.9	13.73				
CV%		15.39	89.46				

Alternaria leaf spot.

This disease was observed only at Nagpur and Nanded. MRC 6160 Bt (15.00 PDI), and Ankur 2534 Bt (12.75 PDI) and the non Bt hybrids MRC 6160 (15.80 PDI) and RCH 335 (14.00 PDI) had higher incidences of the Alternaria leaf spot under unprotected conditions. Some entries such as RCH.335, Ankur.2534Bt and MRC.6160Bt and non-Bt hybrids showed high incidence of the disease in

unprotected plots (as shown in the following table), warranting recommended control measures.

Percent Disease Incidence of Alternaria Leaf Spot

Entry	Nagpur	Nanded	
		Protected	Unprotected
RCH.118Bt	1.23	5.90	5.99
RCH.118	2.31	7.00	9.00
RCH.335Bt	0.71	5.00	5.70
RCH.335	0.74	6.50	14.00
RCH.359Bt	1.35	5.10	5.70
RCH.359	1.03	4.00	5.00
Ankur.651Bt	2.64	5.00	5.10
Ankur.651	1.37	5.90	8.00
Ankur.09Bt	1.61	5.00	5.40
Ankur.09	1.58	5.00	7.50
Ankur.2534Bt	0.97	8.50	12.75
Ankur.2534	0.81	5.20	8.00
MRC.6301Bt	1.12	5.25	9.90
MRC.6301	1.28	5.04	8.00
MRC.6304Bt	1.55	5.00	5.50
MRC.6304	0.87	3.00	5.75
MRC.6160Bt	1.10	5.00	15.00
MRC.6160	1.05	8.57	15.00
NHH.44(ZC)	1.38	5.20	6.00
RCH.2Bt (CC)	1.29	5.50	5.50
MECH.162.Bt (CC)	1.42	3.09	5.00

Grey mildew

Only at the Nanded centre, there was substantial incidence of Grey mildew ranging from 5.00 percent to 40.00 percent with the maximum grades of three and four. Among the nine Bt I hybrids, MRC 6160 Bt had the highest PDI (40.00%) under unprotected conditions and RCH 118 Bt and RCH 335 Bt had the lowest PDI (5.00%). RCH 359 Bt, Ankur 651 Bt, Ankur 09 Bt, Ankur 2534 Bt, MRC 6301 Bt and MRC 6304 Bt were also found susceptible. Both Bt and non Bt hybrids are equally susceptible to this disease. There was no correlation between disease incidence and seed cotton yield in this trial, as shown in the following table. Since overall seed cotton yield was low, the correlation between yield and disease incidence could not be arrived at.

Percent Disease Incidence (PDI) of Grey Mildew and seed cotton yield

Entry	Nanded					
	Protected			Unprotected		
	PDI*	Max. grade	Yield (Kg/ha)	PDI	Max. grade	Yield (Kg/ha)
Ankur.09Bt	10.00	2	1053	30.10	4	807
Ankur.09	12.50	3	612	15.50	3	352
Ankur.651Bt	15.10	3	1493	25.10	4	933
Ankur.651	19.00	3	332	20.00	3	430
Ankur.2534Bt	20.00	4	1306	30.00	4	707
Ankur.2534	10.25	3	406	15.25	3	347
MRC.6301Bt	20.05	4	1272	25.05	4	1072
MRC.6301	20.00	3	595	20.00	3	321
MRC.6304Bt	20.95	4	729	25.95	4	495
MRC.6304	12.00	3	362	15.00	3	273
MRC.6160Bt	30.00	4	1237	40.00	4	764
MRC.6160	30.58	4	278	35.58	4	286
RCH.118Bt	5.00	1	1315	5.00	1	1124

RCH.118	6.00	2	352	10.00	2	512
RCH.335Bt	5.00	1	712	5.00	1	812
RCH.335	3.00	1	462	5.00	1	347
RCH.359Bt	30.10	4	1033	35.70	4	916
RCH.359	10.90	3	610	20.00	3	503
NHH.44(ZC)	20.25	4	464	30.28	4	482
RCH.2Bt (CC)	25.35	4	1102	25.35	4	508
MECH.162.Bt (CC)	27.58	4	929	37.58	4	742

Parawilt

Parawilt was noticed at Khandwa ranging from 0.00% (RCH.118 Bt) to 8.33% (MRC.6160 Bt) under protected conditions and 0.00% (RCH.118 Bt) to 5.83% (Ankur.09 Bt) under unprotected conditions where as at Akola the incidences of parawilt was from 0.00% to 4.00%. There was variation in the incidence of wilt at these two centres. The seed cotton yield was not affected. This may be due to the late occurrence of parawilt in the season. As seen in the following table, there was no relationship with seed cotton yield and Parawilt incidence in most of the entries. The trials at Khandwa and Akola centres showed Parawilt syndrome and hence this observation was specially considered at these centres in the various test entries. However, their relationship with seed cotton yield was not established from the following data during 2004-05.

Percent Disease Incidence (PDI) of Parawilt and seed cotton yield

Entry	Khandwa				Akola (Unprotected)	
	Protected		Unprotected		PDI	Yield (Kg/ha)
	PDI*	Yield (Kg/ha)	PDI	Yield (Kg/ha)		
Ankur.09Bt	5.83	1364	5.83	1387	4.00 (1.81)	648
Ankur.09	4.17	928	0.00	779	0.00 (0.71)	369
Ankur.651Bt	4.17	1435	4.17	1366	1.56 (1.31)	1101
Ankur.651	0.84	1051	0.00	681	1.72 (1.35)	440
Ankur.2534Bt	2.50	1231	0.00	1105	3.18 (1.92)	998
Ankur.2534	3.34	1026	0.84	1167	0.00 (0.71)	436
MRC.6301Bt	4.17	1102	0.84	1460	0.00 (0.71)	995
MRC.6301	0.00	981	0.00	610	0.00 (0.71)	558
MRC.6304Bt	1.67	1062	0.00	782	3.18 (1.92)	842
MRC.6304	0.00	949	1.67	858	0.00 (0.71)	394
MRC.6160Bt	8.33	1185	2.50	1353	0.00 (0.71)	1042
MRC.6160	0.00	884	0.00	1108	0.00 (0.71)	243
RCH.118Bt	0.00	1106	0.00	1142	1.72 (1.35)	1063
RCH.118	4.18	889	0.84	683	0.00 (0.71)	488
RCH.335Bt	5.85	1221	2.50	1327	0.00 (0.71)	1107
RCH.335	0.00	1025	0.00	1120	0.00 (0.71)	273
RCH.359Bt	1.67	1009	0.00	1167	0.00 (0.71)	826
RCH.359	5.00	1111	2.50	995	0.00 (0.71)	354
NHH.44(ZC)	0.00	1009	0.00	888	0.00 (0.71)	877
RCH.2Bt (CC)	0.84	1034	0.00	943	0.00 (0.71)	848
MECH.162.Bt (CC)	2.52	1116	0.84	923	0.00 (0.71)	240
C.D (0.05)	6.50		5.12		0.68	
CV%	35.54		40.90		49.33	

*Values in the parentheses are square root transformed values

Myrothecium leaf spot

This disease was noticed only at Nagpur with a very low incidence ranging from 0.00% to 1.61% in the Bt I trial. The Percent disease incidence of this disease in test entries is given below. It is seen that all entries were infected at very low levels at Nagpur.

Percent Disease Incidence (PDI) of Myrothecium Leaf Spot

Entry	PDI
Ankur.09Bt	0.40
Ankur.09	0.12
Ankur.651Bt	0.32
Ankur.651	0.75
Ankur.2534Bt	0.41
Ankur.2534	0.81
MRC.6301Bt	0.34
MRC.6301	1.19
MRC.6304Bt	0.59
MRC.6304	0.43
MRC.6160Bt	0.00
MRC.6160	1.61
RCH.118Bt	0.92
RCH.118	0.14
RCH.335Bt	0.66
RCH.335	0.49
RCH.359Bt	1.44
RCH.359	0.00
NHH.44(ZC)	0.49
RCH.2Bt (CC)	0.32
MECH.162.Bt (CC)	0.18

OVERALL ASSESSMENT of evaluation of 2004-05 season

In both protected and unprotected conditions, RCH.335Bt, MRC.6301Bt and MRC.6360Bt have performed equally well in terms of seed cotton yield in central zone. Other Bt hybrids such as Ankur.651, Ankur.2534, RCH.118 have yielded more over their non-Bt counterparts as well as over checks, under protected conditions. The yield superiority in central zone of RCH.118Bt (1679 kg/ha) and RCH.335Bt (1616 kg/ha), under protected conditions, is evident from the following table.

Comparative seed cotton yield of test hybrids under Protected and unprotected conditions

Entry	Seed cotton yield (kg/ha)	
	PROTECTED	UNPROTECTED
Ankur.09Bt	1152	1160.8
Ankur.09	991	754.8
Ankur.651Bt	1419	1321.0
Ankur.651	942	725.0
Ankur.2534Bt	1373	1210.6
Ankur.2534	1056	840.0
MRC.6301Bt	1419	1459.4
MRC.6301	929	902.0
MRC.6304Bt	1094	1163.0
MRC.6304	983	859.4
MRC.6160Bt	1428	1460.6
MRC.6160	917	808.8
RCH.118Bt	1679	1389.6
RCH.118	1162	805.4
RCH.335Bt	1616	1512.2
RCH.335	986	831.6
RCH.359Bt	1314	1506.4
RCH.359	1202	927.6
NHH.44(ZC)	1104	1114.4
RCH.2Bt (CC)	1244	1098.8
MECH.162.Bt (CC)	1261	680.0

Combined report for first & Second year (9 Bt hybrids)

Combined report for two seasons-2003 & 2004 *kharif*

The significant points that emerged during the two year evaluations in **Central zone** of the **nine Bt hybrids** from M/S Ankur Seeds Ltd., Mahyco Seeds Ltd. and M/S Rasi Seeds Ltd. in the Central Zone AICCIP centers, are given below.

The yield determining parameters of the test Bt hybrids show that there is consistency in most of the parameters that were subjected to analysis. The number of nodes on the first sympode, its mean length, mean number of fruiting points, total boll number per plant, boll weight, Ginning put turn, Lint and seed index as well as Seed Cotton yield were compared for two years and are given in tables below.

Comparative performance of Bt hybrids over the last two years for various characters

Genotype	Germination percentage		Number of Sympodia		Length of Sympodia		Number of bolls per plant		Boll weight (g)	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Ankur - 09	84	99	15.9	13.1	28.6	42.1	21.4	21.5	3.8	4.0
Ankur - 09 Bt	79	99	17.3	10.8	30.7	38.5	24.1	21.4	4.1	3.6
Ankur - 2534	82	99	17.2	11.6	28.0	39.9	26.3	19.3	4.1	3.5
Ankur - 2534 Bt	83	99	16.5	11.7	33.5	35.3	21.0	27.8	4.0	3.3
Ankur - 651	82	100	15.2	12.2	32.4	42.0	25.8	17.8	4.0	3.7
Ankur - 651 Bt	85	99	18.6	12.5	33.7	40.0	18.9	26.0	3.8	4.0
MRC. 6160	77	99	19.3	11.6	32.0	40.7	24.3	16.3	3.9	3.7
MRC. 6160 Bt	84	98	17.7	12.9	30.4	38.7	28.1	22.3	4.0	3.9
MRC. 6301	83	98	14.2	11.5	26.9	44.0	24.6	19.3	3.8	3.4
MRC. 6301 Bt	87	99	16.6	13.1	32.8	36.1	19.9	25.2	3.6	3.7
MRC. 6304	85	99	18.8	10.3	32.1	43.5	19.5	17.8	3.8	3.7
MRC. 6304 Bt	84	98	17.2	11.5	30.7	37.8	19.3	22.6	3.8	4.0
RCH. 118 Bt	86	99	13.9	14.6	29.3	38.2	23.7	21.0	4.3	3.8
RCH. 118	82	97	16.2	11.8	28.5	45.0	24.0	24.7	4.1	3.9
RCH. 335	80	98	15.0	11.5	32.6	42.8	25.7	26.5	3.8	3.3
RCH. 335 Bt	84	99	18.8	11.7	27.9	40.0	21.0	18.6	4.3	3.5
RCH. 359	86	100	15.8	11.0	31.8	40.7	30.0	22.6	3.9	3.3
RCH. 359 Bt	84	99	16.8	11.5	28.2	40.3	22.1	26.3	4.3	3.7
MECH. 162 Bt	80	98	16.3	13.2	28.9	47.4	24.2	25.3	3.9	3.4
RCH. 2 Bt	87	99	16.6	12.3	28.6	37.9	20.9	23.7	4.0	3.8
NHH. 44 (ZC)	85	99	13.0	14.0	33.1	47.5	19.4	20.7	3.8	3.0

Comparative performance of Bt hybrids over the last two years for various characters

Genotype	Seed index (g)		Lint Index (g)		Ginning outturn (%)	
	2003	2004	2003	2004	2003	2004
Ankur - 09	8.5	7.6	5.1	4.5	37.2	36.2
Ankur - 09 Bt	7.6	7.6	5.1	4.4	39.7	36.1
Ankur - 2534	7.9	7.7	4.8	4.3	36.7	35.5
Ankur - 2534 Bt	8.5	7.8	5.1	4.5	37.4	34.3
Ankur - 651	8.2	8.2	5.6	4.7	39.9	34.7
Ankur - 651 Bt	8.2	7.9	4.4	4.3	34.9	35.0
MRC. 6160	7.9	9.2	4.8	4.7	37.7	33.8
MRC. 6160 Bt	8.2	8.8	5.1	5.3	37.6	36.0
MRC. 6301	8.5	7.9	4.9	4.6	36.5	35.3
MRC. 6301 Bt	8.1	8.7	5.6	5.1	39.9	36.9
MRC. 6304	8.5	8.5	5.1	4.9	37.2	34.1
MRC. 6304 Bt	9.2	8.9	5.5	5.0	37.3	34.2
RCH. 118	8.5	9.1	4.6	4.9	35.2	34.5
RCH. 118 Bt	9.1	9.3	5.2	5.2	37.3	34.6
RCH. 335	7.2	9.4	4.9	5.1	37.4	34.7
RCH. 335 Bt	8.8	8.7	4.7	5.0	34.4	34.9
RCH. 359	7.6	7.7	4.4	4.9	37.0	38.2
RCH. 359 Bt	9.0	8.2	5.5	5.2	38.0	38.4
MECH. 162 Bt	7.9	8.0	4.9	4.5	36.8	36.5
RCH. 2 Bt	9.2	9.3	5.0	5.0	35.3	34.7
NHH. 44 (ZC)	8.6	7.2	4.4	3.8	34.0	34.3

The seed cotton yield superiority, under protected conditions of RCH.118Bt (mean yield of two years under protected condition was 1365 kg/ha) and RCH.335Bt (mean yield of two years under protected condition was 1389 kg/ha) is seen from the following table. In both protected and unprotected conditions, MRC.6360Bt performed well in terms of mean seed cotton yield for two years (1347 & 1288 kg/ha respectively in protected and unprotected plots) in central zone.

Genotype	Seed cotton yield under (Kg/ha)					
	Protected condition		Unprotected conditions		Mean of two years	
	2003	2004	2003	2004	Protected condition	Unprotected conditions
Ankur - 09	1182	991	638	755	1087	697
Ankur - 09 Bt	1251	1152	1066	1161	1202	1114
Ankur - 2534	880	1056	1083	840	968	962
Ankur - 2534 Bt	1046	1373	747	1211	1210	979
Ankur - 651	1121	942	776	725	1032	751
Ankur - 651 Bt	953	1419	588	1321	1186	955
MRC. 6160	1045	917	1180	809	981	995
MRC. 6160 Bt	1266	1428	1114	1461	1347	1288
MRC. 6301	1004	929	1002	902	967	952
MRC. 6301 Bt	899	1419	707	1459	1159	1083
MRC. 6304	972	983	627	859	978	743
MRC. 6304 Bt	1134	1094	664	1163	1114	914
RCH. 118	720	1162	959	805	941	882
RCH. 118 Bt	1050	1679	903	1390	1365	1147
RCH. 335	545	986	908	832	766	870
RCH. 335 Bt	1162	1616	613	1512	1389	1063
RCH. 359	1127	1202	1006	928	1165	967
RCH. 359 Bt	1075	1314	1008	1506	1195	1257
MECH. 162 Bt	802	1261	1025	680	1032	853
RCH. 2 Bt	1201	1244	699	1099	1223	899
NHH. 44 (ZC)	630	1104	538	1114	867	826

The comparative fibre property data, as given below, shows that the test hybrids had long staple fibre length values. The fibre tenacity values were not, however, commensurate with span length recorded in the Bt test hybrids for the desirable yarn quality and yield. In general, 2004 season was more favourable for stable fibre tenacity values. However, fibre samples from large plots shall only provide clear picture about the goodness of these entries.

Comparative fibre properties of two years

Name of entry	2.5% Span length in mm (L)		Tenacity (g/tex) (T)		Micronaire	
	2003	2004	2003	2004	2003	2004
Ankur – 09	29.0	28.0	21.4	20.0	3.8	4.1
Ankur – 09 Bt	27.0	27.0	19.1	18.0	5.0	3.9
Ankur – 2534	28.4	28.0	20.5	20.0	3.8	3.6
Ankur – 2534 Bt	28.8	28.0	21.0	20.0	3.7	4.5
Ankur – 651	27.7	29.0	19.7	21.0	4.7	4.1
Ankur – 651 Bt	27.4	28.0	19.5	19.0	4.5	3.8
MRC. 6160	26.0	27.0	18.5	20.0	4.5	4.3
MRC. 6160 Bt	27.6	27.0	19.8	18.0	4.3	3.2
MRC. 6301	28.3	27.0	20.4	20.0	4.2	3.9
MRC. 6301 Bt	27.4	27.0	20.1	19.0	4.9	3.6
MRC. 6304	28.5	30.0	20.3	22.0	4.6	3.7
MRC. 6304 Bt	28.7	30.0	20.2	21.0	5.0	3.9
RCH. 118	28.9	28.0	20.7	20.0	4.4	3.9
RCH. 118 Bt	28.3	29.0	19.2	19.0	4.5	4.0
RCH. 335	27.0	28.0	19.8	21.0	4.6	4.0
RCH. 335 Bt	28.7	28.0	21.2	20.0	4.0	3.8
RCH. 359	27.9	26.0	20.9	20.0	3.7	4.5
RCH. 359 Bt	28.9	27.0	21.0	20.0	4.3	4.0
RCH.2 Bt	28.0	32.0	20.4	20.0	4.6	3.7
MECH.162 Bt	26.7	26.0	20.0	18.0	4.5	4.1
NHH.44	29.0	25.0	20.3	19.0	4.1	4.0

Pest and disease susceptibility

The susceptibility of all Bt hybrids and their non-Bt counterparts to sap sucking insects such as jassids in certain endemic centres of this zone shall indicate that the cultivation of these hybrids in this zone warrant recommended plan protection measures to prevent their excess build up. The data of 2004-05 indicate that suitable recommendation for protecting the test hybrids from excess build up and damage by jassids and thrips shall be warranted in this zone. The data on number Pink bollworm in the test hybrids of 2004-05 indicate that there is some measure of reduction in Bt test hybrids. However, their natural build up has to be cautiously watched in order to suitably protect the crop from severe damage.

During 2003 - 04, there was very little disease incidence, hence the hybrids could not be evaluated for their reaction to various diseases. Parawilt was noticed at Khandwa ranging from 0.00% (RCH.118 Bt) to 8.33% (MRC.6160 Bt) under protected conditions and 0.00% (RCH.118 Bt) to 5.83 % (Ankur.09 Bt) under unprotected conditions where as at Akola the incidences of parawilt was from 0.00 % to 4.00%. There was variation in the incidence of wilt at these two centres. The seed cotton yield was not affected. This may be due to the late occurrence of parawilt in the

season. As seen in the following table, there was no relationship with seed cotton yield and Parawilt incidence in most of the entries. The trials at Khandwa and Akola centres showed Parawilt syndrome and hence this observation was specially considered at these centres in the various test entries. However, their relationship with seed cotton yield was not established during 2004-05.

The Central zone is prone to Grey mildew disease under favourable climatic conditions. Although some of the test entries were susceptible during this year, this disease could be managed with prophylactic recommendation of suitable fungicide, as is recommended for all other cotton hybrids and varieties, shall be a pre-requisite for extensive cultivation of the Bt hybrids in this zone.

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