

Bt COTTON EVALUATION REPORT

**Second year report and combined report for
2003 & 2004**

**TRANSGENIC COTTON HYBRIDS WITH
Bollgard I GENE
(2 MRC HxB hybrids)**

SOUTH ZONE

Submitted to

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Project Co-ordinator (Cotton Improvement)

**All India Coordinated Cotton Improvement Project
CENTRAL INSTITUTE FOR COTTON RESEARCH**

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Executive Summary

- The sap sucking pests such as jassids and lacerating insects such as thrips was quite high in population in spite of adequate protection in these hybrids. Hence, there shall be special consideration to plan for the protection of these hybrids from these pests. The whitefly population was negligible during this season. However, under unprotected condition, the jassid population was quite high in these Bt and other hybrids of this experiment. These genotypes demand insecticide spray to free them from jassid build up.
- The population of thrips was quite high in all the test entries, under unsprayed condition, warranting insecticide application to suppress their build up.
- The per plant infestation of Spotted bollworms was quite high in check and non-Bt hybrids while their number was less in Bt test hybrids under sprayed condition.
- The Spotted bollworm built up in non-Bt counterparts and in check hybrids in comparison with the Bt test hybrids in unsprayed plots.
- The American bollworm was negligible in unprotected plots too and the test hybrids were never challenged to test the gene action during this season.
- The percent locule damage was between 12 to 14% in Bt test hybrids as against 22 to 30% in check hybrids and non-Bt hybrids under sprayed condition. The percent locule damage shows that the Bt test hybrids did not allow the damage to go above 15% in comparison to 25 – 36%, recorded in non-Bt and check hybrids under unsprayed plots.
- The percent open boll damage was comparable to all the entries and did not vary much between Bt and non-Bt hybrids under protected condition. The percent open boll damage also was less in Bt hybrids in comparison to the non-Bt counterparts as well as in check hybrids in unsprayed condition.
- The maximum number of spraying in all the hybrids was three, mainly for sap sucking insect management.
- The seed cotton yield was the highest in both the test hybrids over check hybrids and non-Bt counterparts. MRC.6928 with 1633 kg/ha was the highest followed by MRC.6918Bt hybrid. The check hybrids yielded between 986 to 1070 kg/ha seed cotton. The non-Bt hybrids recorded between 1070 and 1380 kg/ha seed cotton yield.
- The mean seed cotton yield of the test Bt entries in South zone was 1675 kg/ha for MRC.6928Bt and 1439 kg/ha for MRC.6918 kg/ha. This was quite high in comparison to their non-Bt counterparts as well as to check hybrids.
- The mean seed cotton yield of MRC.6928Bt in south zone was similar in both protected and unprotected condition during 2004 season.

- Fibre quality parameters data of these two hybrids had 34 mm mean span length and was comparable with the check hybrids. The bundle strength or fibre tenacity was around 27 g/tex. The micronaire indicating fibre fineness was around 3.5 and was comparable to check hybrids. However, the fibre strength, according to SITRA (South India Textile Research association – Textile Ministry) should be more to finally spin at 60s count yarn. As stipulated by the All India Coordinated Cotton Improvement Project, the full scale mill test only can bring out the actual fibre property of these hybrids.

Assessment of results for 2003 & 2004 seasons

- The two genotypes were found susceptible to jassids and thrips in both the years at all locations of the zone, warranting insecticide application to contain their build up.
- The American bollworm population was very low. Hence the action of the gene against this pest could not be assessed for both the years. However, during 2004, the damage of Pink bollworm to the test hybrids was high and the action of the gene could be seen when the percent locule damage was between 12 to 14% in Bt test hybrids as against 22 to 30% in check hybrids and non-Bt hybrids under sprayed condition. The percent locule damage shows that the Bt test hybrids did not allow the damage to go above 15% in comparison to 25 – 36%, recorded in non-Bt and check hybrids under unsprayed plots.
- The percent open boll damage was comparable to all the entries and did not vary much between Bt and non-Bt hybrids under protected condition. The percent open boll damage also was less in Bt hybrids in comparison to the non-Bt counterparts as well as in check hybrids in unsprayed condition.
- The average seed cotton yield of 2003 and 2004 under protected and unprotected conditions show that the MRC.6928Bt is superior to MRC.6918Bt. It has also better yield over check hybrids as well as non-Bt hybrids.
- The mean fibre quality parameters of two years show that there is wide variation in fibre length and micronaire values between two years in this zone. Hence, it is important that a full scale mill test shall only give the clear fibre quality status.

INTERSPECIFIC Bt HYBRID EVALUATION

In South Zone, the AICCIP also conducted an evaluation trial for two **interspecific (H x B) Bt hybrids** from M/S Mahyco Seeds Pvt. Ltd., Jalna, viz., MRC.6918Bt and MRC.6928Bt. Acid delinted untreated seeds of the two Bt HxB hybrid seeds and their non-Bt counterparts were supplied by this seed company.

Centres involved:

University of Agricultural Sciences, Cotton Research Station, Dharwad
Tamil Nadu Agricultural Research University, RARS, Vaigai Dam
Central Institute for Cotton Research, Regional Station, Coimbatore

Breeding Evaluation (Protected from bollworms at ETL)

The germination percent ranged between 87 to 89 per cent. The Bt and non-Bt counterparts had good plant stand.

Percent germination in Breeding Evaluation

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	72.21	98.00	90.83	87.01
MRC.6928 Bt	74.74	98.00	96.67	89.80
DCH.32 (CC)	72.72	95.00	95.83	87.85
TCHB.213 (CC)	78.78	98.00	92.92	89.90
DHB.105 (CC)	77.77	95.00	94.59	89.12
MRC.6918	72.21	97.00	100.00	89.74
MRC.6928	75.75	97.00	95.83	89.53
CD at 5%	NS	2.03	23.07	
CV%	8.05	2.52	20.06	

The total bolls per plant did not vary between test hybrids and the check hybrids. However, they were less than the non-Bt hybrids, as the following data indicates.

TOTAL BOLLS/PLANT

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	16	24.9	49	29.97
MRC.6928 Bt	11.8	26.48	57	31.76
DCH.32 (CC)	18.53	22.34	44	28.29
TCHB.213 (CC)	11.93	26.8	45	27.91
DHB.105 (CC)	15.33	28.5	47	30.28
MRC.6918	24.8	26.03	33	27.94
MRC.6928	24.47	27.1	24	25.19
CD at 5%		5.25	6.01	
CV(%)		13.97	9.12	

The boll weight ranged from 4.1 to 4.2 g in Bt hybrids in comparison to 3.56 and 3.88 of non-Bt counterparts.

BOLL WEIGHT (g)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	3.63	4.24	4.58	4.15
MRC.6928 Bt	4.08	4.48	4.10	4.22
DCH.32 (CC)	3.80	4.19	3.79	3.93
TCHB.213 (CC)	3.58	4.53	3.91	4.01
DHB.105 (CC)	3.75	3.84	3.76	3.78
MRC.6918	3.50	3.64	3.55	3.56
MRC.6928	3.67	4.33	3.65	3.88
CD at 5%	0.33	0.5	0.46	
CV(%)	5.03	8.44	7.91	

The ginning out turn percentage was between 31 and 32% in Bt hybrids. All check hybrids had similar numbers.

Ginning Out Turn (%)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	26.33	32.30	34.45	31.03
MRC.6928 Bt	31.00	33.40	32.64	32.35
DCH.32 (CC)	33.22	37.40	36.20	35.61
TCHB.213 (CC)	25.77	30.40	33.26	29.81
DHB.105 (CC)	32.22	34.40	35.20	33.94
MRC.6918	32.66	32.90	32.42	32.66
MRC.6928	31.72	31.90	33.32	32.31
CD at 5%	0.72	2.41	1.54	
CV(%)	1.35	5.28	3.12	

The mean lint index data shows that the test hybrids recorded 5.1 and 5.3 g lint index.

MEAN LINT INDEX (g)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	3.57	5.97	5.75	5.10
MRC.6928 Bt	4.49	5.74	5.83	5.35
DCH.32 (CC)	4.96	6.81	5.30	5.69
TCHB.213 (CC)	3.22	6.15	5.41	4.93
DHB.105 (CC)	5.38	6.03	5.25	5.55
MRC.6918	5.68	5.17	4.91	5.25
MRC.6928	5.38	5.77	5.97	5.71
CD at 5%	0.31	0.61	0.68	
CV(%)	3.9	7.26	8.32	

The mean seed index was above 11g in the test hybrids. The check hybrids had this below 11g.

MEAN SEED INDEX (g)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	10.00	12.51	10.94	11.15
MRC.6928 Bt	10.00	11.47	12.00	11.16
DCH.32 (CC)	10.00	11.41	9.34	10.25
TCHB.213 (CC)	9.33	14.11	10.86	11.43
DHB.105 (CC)	11.33	11.52	9.68	10.84
MRC.6918	11.67	10.58	10.24	10.83
MRC.6928	12.00	12.31	11.94	12.08
CD at 5%	0.57	0.73	1.04	
CV(%)	3.19	4.28	6.54	

The seed cotton yield was the highest in both the test hybrids over check hybrids and non-Bt counterparts. MRC.6928 with 1633 kg/ha was the highest followed by MRC.6918Bt hybrid. The check hybrids recorded between 986 to 1070 kg/ha. The non-Bt hybrids also recorded between 1070 and 1380 kg/ha.

SEED COTTON YIELD (Protected condition)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	356	1722	1810	1296
MRC.6928 Bt	266	2203	2431	1633
DCH.32 (CC)	537	884	1536	986
TCHB.213 (CC)	346	1000	1639	995
DHB.105 (CC)	350	1060	1799	1070
MRC.6918	1142	1079	1474	1232
MRC.6928	1355	1384	1401	1380
CD at 5%	120	291.48	303.54	
CV(%)	9.65	13.98	11.69	

Fibre quality parameters data of these two hybrids had 34 mm mean span length and was comparable with the check hybrids. The bundle strength or fibre tenacity was around 27 g/tex. The micronaire indicating fibre fineness was around 3.5 and was comparable to check hybrids. However, the fibre strength, according to SITRA (South India Textile Research association – Textile Ministry) should be more to finally spin at 60s county yarn. As stipulated by the All India Coordinated Cotton Improvement Project, the full scale mill test only can bring out the actual fibre property of these hybrids.

2.5% span length (mm)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	31.60	34.00	36.10	33.90
MRC.6928 Bt	33.00	34.00	34.90	33.97
DCH.32 (CC)	33.80	34.00	36.40	34.73
TCHB.213 (CC)	32.80	35.10	36.70	34.87
DHB.105 (CC)	29.30	34.40	32.20	31.97
MRC.6918	32.20	34.40	35.50	34.03
MRC.6928	33.40	35.70	36.30	35.13

Bundle strength (g/tex)

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	29.20	25.00	25.80	26.67
MRC.6928 Bt	28.20	27.30	28.00	27.83
DCH.32 (CC)	25.10	22.00	23.30	23.47
TCHB.213 (CC)	26.40	22.70	23.90	24.33
DHB.105 (CC)	22.90	25.20	24.10	24.07
MRC.6918	27.90	25.20	24.00	25.70
MRC.6928	28.80	28.20	28.10	28.37

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

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	3.00	3.80	3.70	3.50
MRC.6928 Bt	3.30	3.50	3.40	3.40
DCH.32 (CC)	2.70	3.50	3.50	3.23
TCHB.213 (CC)	2.90	3.40	3.70	3.33
DHB.105 (CC)	3.40	2.90	3.80	3.37
MRC.6918	3.00	2.90	3.70	3.20
MRC.6928	3.10	3.50	3.80	3.47

Mean Table of Fiber Quality

Entry	Span length (mm)	Fibre tenacity	Micronaire
MRC.6918 Bt	33.90	26.67	3.50
MRC.6928 Bt	33.97	27.83	3.40
DCH.32 (CC)	34.73	23.47	3.23
TCHB.213 (CC)	34.87	24.33	3.33
DHB.105 (CC)	31.97	24.07	3.37
MRC.6918	34.03	25.70	3.20
MRC.6928	35.13	28.37	3.47

Entomological Evaluation – Protected Trial

The sap sucking pests such as jassids and lacerating insects such as thrips was quite high in population in spite of adequate protection in these hybrids. Hence, there shall be special consideration to plan for the protection of these hybrids from these pests. The whitefly population was negligible during this season. The following tables depict the data.

Jassids (average of 3 leaves/plant)

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	1.58	17.00	9.29
MRC.6928 Bt	2.35	21.25	11.80
DCH.32 (CC)	6.72	13.75	10.24
TCHB.213 (CC)	2.30	12.50	7.40
DHB.105 (CC)	6.92	11.50	9.21
MRC.6918	1.96	17.25	9.61
MRC.6928	2.57	17.50	10.04
CD at 5%	0.4	0.44	
CV(%)	10.1	7.75	

Thrips (average of three leaves per plant)

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	1.00	5.75	3.38
MRC.6928 Bt	0.33	11.25	5.79
DCH.32 (CC)	1.33	4.50	2.92
TCHB.213 (CC)	2.15	7.75	4.95
DHB.105 (CC)	1.05	6.75	3.90
MRC.6918	3.00	7.00	5.00
MRC.6928	2.05	8.75	5.40
CD at 5%	0.9	0.46	
CV(%)	7.9	11.66	

Whitefly (average of 3 leaves/plant)

Entry	Coimbatore	Mean
MRC.6918 Bt	1.30	1.30
MRC.6928 Bt	1.00	1.00
DCH.32 (CC)	0.85	0.85
TCHB.213 (CC)	0.65	0.65
DHB.105 (CC)	0.87	0.87
MRC.6918	0.57	0.57
MRC.6928	0.82	0.82
CD at 5%	0.5	
CV(%)	9	

The per plant infestation of Spotted bollworms was quite high in check and non-Bt hybrids while their number was less in Bt test hybrids.

Spotted bollworms (No. of larvae/5 plants)

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	1.00	1.50	1.25
MRC.6928 Bt	0.00	3.75	1.88
DCH.32 (CC)	2.00	7.50	4.75
TCHB.213 (CC)	1.00	8.00	4.50
DHB.105 (CC)	1.00	4.75	2.88
MRC.6918	1.00	4.75	2.88
MRC.6928	1.00	6.50	3.75
CD at 5%	NS	0.41	
CV(%)	14.4	13.62	

The population of American bollworm was very low during the season and hence the hybrids could not be tested well against this bollworm.

American bollworms (No. of larvae/5 plants)

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	0.00	0.50	0.25
MRC.6928 Bt	0.00	0.25	0.13
DCH.32 (CC)	1.00	0.75	0.88
TCHB.213 (CC)	1.00	0.50	0.75
DHB.105 (CC)	1.00	0.75	0.88
MRC.6918	2.00	1.00	1.50
MRC.6928	0.00	0.75	0.38
CD at 5%	NS	NS	
CV(%)	13.2	17.04	

The percent locule damage was between 12 to 14% in Bt test hybrids as against 22 to 30% in check hybrids and non-Bt hybrids.

Percent Locule damage

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	3.12	26.33	14.73
MRC.6928 Bt	2.55	21.66	12.11
DCH.32 (CC)	9.66	34.54	22.10
TCHB.213 (CC)	8.45	52.04	30.25
DHB.105 (CC)	6.25	39.63	22.94
MRC.6918	7.88	54.04	30.96
MRC.6928	4.52	55.34	29.93
CD at 5%	6.9	4.43	
CV(%)	16.7	8	

The percent open boll damage was comparable to all the entries and did not vary much between Bt and non-Bt hybrids under protected condition.

Percent Open boll damage

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	2.25	10.11	6.18
MRC.6928 Bt	1.25	9.95	5.60
DCH.32 (CC)	5.25	7.58	6.42
TCHB.213 (CC)	4.65	10.10	7.38
DHB.105 (CC)	5.55	8.09	6.82
MRC.6918	5.23	10.34	7.79
MRC.6928	2.33	16.59	9.46
CD at 5%	2.9	0.59	
CV(%)	9.3	2.13	

PLANT PROTECTION EVALUATION UNDER UNPROTECTED CONDITION

Under unprotected condition, the jassid population was quite high in these Bt and other hybrids of this experiment. These genotypes demand insecticide spray to free them from jassid build up.

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

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	3.45	3.36	20.50	9.10
MRC.6928 Bt	2.39	4.23	16.25	7.62
DCH.32 (CC)	3.19	6.72	22.50	10.80
TCHB.213 (CC)	2.30	3.84	14.25	6.80
DHB.105 (CC)	2.92	6.92	18.75	9.53
MRC.6918	3.28	3.96	21.75	9.66
MRC.6928	1.77	2.84	23.50	9.37
CD at 5%	0.37	12.29	0.24	
CV(%)	8.45	14.16	3.76	

The population of thrips was quite high in all the test entries, under unsprayed condition, warranting insecticide application to suppress their build up.

Thrips – Unprotected Condition

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	12.06	2.20	7.25	7.17
MRC.6928 Bt	11.56	0.00	6.75	6.10
DCH.32 (CC)	11.76	4.15	9.25	8.39
TCHB.213 (CC)	14.26	3.33	6.75	8.11
DHB.105 (CC)	9.33	4.50	5.75	6.53
MRC.6918	11.36	4.20	13.75	9.77
MRC.6928	12.46	3.80	8.75	8.34
CD at 5%	1.81	4.51	0.65	
CV(%)	9.04	10.86	15.17	

The Spotted bollworm built up in non-Bt counterparts and in check hybrids in comparison with the Bt test hybrids.

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

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	0.20	1.00	2.50	1.23
MRC.6928 Bt	0.13	0.00	3.75	1.29
DCH.32 (CC)	0.03	2.00	9.00	3.68
TCHB.213 (CC)	0.23	1.00	9.50	3.58
DHB.105 (CC)	0.20	2.00	6.25	2.82
MRC.6918	0.13	1.00	7.25	2.79
MRC.6928	0.10	1.00	7.50	2.87
CD at 5%	0.18	NS	0.36	
CV(%)	8.25	14.4	10.5	

The American bollworm was negligible in unprotected plots too and the test hybrids were never challenged to test the gene action during this season.

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

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	1.83	0.00	0.25	0.69
MRC.6928 Bt	1.67	0.00	0.75	0.81
DCH.32 (CC)	0.52	1.00	0.25	0.59
TCHB.213 (CC)	0.50	1.00	0.50	0.67
DHB.105 (CC)	0.83	1.00	0.75	0.86
MRC.6918	0.83	1.00	0.75	0.86
MRC.6928	1.17	0.00	1.00	0.72
CD at 5%	NS	NS	0.2	
CV(%)	9.14	8	13.72	

The percent locule damage shows that the Bt test hybrids did not allow the damage to go above 15% in comparison to 25 – 36%, recorded in non-Bt and check hybrids.

Percent Locule damage – Unprotected Condition

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	17.99	5.25	24.15	15.80
MRC.6928 Bt	13.77	4.33	22.69	13.60
DCH.32 (CC)	18.45	25.55	51.25	31.75
TCHB.213 (CC)	16.54	18.36	53.40	29.43
DHB.105 (CC)	13.11	12.58	37.70	21.13
MRC.6918	13.72	19.33	42.26	25.10
MRC.6928	43.46	8.56	57.56	36.53
CD at 5%	3.19	2.8	3.55	
CV(%)	7	9.4	6.28	

The percent open boll damage also was less in Bt hybrids in comparison to the non-Bt counterparts as well as in check hybrids.

Percent Open boll damage – Unprotected Condition

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	20.87	6.56	13.14	13.52
MRC.6928 Bt	18.02	3.75	12.86	11.54
DCH.32 (CC)	23.40	21.25	12.08	18.91
TCHB.213 (CC)	23.94	12.15	11.90	16.00
DHB.105 (CC)	29.01	17.40	11.80	19.40
MRC.6918	22.22	18.55	11.97	17.58
MRC.6928	30.32	8.95	18.61	19.29
CD at 5%	3.01	6.6	0.76	
CV(%)	5.94	15.2	9.39	

The maximum number of spraying in all the hybrids was three, mainly for sap sucking insect management.

Number of sprays for sap sucking pests – Protected

Entry	Coimbatore		Vaigai Dam
	Protected	Unprotected	
MRC.6918 Bt	-	-	3
MRC.6928 Bt	-	-	3
DCH.32 (CC)	-	1	3
TCHB.213 (CC)	-	1	3
DHB.105 (CC)	1	1	3
MRC.6918	-	1	3
MRC.6928	-	-	3

The mean seed cotton yield of the test Bt entries in South zone was 1675 kg/ha for MRC.6928Bt and 1439 kg/ha for MRC.6918 kg/ha. This was quite high in comparison to their non-Bt counterparts as well as to check hybrids.

Seed cotton yield (Kg/ha) – Unprotected Condition

Entry	Dharwad	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	1922	1296	1100	1439
MRC.6928 Bt	1672	2122	1231	1675
DCH.32 (CC)	448	826	1006	760
TCHB.213 (CC)	495	958	1133	862
DHB.105 (CC)	812	852	910	858
MRC.6918	1059	805	923	929
MRC.6928	476	1250	838	855
CD	172	228	409	
CV(%)	8.9	13.9	15.7	

It is to be noted that the mean seed cotton yield of MRC.6928Bt in south zone was similar in both protected and unprotected condition during 2004 season, as given below.

Entry	Mean seed cotton yield (kg/ha)	
	Protected	Unprotected
MRC.6918 Bt	1296	1439
MRC.6928 Bt	1633	1675
DCH.32 (CC)	986	760
TCHB.213 (CC)	995	862
DHB.105 (CC)	1070	858
MRC.6918	1232	929
MRC.6928	1380	855

Plant Pathology Evaluation

The percent disease incidence of Grey mildew was found to be moderate to high in the test Bt hybrids. Suitable prophylactic measures are needed to prevent serious disease incidence.

Percent Disease Incidence (PDI) of Grey Mildew

Entry	Coimbatore	Vaigai Dam	Mean
MRC.6918 Bt	18.75	3.83	11.3
MRC.6928 Bt	32.5	3.88	18.2
DCH.32 (CC)	45	3.93	24.5
TCHB.213 (CC)	28.75	2.7	15.7
DHB.105 (CC)	35	4	19.5
MRC.6918	16.25	3.6	9.9
MRC.6928	13.75	3.6	8.7
CD at 5%		0.35	
CV(%)		6.55	

The incidence of Alternaria blight and Bacterial blight was not recorded during this year.

Assessment of results for 2003 & 2004 seasons

The two genotypes were found susceptible to jassids and thrips in both the years at all locations of the zone, warranting insecticide application to contain their build up.

The American bollworm population was very low. However, during 2004, the damage of Pink bollworm to the test hybrids was high and the action of the gene could be seen when the percent locule damage was between 12 to 14% in Bt test hybrids as against 22 to 30% in check hybrids and non-Bt hybrids under sprayed condition. The percent locule damage shows that the Bt test hybrids did not allow the damage to go above 15% in comparison to 25 – 36%, recorded in non-Bt and check hybrids under unsprayed plots.

The percent open boll damage was comparable to all the entries and did not vary much between Bt and non-Bt hybrids under protected condition. The percent open boll damage also was less in Bt hybrids in comparison to the non-Bt counterparts as well as in check hybrids in unsprayed condition.

The average seed cotton yield of 2003 and 2004 under protected and unprotected conditions show that the MRC.6928Bt is superior to MRC.6918Bt. It has also better yield over check hybrids as well as non-Bt hybrids.

Mean seed cotton yield (kg/ha) of two years

Entry	Protected	Unprotected
MRC. 6918Bt	1493	1360
MRC. 6928Bt	1625	1408
DCH. 32	1047	999
TCHB. 213	1095	1209
DHB. 105	1344	1330
MRC. 6918	1202	1132
MRC. 6928	1227	960

The mean fibre quality parameters of two years show that there is wide variation in fibre length and micronaire values between two years in this zone. Hence, it is important that a full scale mill test shall only give the clear fibre quality status before commercial cultivation begins.

Entry	Span length (mm)		Fibre tenacity		Micronaire	
	2003	2004	2003	2004	2003	2004
MRC.6918 Bt	36.5	33.90	27.3	26.67	4.0	3.50
MRC.6928 Bt	35.7	33.97	25.8	27.83	4.0	3.40
DCH.32 (CC)	36.9	34.73	25.1	23.47	3.6	3.23
TCHB.213 (CC)	36.2	34.87	25.0	24.33	4.5	3.33
DHB.105 (CC)	33.4	31.97	23.8	24.07	4.4	3.37
MRC.6918	36.6	34.03	24.3	25.70	4.3	3.20
MRC.6928	37.6	35.13	28.5	28.37	4.2	3.47

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