Bt COTTON
EVALUATION REPORT

Second year and combined report of 2003 and 2004 seasons

TRANSGENIC COTTON HYBRIDS WITH DELTA ENDOTOXIN Cry1A(c) + Cry 2A(b) Bollgard II GENE

SOUTH ZONE

Submitted to
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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Executive Summary

- The All India Coordinated Cotton Improvement Project (AICCIP) undertook the evaluation of three cotton hybrids for South zone. The three hybrids tested in five South zone centers are MRC.7201Bt, MRC.7322Bt and MRC.7703Bt. M/S Maharashtra Hybrid Company (MAHYCO) Seeds Pvt. Ltd., Jalna submitted the seeds for the multi-location testing of these six Bollgard II hybrids, possessing the Cry 1A(c) and Cry 2A(b) genes for the management of cotton bollworms, based on the ICAR letter No. 2(8)/2003-C.C.I. dated 25.4.2003. These hybrids having both **(*Cry* 1A (c)+ *Cry* 2A (b)** genes are named as BOLLGARD II (BG II) hybrids. These were tested at South Zone centres, viz., Central Institute for Cotton Research Institute- Regional Station, Coimbatore, University of Agricultural Sciences, Dharwad and its RARS, Siruguppa, Acharya NG Ranga Agricultural University, RARS, Guntur and RARS, Nandyal.
- These were subjected to Breeding (protected against sap sucking insects at their respective threshold levels) and Entomology (without any plant protection for insect pests and diseases) evaluations during 2004 *kharif* season.
- The Bt genes of Bollgard II test hybrids were evaluated for various aspects of breeding parameters. The percent germination, as given below, was found to be very good, being more than 95% in Bt and non-Bt hybrids.
- The position of first sympodial node was similar in all test hybrids, above 4^{th} node, and local check hybrid was it at 3.9^{th} node. The mean first sympodial length in this zone was smaller in some of the Bt hybrids except MRC.7322 where both the test entries had longer first sympodium. The number of bolls on BG II hybrids in this zone was ranging from 31.81 to 34.55. Some of the non-Bt hybrids were observed to have lower number of bolls over the check hybrids.
- In the protected and unprotected plots, jassids were the highest in BG II hybrids in Coimbatore and Nandyal. Mean number of 6.5 to 8.7 number of jassids/3 leaves was recorded in the zone. The thrips population was found t be extensive in all the test hybrids at both Nandyal and Guntur during this season. All the genotypes are susceptible to these pests.
- The American bollworm population was very low in this zone in the test centres during this year. The response of the BGII could not be assessed due to lack of bollworm pressure. It is noted that Pink bollworm infestation was high in 22.7% in

local check hybrid. The BG II hybrids did have less than 50% infestation of locules over the check hybrids. The major point to be noted was that BG I hybrids recorded 11% locule damage. The percent open boll damage was reduced considerably over the check hybrids. The Pink bollworm damage was significant in non-Bt hybrids. The Bt hybrids with BG I and BG II genes did reduce the open boll damage.

- The number of sprayings against both sap sucking pests and bollworms, in protected plots, ranged between 3.8 to 4.8 in BG II hybrids in protected plots. The non-Bt hybrids had up to 7.3 sprayings. In the unprotected plots, the sap sucking pests were managed by 2.3 to 2.7 sprayings in this zone in 2004-05 season. However, under protected conditions, this figure was around two and half times.
- There was moderate to high level of incidences of Grey mildew and Alternaria leaf spot at Dharwad, Siruguppa, Lam (Guntur) and Coimbatore; moderate incidence of Bacterial leaf blight at Dharwad and Siruguppa and Helminthosporium and Cercospora leaf spots at Lam. All three BG II test hybrids were susceptible to Alternaria leaf spot and their reactions were similar to check hybrids in the centres tested. All hybrids (Bt and non-Bt) as well as check was found to be moderately susceptible to Helminthosporium and Cercospora leaf spots diseases.
- The mean seed cotton yield was the highest under protected condition in MRC.7703 BGII (1787 kg/ha) in South Zone. RCH.2Bt, an adapted BG I hybrid o this zone yielded 1780 kg/ha during 2004-05. The unprotected plots of MRC.7703 BGII hybrids yielded 1413.52 kg/ha. The BG I check hybrids had similar yield of 1156 and 1157 kg/ha. Other BG II hybrids had similar yields of 132 kg/ha.
- The fibre quality data of these hybrids do not provide enough evidence that they conform to SITRA norms that is now accepted as the yard-stick of fibre quality for achieving defined yarn quality and yield. Confirmation of this through full scale mill test is desirable to recommend the promising hybrids for cultivation by farmers in this zone. The worthiness of the genotype has to be based on their ability to reduce damage due to the three bollworms along with desirable fibre property.

EVALUATION REPORT FOR SECOND YEAR

Introduction

The All India Coordinated Cotton Improvement Project (AICCIP) undertook the evaluation of **Three cotton hybrids, viz.,** MRC 7703 BGII, MRC 7322 BGII, MRC 7201 BGII were evaluated with MECH.162Bt and RCH.2Bt as check hybrids and Bunny as Zonal hybrid check in South Zone centres, viz., Central Institute for Cotton Research Institute, Regional Station, Coimbatore, University of Agricultural Sciences, Dharwad and its RARS, Siruguppa, Acharya NG Ranga Agricultural University, RARS, Guntur and RARS, Nandyal for the second year in succession (vide ICAR letter No.2(8)/2003-C.C.I. dated 25.4.2003) with the same protocol observed during 2003 *kharif* season.

Breeding & Plant Protection Evaluations

DESIGN-RBD – No. of treatments :8, 3 REPLICATIONS – 6 ROWS X 6 metre rows

Plant Breeding Evaluation

The breeding evaluation concentrated on various observations on plant biometric characters such as number of sympodia per plant, 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 of seed cotton yield per hectare in addition to the fibre length, strength and micronaire of the test hybrids.

The Bt genes of Bollgard II test hybrids were evaluated for various aspects of breeding parameters. The percent germination, as given below, was found to be very good, being more than 95% in Bt and non-Bt hybrids.

Breeding Evaluation- Germination %

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	98.89	99.00	60.60	74.74	89.10	90.43
MRC 7322 BGII	96.67	98.00	59.70	75.75	93.00	84.62
MRC 7201 BGII	97.78	100.00	60.00	75.24	89.30	84.46
MRC.7201	97.37	99.00	59.70	75.08	84.10	83.05
MRC.7322	99.44	100.00	60.00	74.07	94.80	85.66
MRC.7703	99.44	98.00	59.70	75.75	90.20	84.62
MECH 162 Bt (CC)	95.56	99.00	59.00	77.26	87.10	83.58
RCH.2 Bt(CC)	98.89	99.00	59.70	74.08	87.40	83.81
LAHH/DHH11/Bunny (LC)	96.67	99.00	59.00	77.26	89.00	84.19

FIRST SYMPODIAL NODE and its mean length

The position of first sympodial node was similar in all test hybrids, above 4th node, and local check hybrid was it at 3.9th node. The mean first sympodial length in this zone was smaller in some of the Bt hybrids except MRC.7322 where both the test entries had longer first sympodium, as seen in the table below.

Entry	1st Sympodial Node (cm)	MEAN LENGTH OF FIRST SYMPODIUM (cm)		
	Nandyal	Nandyal	CICR CBE	Mean
MRC 7703 BGII	4.4	48.3	18.7	33.5
MRC 7322 BGII	4.3	54.8	21.3	38.1
MRC 7201 BGII	4.6	48.0	11.3	29.7
MRC.7201	4.9	53.1	19.7	36.4
MRC.7322	4.1	61.1	31.5	46.3
MRC.7703	5.0	58.4	16.8	37.6
MECH 162 Bt (CC)	4.5	61.0	17.7	39.4
RCH.2 Bt(CC)	4.6	51.1	19.9	35.5
LAHH/DHH11/Bunny (LC)	3.9	48.3	19.5	33.9
CD (0.05)	0.3	2.0	4.7	
CV%	3.3	1.9	13.8	

Total number of bolls/plant

The number of bolls on BG II hybrids in this zone was ranging from 31.81 to 34.55. Some of the non-Bt hybrids were observed to have lower number of bolls over the check hybrids.

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	Mean
MRC 7703 BGII	30.56	16.90	66.56	13.20	31.81
MRC 7322 BGII	39.30	21.90	61.93	14.60	34.43
MRC 7201 BGII	37.90	17.90	60.53	14.47	32.70
MRC.7201	23.90	10.10	43.10	9.93	21.76
MRC.7322	23.00	12.10	49.60	9.00	23.43
MRC.7703	35.40	18.40	57.76	14.07	31.41
MECH 162 Bt (CC)	35.00	16.90	72.90	13.40	34.55
RCH.2 Bt(CC)	38.00	15.30	69.26	15.87	34.61
LAHH/DHH11/Bunny (LC)	44.50	12.50	59.30	11.60	31.98
CD (0.05)	7.30	0.25	4.65	6.89	
CV%	13.70	4.60	13.82	6.60	

Boll weight (g)

The following table gives the zone's boll weight in these test hybrids in the BG II hybrids. The boll weight was more in BG II hybrids over their non-Bt hybrid counterparts.

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	4.48	3.40	4.86	5.72	5.30	4.75
MRC 7322 BGII	4.56	3.60	4.86	5.77	5.50	4.86
MRC 7201 BGII	4.86	3.30	4.84	6.17	5.50	4.93
MRC.7201	4.25	2.50	5.53	6.15	6.10	4.91
MRC.7322	3.99	2.60	5.10	5.85	5.70	4.65
MRC.7703	4.15	2.70	4.07	4.58	4.40	3.98
MECH 162 Bt (CC)	4.89	2.60	3.59	4.78	4.30	4.03
RCH.2 Bt(CC)	4.48	2.70	4.31	5.22	5.90	4.52
LAHH/DHH11/Bunny (LC)	4.68	2.40	4.91	5.25	5.00	4.45
CD (0.05)	0.52	0.25	0.49	0.70	0.60	
CV%	6.66	4.65	6.10	7.35	6.53	

Ginning out turn (%)

The Ginning out turn percentage, as given below, was noted to be high in MRC 7703 BGII hybrid (35.78%). The highest GOT was recorded in MECH.162Bt check hybrid (37.19%).

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	33.79	37.50	34.03	37.88	35.70	35.78
MRC 7322 BGII	33.94	36.40	32.48	36.99	35.00	34.96
MRC 7201 BGII	30.79	32.80	33.76	35.11	33.00	33.09
MRC.7201	34.47	39.20	34.01	36.55	33.30	35.51
MRC.7322	32.44	35.70	33.59	33.33	30.70	33.15
MRC.7703	33.38	32.30	33.09	34.88	34.00	33.53
MECH 162 Bt (CC)	36.15	39.60	35.52	38.77	36.70	37.35
RCH.2 Bt(CC)	35.16	32.00	34.02	37.33	35.30	34.76
LAHH/DHH11/Bunny (LC)	38.10	36.30	34.30	41.55	35.70	37.19
CD (0.05)	1.96	-	1.32	0.91	1.90	
CV%	3.30	-	2.20	1.43	3.16	

Mean Lint Index (g)

The mean lint index in this zone was in the range of 4.94 to 5.37 in BG II hybrids.

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	4.25	5.00	4.67	6.09	6.30	5.26
MRC 7322 BGII	4.33	6.00	4.77	5.86	5.90	5.37
MRC 7201 BGII	4.22	4.00	5.20	5.58	5.70	4.94
MRC.7201	4.62	6.00	4.93	6.14	6.20	5.58
MRC.7322	3.50	5.00	4.43	4.99	4.80	4.54
MRC.7703	3.68	3.00	4.30	5.11	5.40	4.30
MECH 162 Bt (CC)	4.54	5.00	4.87	5.69	5.50	5.12
RCH.2 Bt(CC)	5.04	4.00	5.20	5.95	7.40	5.52
LAHH/DHH11/Bunny (LC)	4.79	4.00	5.50	5.68	5.80	5.15
CD (0.05)	0.44	-	0.35	0.37	0.70	
CV%	5.89	-	4.20	3.86	7.28	

Mean Seed Index (g)

The mean seed index in this zone for BG II hybrids ranged from 9.5 to 10.5 while the lowest was in MECH.162Bt check hybrid (8.5).

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	8.3	8.0	9.6	10.0	11.4	9.5
MRC 7322 BGII	8.4	10.0	9.9	10.0	10.8	9.8
MRC 7201 BGII	9.5	10.0	11.2	10.3	11.5	10.5
MRC.7201	8.8	9.0	11.5	10.7	12.5	10.5
MRC.7322	7.3	9.0	10.5	10.0	10.8	9.5
MRC.7703	7.4	6.0	9.2	9.3	11.3	8.6
MECH 162 Bt (CC)	8.0	7.0	8.9	9.0	9.6	8.5
RCH.2 Bt(CC)	9.3	10.0	10.7	10.0	13.4	10.7
LAHH/DHH11/Bunny (LC)	7.8	7.0	11.2	8.0	10.7	8.9
CD (0.05)	0.8	-	1.0	0.6		
CV%	5.5	-	5.5	3.6		

Seed Cotton Yield (kg/ha)

The mean seed cotton yield was the highest under protected condition in MRC.7703 BGII (1787 kg/ha) in South Zone. RCH.2Bt, an adapted BG I hybrid o this zone yielded 1780 kg/ha during 2004-05.

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	1840	1109	3930	597	1460	**1787**
MRC 7322 BGII	1640	960	3650	577	1473	1660
MRC 7201 BGII	1770	1189	3532	794	1236	**1704**
MRC.7201	670	542	2880	660	1222	1195
MRC.7322	550	371	2938	479	1031	1074
MRC.7703	1050	525	2796	882	996	1250
MECH 162 Bt (CC)	1230	634	3021	698	1526	1422
RCH.2 Bt (CC)	1310	1103	3776	907	1804	1780
LAHH/DHH11/Bunny (LC)	850	458	3616	541	1383	1370
CD (0.05)	55	218	338.8	195	353.4	
CV%	25.9	16.5	5.8	16.49	15.14	

Fibre quality parameters

2.5% Span length (mm)

The BG II hybrids had long staple fibres. The longest fibre was recorded in RCH.2Bt BGI hybrid (30.73 mm), as seen in the table below.

Entry	Nandyal	Lam Guntur	Dharwad	Mean
MRC 7703 BGII	27.14	30.32	27.60	28.35
MRC 7322 BGII	29.03	30.36	28.10	29.16
MRC 7201 BGII	29.13	31.11	29.50	29.91
MRC.7201	28.10	31.42	30.40	29.97
MRC.7322	28.71	30.99	30.20	29.97
MRC.7703	23.48	26.56	26.30	25.45
MECH 162 Bt (CC)	23.94	26.13	24.80	24.96
RCH.2 Bt(CC)	30.23	31.25	30.70	30.73
LAHH/DHH11/Bunny (LC)	24.89	28.96	26.00	26.62

Strength (g/tex)

The fibre strength was of the range of 20.98 to 22.34 in BG II.

Entry	Nandyal	Lam Guntur	Dharwad	Mean
MRC 7703 BGII	21.80	21.13	23.20	22.04
MRC 7322 BGII	20.00	20.63	22.30	20.98
MRC 7201 BGII	22.70	21.13	23.20	22.34
MRC.7201	23.00	22.06	22.90	22.65
MRC.7322	20.90	20.56	24.00	21.82
MRC.7703	19.90	22.93	22.10	21.64
MECH 162 Bt (CC)	19.30	20.00	21.60	20.30
RCH.2 Bt(CC)	20.90	19.13	23.30	21.11
LAHH/DHH11/Bunny (LC)	22.60	20.60	21.20	21.47

Micronaire

The micronaire value ranged from 3.89 to 4.28 in BG II hybrids.

Entry	Nandyal	Lam Guntur	Dharwad	Mean
MRC 7703 BGII	2.69	4.79	4.20	3.89
MRC 7322 BGII	3.10	5.34	4.40	4.28
MRC 7201 BGII	3.20	5.06	4.30	4.19
MRC.7201	3.20	4.81	4.20	4.07
MRC.7322	2.68	4.88	3.80	3.79
MRC.7703	2.21	4.41	3.70	3.44
MECH 162 Bt (CC)	2.67	5.03	4.00	3.90
RCH.2 Bt(CC)	3.03	4.09	3.60	3.57
LAHH/DHH11/Bunny (LC)	2.39	4.97	4.10	3.82

The fibre quality data of these hybrids do not provide enough evidence that they conform to SITRA norms that is now accepted as the yard-stick of fibre quality for achieving defined yarn quality and yield. Confirmation of this through full scale mill test is desirable to recommend the promising hybrids for cultivation by farmers in this zone. The worthiness of the Bt hybrid has to be based on their ability to reduce damage due to the three bollworms along with desirable fibre property.

Mean fibre property of various BG II entries

Entry	Span length (mm)	Fibre tenacity (g/tex)	Micronaire
MRC 7703 BGII	28.35	22.04	3.89
MRC 7322 BGII	29.16	20.98	4.28
MRC 7201 BGII	29.91	22.34	4.19
MRC.7201	29.97	22.65	4.07
MRC.7322	29.97	21.82	3.79
MRC.7703	25.45	21.64	3.44
MECH 162 Bt (CC)	24.96	20.30	3.90
RCH.2 Bt(CC)	30.73	21.11	3.57
LAHH/DHH11/Bunny (LC)	26.62	21.47	3.82

Plant Protection Evaluation – Protected Condition

Jassids (average of 3 leaves / plant)

This insect was the highest in BG II hybrids in Coimbatore and Nandyal. Mean number of 6.5 to 8.7 number of jassids/3 leaves was recorded in the zone.

Entry	Siruguppa	Nandyal		Lam Guntur		CICR CBE	Mean number
	Number	*TV	Number	TV	Number	Number	
MRC 7703 BGII	0.53	2.87	8.13	1.35	0.86	16.7	6.6
MRC 7322 BGII	0.4	3.06	9.4	1.5	1.3	14.7	6.5
MRC 7201 BGII	0.33	3.09	9.86	2.72	6.43	18.7	8.8
MRC.7201	0.47	2.67	8.33	1.22	0.5	15.7	6.3
MRC.7322	0.4	3.5	11.86	1.22	0.5	16.7	7.4
MRC.7703	0.33	3.15	9.8	2.84	7.1	17.7	8.7
MECH 162 Bt (CC)	0.33	2.97	10.53	1.41	1.1	19.7	7.9
RCH.2 Bt(CC)	0.53	3.74	13.66	2.91	7.53	21.3	10.8
LAHH/DHH11/Bunny (LC)	0.53	3.21	10.53	1.29	0.73	20	7.9
CD (0.05)	0.15		1.09		0.27	-	
CV%	19.72		20.16		8.6	25.96	

*TV-transformed value

Thrips

The thrips population was found t be extensive in all the test hybrids at both Nandyal and Guntur during this season.

Entry	Nandyal		Lam Guntur		Mean Number
	*TV	Number	TV	Number	
MRC 7703 BGII	3.69	14.13	4.88	22.93	18.5
MRC 7322 BGII	3.59	13.33	3.56	11.73	12.5
MRC 7201 BGII	3.53	16	4.13	16.13	16.1
MRC.7201	3.12	9.66	4.02	15.2	12.4
MRC.7322	4.21	17.73	4.52	19.66	18.7
MRC.7703	4.09	16.4	4.8	22.47	19.4
MECH 162 Bt (CC)	4.74	23.06	4.26	17.2	20.1
RCH.2 Bt(CC)	2.96	8.26	3.62	12.23	10.2
LAHH/DHH11/Bunny (LC)	4.52	20.4	3.79	13.43	16.9
CD (0.05)	20		0.79		
CV%	30.16		10.9		

*TV-transformed value

Whitefly

There was negligible whitefly population on the test hybrids in the following test centres during this season.

Entry	Nandyal		Lam Guntur		CICR CBE	Mean Number
	*TV	Number	TV	Number	Number	
MRC 7703 BGII	1.77	2.86	1.37	0.93	0.0	1.3
MRC 7322 BGII	1.54	1.99	1.37	1.00	1.0	1.3
MRC 7201 BGII	1.75	3.06	1.40	1.06	0.6	1.6
MRC.7201	1.46	1.72	1.32	0.73	0.3	1.1
MRC.7322	1.74	2.8	1.47	1.26	0.3	1.5
MRC.7703	2.38	5.8	1.82	2.6	0.0	2.5
MECH 162 Bt (CC)	1.68	2.33	1.40	1.00	0.6	1.3
RCH.2 Bt(CC)	163	2.29	1.12	0.26	1.3	1.3
LAHH/DHH11/Bunny (LC)	1.71	2.56	1.38	1.00	0.3	1.3
CD (0.05)	0.88		NS			
CV%	29.31		27.2			

*TV-transformed value

American bollworms

The American bollworm population was very low in this zone in the test centres during this year. The response of the BGII could not be assessed due to lack of bollworm pressure.

Entry	Siruguppa	Nandyal		Lam Guntur		CICR CBE		Mean
	Number	*TV	Number	TV	Number	TV	Number	Number
MRC 7703 BGII	0.8	0.87	0.33	1	0	0.71	0	0.3
MRC 7322 BGII	0.6	0.87	0.33	1	0	0.71	0	0.2
MRC 7201 BGII	1.067	0.7	0	1	0	0.71	0	0.3
MRC.7201	0.4	0.77	0	1.12	0.26	1.58	2	0.7
MRC.7322	1.27	0.77	0	1.12	0.26	1.58	2	0.9
MRC.7703	0.93	0.99	0.66	1.11	0.26	1.34	1.3	0.8
MECH 162 Bt (CC)	0.9	0.87	0.33	1.06	0.13	0.89	0.3	0.4
RCH.2 Bt (CC)	0.93	0.99	0.66	1.06	0.13	0.89	0.3	0.5
LAHH/DHH11/Bunny (LC)	0.3	0.7	0	1.14	0.6	0.71	0	0.2
CD (0.05)	0.309	0.37		NS		0.53		
CV%	22.34	26.05		10.1		31.07		

*TV-transformed value

Locule damage (%)

It is noted that Pink bollworm infestation was high in 22.7% in local check hybrid. The BG II hybrids did have less than 50% infestation of locules over the check hybrids. The major point to be noted was that BG I hybrids recorded 11% locule damage.

Entry	Siruguppa	Nandyal		Lam Guntur		CICR CBE		Mean
	%	*TV	%	TV	%	TV	%	%
MRC 7703 BGII	16.81	15.41	7.74	2.9	2.97	10.78	3.5	7.8
MRC 7322 BGII	15.49	8.19	2.68	3.34	3.13	10.47	3.3	6.2
MRC 7201 BGII	17.82	14.93	7.13	3.06	2.24	7.27	1.6	7.2
MRC.7201	18.3	20.07	13.1	4.07	8.36	24.43	17.1	14.2
MRC.7322	19.54	24.62	33.47	3.61	4.37	24.04	16.6	18.5
MRC.7703	15.1	26.07	22.47	6.37	3.35	17.76	9.3	12.6
MECH 162 Bt (CC)	20.5	23.97	17.13	3.27	3.1	10.14	3.1	11.0
RCH.2 Bt(CC)	21.35	21.63	17.73	3.19	2.62	8.72	2.3	11.0
LAHH/DHH11/Bunny (LC)	20.58	45.86	51.3	3.14	2.57	23.73	16.2	22.7
CD (0.05)	1.84	17.42		NS		4.07		
CV%	5.66	29.7		16		15.55		

*TV-transformed value

Open boll damage (%)

The percent open boll damage was reduced considerably over the check hybrids. The Pink bollworm damage was significant in non-Bt hybrids. The Bt hybrids with BG I and BG II genes did reduce the open boll damage.

Entry	Siruguppa	Nandyal		Lam Guntur		CICR CBE		Mean
	AV	*TV	%	TV	%	TV	%	%
MRC 7703 BGII	25.95	15.02	8.42	11.63	5.73	17.85	9.4	12.4
MRC 7322 BGII	27.15	12.07	5.88	14.45	6.23	17.56	9.1	12.1
MRC 7201 BGII	24.37	18.82	11.68	12.49	4.72	14.65	6.4	11.8
MRC.7201	24.72	48.23	55.53	17.52	9.11	34.45	32	30.3
MRC.7322	28.7	58.37	71.03	17.28	8.86	31.56	27.4	34.0
MRC.7703	41.82	37.95	38.62	15.9	7.68	25.25	18.2	26.6
MECH 162 Bt (CC)	28.78	17.41	9.54	14.92	7.08	17.95	9.5	13.7
RCH.2 Bt (CC)	28.33	23.43	15.86	11.07	3.9	14.89	6.6	13.7
LAHH/DHH11/Bunny (LC)	26.55	41.45	44.36	12.89	5.17	32.9	29.5	26.4
CD (0.05)	2.54	24.32	NS	5.24				
CV%	4.96	46.37		23		13.22		

*TV-transformed value

The number of sprayings in protected plots ranged between 3.8 to 4.8 in BG II hybrids in protected plots. The non-Bt hybrids had up to 7.3 sprayings.

Entry	Siruguppa			Nandyal			Lam Guntur			CICR CBE			Mean		
	SP#	BW*	total	SP	BW	total	SP	BW	total	SP	BW	Total	SP	BW	Total
MRC 7703 BGII	3	2	5	4	0	4	1	0	1	4	1	5	3.0	0.8	3.8
MRC 7322 BGII	3	2	5	4	0	4	0	1	1	4	3	7	2.8	1.5	4.3
MRC 7201 BGII	3	2	5	4	3	7	1	1	2	4	1	5	3.0	1.8	4.8
MRC.7201	3	2	5	4	3	7	0	6	6	4	6	10	2.8	4.3	7.0
MRC.7322	3	2	5	4	2	6	0	5	5	4	6	10	2.8	3.8	6.5
MRC.7703	3	2	5	4	4	8	1	6	7	4	5	9	3.0	4.3	7.3
MECH 162 Bt (CC)	3	2	5	4	3	7	0	3	3	4	5	9	2.8	3.3	6.0
RCH.2 Bt(CC)	3	2	5	4	3	7	1	1	2	4	2	6	3.0	2.0	5.0
LAHH/DHH11/Bunny (LC)	3	2	5	4	1	5	0	3	3	4	5	9	2.8	2.8	5.5

SP-Sucking pests, * BW-bollworm

Plant Protection Evaluation – Protected Condition

Sap sucking pests

The following tables provide the data on the response of BG II test genotypes to jassids, thrips and whitefly. All the genotypes are susceptible to these pests, as seen in the following tables. However, the whitefly population was low during the season although all the hybrids were found to be infested uniformly under unprotected conditions.

Jassids (average of 3 leaves/plant)

Entry	Siruguppa	Nandyal		Lam Guntur		Dharwad	CICR CBE	Mean Number
	Number	*TV	Number	TV	Number	Number	Number	
MRC 7703 BGII	0.93	2.94	8.46	2.37	4.8	2.03	17.33	7.9
MRC 7322 BGII	1.13	3.21	10.13	2.1	5.13	2.86	19.33	8.9
MRC 7201 BGII	0.73	3.25	10.53	2.43	5.06	1.62	17.33	8.4
MRC.7201	2.07	3.03	9.33	2.25	4.13	1.38	24.67	10.1
MRC.7322	1.27	3.64	12.86	2.43	5.13	1.56	18.33	9.4
MRC.7703	1	3.28	10.46	2.11	3.46	2.64	18.67	8.4
MECH 162 Bt (CC)	1.47	3.22	11.2	2.52	5.6	1.56	17.33	8.9
RCH.2 Bt (CC)	3.07	4.09	16.4	3.53	11.53	1.86	23.33	13.6
LAHH/DHH11/ Bunny (LC)	2.87	3.47	11.86	2.72	6.53	2.03	18.33	9.9
CD (0.05)	0.2		0.9		0.73	0.24	-	
CV%	7.29		15.7		17	7.4	7.82	

*TV-transformed value

Thrips(average of 3 leaves/plant)

Entry	Nandyal		Lam Guntur		Dharwad	Mean Number
	*TV	Number	TV	Number	Number	
MRC 7703 BGII	5.42	29.06	41.46	6.4	12	15.8
MRC 7322 BGII	5.18	26.36	29.93	5.55	12.66	14.9
MRC 7201 BGII	5.1	25.82	25.3	5.09	10.6	13.8
MRC.7201	4.51	20.22	30.73	4.48	12.8	12.5
MRC.7322	5.08	26.12	42.06	5.38	10.86	14.1
MRC.7703	4.6	21.66	53.2	7.34	11	13.3
MECH 162 Bt (CC)	4.78	22.5	48.8	7	13.5	14.3
RCH.2 Bt(CC)	4.42	19.19	21.9	4.75	10.86	11.6
LAHH/DHH11/Bunny (LC)	4.3	28.7	36.7	6.02	13.03	15.9
CD (0.05)	1.37		NS		1.18	
CV%	16.11		21.9		5.76	

*TV-transformed value

Whitefly (average of 3 leaves/plant)

Entry	Nandyal		Lam Guntur		CICR CBE	Mean
	*TV	AV	TV	AV	AV	
MRC 7703 BGII	1.77	2.86	1.72	2.13	1	2.0
MRC 7322 BGII	1.54	1.99	1.79	2.26	1	1.8
MRC 7201 BGII	1.75	3.06	1.71	1.94	0	1.7
MECH 162 Bt (CC)	1.68	2.33	1.85	2.53	1.6	2.2
LAHH/DHH11/Bunny (LC)	1.71	2.56	1.85	2.86	1.3	2.2
RCH.2 Bt(CC)	1.63	2.29	1.77	2.33	0.6	1.7
MRC.7201	1.46	1.72	1.79	2.33	1	1.7
MRC.7322	1.74	2.8	1.58	1.6	0.6	1.7
MRC.7703	2.38	5.8	1.72	2.06	1.6	3.2
CD (0.05)		0.88		NS	-	
CV%		29.31		7.9	40.13	

*TV-transformed value

American bollworms

The American bollworm population was very low in this zone in the test centres during this year. The response of the BGII could not be assessed due to lack of bollworm pressure.

Entry	Siruguppa	Nandyal		Lam Guntur		Dharwad	CBE	Mean
	%	*TV	%	TV	%	%	%	%
MRC 7703 BGII	0.9	0.87	0.33	0	1	1.53	0.3	0.7
MRC 7322 BGII	0.7	0.87	0.33	0	1	1.63	0.3	0.7
MRC 7201 BGII	1.2	0.7	0	0	1	1.52	0	0.6
MRC.7201	0.8	0.7	0	1.33	1.12	1.91	2.3	1.4
MRC.7322	1.43	0.7	0	1.33	1.12	1.35	0.3	0.8
MRC.7703	1.37	0.99	0.66	1.33	1.11	1.46	0.3	0.9
MECH 162 Bt (CC)	1.22	0.87	0.33	0.65	1.06	1.35	1.7	1.2
RCH.2 Bt(CC)	1.23	0.99	0.66	0.65	1.06	1.21	0.3	0.8
LAHH/DHH11/Bunny (LC)	0.47	0.7	0	3	1.14	1.68	3	1.5
CD (0.05)	0.303		0.37	NS		0.24		
CV%	16.93		26.05	10.1		9.38	47.57	

*TV-transformed value

Locule damage (%)

The percent locule damage was similar in BG II and BG I hybrids. However, non-Bt hybrids had higher locule damage.

Entry	Siruguppa	Lam Guntur		Dharwad	CICR CBE		Mean %
	%	*TV	%	%	TV	%	
MRC 7703 BGII	17.41	4.41	12.01	16.14	11.83	4.2	12.4
MRC 7322 BGII	19.11	5.92	13.6	10.67	13.8	5.7	12.3
MRC 7201 BGII	26.39	5.85	13.64	21.35	10.3	3.2	16.1
MRC.7201	29.21	9.64	18.05	13.67	28.32	22.5	20.9
MRC.7322	26.39	16.15	23.7	35.21	28.93	23.4	27.2
MRC.7703	21.97	6.87	15.18	23.17	22.38	14.5	18.7
MECH 162 Bt (CC)	22.74	6.3	13.64	13.93	11.68	4.1	13.6
RCH.2 Bt(CC)	24.17	9.41	17.51	13.15	11.24	3.8	14.7
LAHH/DHH11/Bunny (LC)	25.8	17.59	23.97	22.89	25.47	18.5	22.8
CD (0.05)	2.14	NS		2.36	5.65	5.65	
CV%	5.32	82.9		5.47	18.11	18.11	

*TV-transformed value

Open boll damage (%)

The percent open boll damage was quite high in non-Bt hybrids in comparison to the BG II and check BG I hybrids.

Entry	Siruguppa	Lam Guntur		Dharwad	CICR CBE		Mean
	%	*TV	%	%	TV	%	%
MRC 7703 BGII	29.1	18.5	10.83	16.7	20.79	12.6	17.3
MRC 7322 BGII	31.09	21.14	13.33	13.36	21.89	13.9	17.9
MRC 7201 BGII	25.44	25.64	19.47	9.59	19.73	11.4	16.5
MRC.7201	39.44	22.81	18.08	36.82	39.64	40.7	33.8
MRC.7322	45.77	36.01	35	35.69	41.27	43.5	40.0
MRC.7703	48.54	29.99	26.3	23.19	32.58	29	31.8
MECH 162 Bt (CC)	34.3	14.16	6.77	13.93	19.28	10.9	16.5
RCH.2 Bt(CC)	29.5	28.56	23.07	15.32	21.89	13.9	20.4
LAHH/DHH11/Bunny (LC)	36.74	20.25	13.21	23.42	34.51	32.1	26.4
CD (0.05)	1.41		NS	3.19		6.34	
CV%	2.29		37.4	6.93		13.17	

*TV-transformed value

Number of sprayings undertaken in different Bt and non Bt genotypes

In the unprotected plots, the sap sucking pests were managed by 2.3 to 2.7 sprayings in this zone in 2004-05 season. However, under protected conditions, this figure was around two and half times.

Entry	Siruguppa	Nandyal	Lam Guntur	Mean
MRC 7703 BGII	2	4	1	2.3
MRC 7322 BGII	2	4	1	2.3
MRC 7201 BGII	2	4	22	9.3
MECH 162 Bt (CC)	2	4	1	2.3
LAHH/DHH11/Bunny (LC)	2	4	1	2.3
RCH.2 Bt(CC)	2	4	2	2.7
MRC.7201	2	4	1	2.3
MRC.7322	2	4	1	2.3
MRC.7703	2	4	1	2.3

SP-Sucking pests, * BW-bollworm

Seed cotton yield

The unprotected plots of MRC.7703 BGII hybrids yielded 1413.52 kg/ha. The BG I check hybrids had similar yield of 1156 and 1157 kg/ha. Other BG II hybrids had similar yields of 132 kg/ha.

Seed cotton yield (Kg/ha) - (Unprotected)

Entry	Siruguppa	Nandyal	Lam Guntur	Dharwad	CICR CBE	Mean
MRC 7703 BGII	1630	1051.6	1897	1029	1460	**1413.5**
MRC 7322 BGII	1500	1063.1	1657	919.2	1474	1322.7
MRC 7201 BGII	1590	1160.2	1801	815.1	1237	1320.7
MRC.7201	520	120.1	1170	560.6	1222	718.5
MRC.7322	480	10.29	1331	424.5	1031	655.4
MRC.7703	980	285.8	1949	488.9	997	940.1
MECH 162 Bt (CC)	1120	583	1670	885.4	1526	1156.9
LAHH/DHH11/Bunny (LC)	780	188.6	1386	506.9	1383	848.9
RCH.2 Bt(CC)	1120	920.2	975	969.9	1804	1157.8
CD (0.05)	56	275.62	278	116.9	353.35	
CV%	28.6	26.17	10.7	9.92	15.14	

PLANT PATHOLOGY EVALUATION

During 2004 – 05, there was moderate to high level of incidences of Grey mildew and Alternaria leaf spot at Dharwad, Siruguppa, Lam (Guntur) and Coimbatore; moderate incidence of Bacterial leaf blight at Dharwad and Siruguppa and Helminthosporium and Cercospora leaf spots at Lam. We were able to assess properly the reaction of various Bt and non-Bt hybrids to the above mentioned diseases in the Southern Centres.

All three BG II hybrids *viz*., MRC 7703 BG II, MRC 7322 BG II and MRC 7201BG II were susceptible to Alternaria leaf spot and their reactions were similar to check hybrids in the centres tested as given in the following table.

Alternaria leaf spot (Per cent Disease Incidence) in protected and unprotected plots

Name of entry	Dharwad		Siruguppa		LAM		CICR,CBE		Overall Mean	
	P	UP	P	UP	P	UP	P	UP	P	UP
MRC.7703 BG II	32.94 (35.00)	37.62 (37.82)	34.70 (36.09)	38.36 (38.29)	15.33 (22.98)	21.33 (27.48)	17.5	17.5	25.1	28.7
MRC.7322 BG II	35.69 (36.69)	38.92 (38.59)	31.01 (33.83)	40.63 (39.58)	12.66 (20.79)	17.66 (24.82)	7.5	7.5	21.7	26.1
MRC.7201 BG II	33.02 (35.00)	37.45 (37.76)	33.48 (35.37)	38.26 (38.23)	13.33 (21.27)	18.66 (25.56)	25.0	20.8	26.2	28.7
MECH.162 Bt (CC)	36.38 (37.11)	36.79 (37.35)	34.31 (35.85)	38.60 (38.41)	10.33 (18.72)	15.66 (23.32)	20.8	10.9	25.4	25.4
Local checks	38.70 (38.47)	36.38 (37.11)	33.33 (35.24)	40.58 (39.58)	12 (20.17)	15.66 (23.3)	14.2	12.5	24.5	26.2
RCH.2 Bt (CC)	37.06 (37.46)	35.69 (36.69)	33.62 (35.43)	38.98 (38.65)	12.66 (20.66)	18.66 (25.47)	14.2	16.7	24.3	27.5
MRC.7201	37.43 (37.70)	35.47 (36.57)	33.34 (35.24)	37.23 (37.58)	16 (23.47)	20.66 (27.01)	25.8	30.0	28.1	30.8
MRC.7322	36.02 (36.87)	36.17 (36.99)	32.32 (34.63)	36.53 (37.17)	12 (20.17)	19 (25.82)	15.0	10.7	23.8	25.6
MRC.7703	35.29 (36.45)	36.55 (37.23)	32.38 (34.70)	36.55 (37.17)	12 (20.17)	18.33 (25.27)	8.3	4.2	21.9	23.9
CD at 5%	NS	NS	NS	1.24						
CV %	5.67	3.2	4.17	1.88	12.7	8.6				

Local Check: LAHH.5/DHH.11/BUNNY ; P=Protected; UP= Unprotected

Bacterial leaf blight

This disease was noticed only in the Dharwad and Siruguppa centres at moderate level on BG II hybrids (14.73 to 21.09 %). All hybrids (Bt and non-Bt) were moderately susceptible in both trials and there were no significant differences among them in the following table.

Bacterial blight (Per cent Disease Incidence) in protected and unprotected plots

Name of entry	Dharwad		Siruguppa		Overall Mean	
	Protected	Unprotected	Protected	Unprotected	Protected	Unprotected
MRC.7703 BG II	17.20 (24.50)	19.64 (26.28)	15.32 (23.03)	19.01 (25.84)	16.26	19.33
MRC.7322 BG II	18.43 (25.40)	18.98 (25.84)	13.01 (21.13)	21.19 (27.35)	15.72	20.09
MRC.7201 BG II	17.41 (24.65)	17.38 (24.65)	15.24 (22.95)	23.31 (28.86)	16.33	20.35
MECH.162 Bt (CC)	16.60 (24.04)	16.68 (24.12)	14.00 (21.97)	21.85 (27.90)	15.3	19.27
LAHH.5/DHH.11/BUNNY (Local checks)	17.61 (24.80)	18.21 (25.25)	13.87 (21.89)	24.79 (29.87)	15.74	21.5
RCH.2 Bt (CC)	17.68 (24.88)	16.64 (24.04)	16.63 (24.04)	22.10 (28.04)	17.16	19.37
MRC.7201	16.38 (23.89)	15.86 (23.50)	13.36 (21.47)	23.24 (28.79)	14.87	19.55
MRC.7322	14.86 (22.71)	17.48 (24.73)	14.59 (22.46)	20.24 (26.71)	14.73	18.86
MRC.7703	15.96 (23.58)	16.44 (23.89)	14.76 (22.63)	25.74 (30.46)	15.36	21.09
CD at 5%	NS	NS	NS	NS		
CV %	8.42	5.54	6.42	14.89		

Grey mildew

The BG II hybrids *viz*., MRC 7703 BG II, MRC 7322 BG II and MRC 7201BG II were also found to be highly susceptible to Grey mildew in the three centres tested with the over all mean incidence ranging from 35.37 percent (MRC 7201BG II) to 37.21 percent (MRC 7322 BG II) in breeding plots and 34.01 percent (MRC 7322 BG II) to 35.77 percent (MRC 7201BG II) in entomology plots. The common checks had 33.91 percent to 35.32 percent (MECH 162 Bt) and 36.96 to 40.72 percent (RCH 2 Bt). The disease incidence on non-Bt hybrids varied from 33.55 to 37.91 percent as given in the table below.

Grey mildew disease in protected and unprotected plots

(Per cent Disease Incidence)

Name of entry	Dharwad		Siruguppa		LAM		Overall Mean	
	P	UP	P	UP	P	UP	P	UP
MRC.7703 BG II	48.50 (44.14)	46.91 (43.22)	42.06 (40.45)	36.16 (36.99)	19 (25.81)	21.91 (22.98)	36.52	34.99
MRC.7322 BG II	47.35 (43.51)	42.07 (40.45)	43.12 (41.03)	36.64 (37.23)	21.16 (27.35)	23.33 (20.79)	37.21	34.01
MRC.7201 BG II	48.51 (44.14)	44.63 (41.90)	35.95 (36.87)	36.78 (37.35)	21.66 (27.7)	25.91 (21.27)	35.37	35.77
MECH.162 Bt (CC)	53.02 (46.72)	46.08 (42.76)	36.35 (37.11)	35.64 (36.63)	16.58 (24.01)	20 (18.72)	35.32	33.91
Local checks	51.61 (45.92)	45.37 (42.36)	46.18 (42.82)	37.02 (37.46)	18.33 (25.32)	22.5 (20.17)	38.71	34.96
RCH.2 Bt (CC)	55.77 (48.33)	47.39 (43.51)	44.06 (41.61)	34.50 (35.97)	22.33 (28.17)	29 (20.66)	40.72	36.96
MRC.7201	51.78 (46.03)	46.14 (42.76)	40.89 (39.76)	36.52 (37.17)	19.83 (26.34)	24.66 (22.47)	37.91	35.77
MRC.7322	52.74 (46.55)	47.60 (43.62)	41.15 (39.93)	33.48 (35.37)	15.33 (22.99)	19.58 (20.17)	36.41	33.55

MRC.7703	50.47 (45.29)	46.34 (42.88)	40.82 (39.70)	35.72 (36.69)	21.16 (27.35)	28.08 (20.17)	37.48	36.71
CD at 5%	NS	NS	NS	NS	2.30	3.63		
CV %	7.12	5.03	5.7	4.49	8	7.2		

Local checks: LAHH.5/DHH.11/BUNNY; ; P=Protected; UP= Unprotected

Helminthosporium and Cercospora leaf spots

These two diseases were observed only in the Lam (Guntur) centre in the H x H Bt I and BG II hybrid trials. All hybrids (Bt and non-Bt) as well as check was found to be moderately susceptible to Helminthosporium and Cercospora leaf spots diseases.

***Helminthosporium* and *Cercospora* in protected and unprotected plots**

(Percent Disease Incidence)

Name of entry	LAM		LAM	
	Helminthosporium		*Cercospora*	
	Protected	Unprotected	Protected	Unprotected
MRC.7703 BG II*	15.66(23.26)	22.66(28.33)	18(25.06)	23(28.58)
MRC.7322 BG II*	20.5(26.85)	23.66(28.05)	15.33(22.84)	19(25.63)
MRC.7201 BG II	23.33(28.75)	29.66(38.93)	18.33(25.12)	28(31.82)
MECH.162 Bt (CC)	25(28.93)	28.66(32.38)	18.66(25.54)	27.66(31.59)
Local checks	22.25(28.11)	27.33(31.52)	15.33(22.98)	21.33(27.32)
RCH.2 Bt (CC)	25.5(30.28)	30.33(33.49)	12(20.17)	16.66(24.05)
MRC.7201	23.8(29.26)	28(31.92)	17.33(24.53)	23.33(28.80)
MRC.7322	16.33(23.83)	24.66(29.77)	21.33(27.46)	28.33(28.75)
MRC.7703	21.5(27.61)	27.33(31.56)	21(27.03)	30.66(33.46)

Local checks: LAHH.5/DHH.11/BUNNY

Combined report of 2003 and 2004 season

During 2003 season, evaluation of three BG II hybrids, viz., MRC.7201, MRC. 7322 and MRC.7703 along with their non-Bt counterparts and MECH.162 (BG I) Bt check hybrid and non-Bt check hybrid (Savitha) for reaction to all the prevailing pests and diseases.. In 2004 season, MECH.162Bt, RCH.2Bt and Bunny were the checks.

The seed cotton yield in protected plots of 2003 season was lower than that of unprotected plots. However, in both the evaluations, the BG II hybrids were superior other test hybrids. During 2004 season also similar trends was seen, as given in the following table.

Seed cotton yield (kg/ha)

Entry	2003 season		2004 season	
	Protected	Unprotected	Protected	Unprotected
MRC 7703 BGII	1823	**2182**	**1787**	**1413.5**
MRC 7322 BGII	1848	1963	1660	1322.7
MRC 7201 BGII	1879	**2046**	1704	1320.7
MRC.7201	1501	1317	1195	718.5
MRC.7322	1377	1374	1074	655.4
MRC.7703	1831	2101	1250	940.1
MECH 162 Bt (CC)	2381	1145	1422	1156.9
LAHH/DHH11/Bunny (LC)	1965	1600	1780	848.9
RCH.2 Bt(CC)	-	-	1370	1157.8

Mean seed cotton yield (kg/ha) in protected and unprotected plots in two years

Entry	protected	Unprotected
MRC 7703 BGII	1805	1798
MRC 7322 BGII	1754	1643
MRC 7201 BGII	1792	1683
MRC.7201	1348	1018
MRC.7322	1226	1015
MRC.7703	1541	1521
MECH 162 Bt (CC)	1902	1151
LAHH/DHH11/Bunny (LC)	1873	1224
RCH.2 Bt(CC)	1370	1158

However, the fibre property values of two years did not indicate satisfactory values since their span length and strength did not conform to SITRA (South India Textile Research Association – Textile Ministry) norms. In order to fully evaluate the fibre property of the most promising hybrids such as MRC.7703 BGII, large scale mill test has to be undertaken, as is stipulated in All India Coordinated Cotton Improvement Project final stages of evaluations of genotypes. The fibre quality data of these hybrids do not provide enough evidence that they conform to SITRA norms that is now accepted as the yard-stick for achieving defined yarn yield and quality.

The worthiness of the genotype has to be based on their ability to reduce damage due to the three bollworms along with desirable fibre property.

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