

EVALUATION OF BOLLWORM TOLLERENCE IN F₁ AND F₂ Bt COTTON UNDER UNPROTECTED CONDITION

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Abstract: Field experiment was conducted during kharif 2005, at the experimental farm of the Department of Genetics and Plant Breeding, College of Agriculture, Marathwada Agricultural University, Parbhani, Maharashtra. F₁ and F₂ hybrids of 23 Bt and 5 non-Bt hybrids were grown in a randomized block design with two replications. The results showed that among F₁ hybrids, open boll damage due to bollworm complex was not noticed in 4233 Bt and 4247 Bt cotton hybrids which were found significantly superior over MECH 6301 Bt (3.2 %), 4255 Bt (3.28 %) and it was at par with rest of the hybrids. Among F₂ hybrids minimum open boll damage (3.10 %) was noticed in Proagro 144 Bt, which was found significantly superior over rest of the hybrids except 4234 Bt (4.17 %) and 4254 Bt (4.98 %) which were at par with each other. In respect of seed cotton yield, among F₁ hybrids maximum yield (15.51 q/ha) was recorded in 4233 Bt which was found significantly superior over rest of the hybrids except 4237 Bt (15.24 q/ha). Among F₂ maximum yield (15.44 q/ha) was recorded in 4233 Bt which was found significantly superior over rest of the hybrids except 4258 Bt (15.41 q/ha), 4239 Bt (15.098 q/ha) which were at par with each other. Thus F₂ Bt cotton express Bt protein in segregated pattern in which bollworm attack was more as compared to F₁ which affects yield as well as quality of lint.

Keywords: Bt Cotton, Bollworms, F₁ & F₂ Generations, Unprotected Condition.

Introduction: Government of India has taken decision on 26 th March, 2002 to permit commercial release of three Bt transgenic cotton hybrids viz., MECH-12 Bt, MECH-162 Bt and MECH-184 Bt, developed by Maharashtra Hybrid Seeds Company (Mahyco) in collaboration with Monsanto. With the introduction of Bt cotton hybrids, the demand for hybrid seeds kept increasing. Hence, F₂ generation cotton hybrids are cultivated in large scale, either knowingly or unknowingly as F₁ hybrids by Indian farmers. F₂ is segregating generation, where yield as well as the quality of lint is affected.

In the present experiment, various Bt cotton hybrids were grown along with their F₂ generation. Basically, as it has been proved that there is segregation in F₂ generation, recommendation generation for cultivation is not given. As observed, knowingly or unknowingly there is practice to grow F₂ of cotton. Accordingly there are queries whether F₂ Bt will give some tolerance to cotton bollworms or all F₂ are giving same bollworm tolerance, for these questions some study is required.

Materials And Methods: A Field experiment was conducted during *kharif* 2005, at the experimental farm of the Department of Genetics and Plant Breeding, Marathwada Agricultural University, Parbhani (Maharashtra). The observations were recorded on twenty randomly selected plants from each F₂ plot and five randomly selected plants in from each F₁ plot in each replication, Total number of loculi and loculi damaged by pink bollworm of the open bolls observed at each picking from the randomly selected plants from each plot. From this

per cent loculi damage due to pink bollworm at harvest was worked out. The data on per cent loculi damage were subjected to arcsine transformation. The cotton seed yield data were converted in quintal per hectare.

Results And Discussion: The data recorded on cumulative average per cent green fruiting bodies damage due to bollworm complex are presented in Table 1 revealed that among F₁ hybrids green fruiting bodies damage was observed in Bt cotton hybrids ranged from 2.29 to 14.33 per cent and in non Bt cotton hybrids it ranged from 15.70 to 27.03per cent. Minimum bollworm damage was recorded in 4233 Bt (2.29%) which was found significantly superior over rest of the hybrids except 4247 Bt (2.32%), 4256 Bt (2.7%) and Proagro-144 Bt (2.87%) which were at par with each other. Maximum bollworm damage was recorded in PHH-316 NBt (27.03%) followed by MECH-184 NBt (20.81%), Bunny-NBt (19.12%), NHH-44 NBt (17.36%), Rasi-2 NBt (15.70%) and KDCHH-9632 Bt (14.33%).

Among F₂ hybrids, green fruiting bodies damage observed in Bt cotton hybrids ranged from 3.50 to 16.20 per cent and in non Bt cotton hybrids it ranged from 16.76 to 28.97 per cent. Minimum bollworm damage (3.50%) was recorded in 4233-Bt and 4247-Bt which were found significantly superior over 4223 Bt (4.78%), 4253 Bt (4.80%), KDCHH-621 Bt (15.24%), 4239 Bt (15.32%), KDCHH-9632 Bt (15.76%), KDCHH-9810 Bt (16.20%) and it was at par with rest of the hybrids. Maximum bollworm damage was recorded in PHH-316-NBt (28.97%) which was followed by MECH-184 NBt (21.71%), Bunny-NBt (20.26%), NHH-

44NBt (18.32%), Rasi-2 NBt (16.76%) and KDCHH 9810-Bt (16.20%).

The results of present investigation are discussed in the light of findings of previous workers.

Bt cotton hybrids (MECH-12 Bt, MECH-162-Bt, MECH-184-Bt) had significantly less fruiting bodies damage (0.2 to 2.7 %) as compared to non Bt cotton (4.2 to 10.2 %) and check hybrids (7 to 9.5 %) (Anonymous, 2001b). Under ETL based protection, minimum damage in green bolls due to bollworm complex was recorded in MECH-12 Bt (6.17%) followed by MECH-184-Bt (8.69%) and MECH-162-Bt (14.33%). All these three Bt cotton hybrids were found significantly superior over their non Bt and check hybrids (PKV-Hy-2 and NHH-44) (Anonymous, 2002c). Badrinarayanan (2002) reported that sometimes Bt cotton was at par with non Bt cotton in the evaluation on bollworm damages. Daware *et al.* (2003) reported significantly low damage of bollworm complex in fruiting bodies in Bt cotton (MECH-12 Bt, MECH-162-Bt, MECH-184-Bt) over non Bt cotton. Vennila *et al.* (2004) evaluated five Bt transgenic cotton viz., 2 Bt, 20 Bt, 134 Bt, 138 Bt and 144 Bt with Cry 1 Ac gene on field for their reaction to sucking pest and bollworms and reported that on a seasonal mean basis, Bt cotton hybrids had suffered lesser square and green boll damage than the conventional and commercial Bt hybrid. Kengegowada *et al.* (2005) investigated insect pest population dynamics on Bt and non Bt and popular hybrids at Regional Agricultural Research Station, Raichur during 2002-03 and reported that under unprotected, irrigated condition that Bt cotton hybrid exhibited less fruiting bodies damage by bollworm as compared to non Bt and popular hybrids.

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Thus, the findings are in confirmation with the findings of previous workers.

The data recorded on yield of seed cotton are presented in Table 2 revealed that among F₁ hybrids the seed cotton yield of Bt hybrids ranged from 5.56 to 15.51 q/ha and in non Bt hybrids it ranged from 6.31 to 12.20 q/ha. Maximum yield (15.51 q/ha) was recorded in 4233 Bt which was found significantly superior over rest of the hybrids except 4237 Bt (15.51 q/ha), 4253 Bt (14.48 q/ha), 4254 Bt (14.22 q/ha) and 4248 Bt (14.01 q/ha), which were at par with each other. Among F₂ hybrids the seed cotton yield of Bt hybrids ranged from 3.05 to 15.44 q/ha and in non Bt hybrids it ranged from 6.49 to 10.65 (q/ha). Maximum yield (15.44 q/ha) was recorded in 4233 Bt which was found significantly superior over rest of hybrids except 4248 Bt 13.41 q/ha), 4234 Bt (13.98 q/ha) and 4254Bt (13.72 q/ha), which were at par with each other.

These present findings are in confirmation with those reported by Benedict *et al.* (1996) screened Bt cotton lines under unprotected condition and recorded average yield of Bt lines was 1460 kg/ha as against 1050 kg/ha in non Bt lines. Hua-Heliang *et al.* (1999) conducted an experiment and found that Boll weight of the F₁ Bt hybrid was higher than their parents, while the F₂ Bt hybrid boll weight was lower than that of their parents. Transgenic Bt cotton yield ranged from 7.56 to 17 q/ha as against 4.27 to 5.61 q/ha in non Bt counter part and in check it ranged from 3.85 to 4.40 q/ha. Manjunath (2007) reported that F₂ Bt cotton express Bt protein in a segregated pattern i.e. a portion of plant population will not contain the Bt gen. In addition, the yield will be poor because of the loss in hybrid vigour.

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Table 1. Average per cent damage in green fruiting bodies due to bollworm complex on Bt and NBT cotton hybrids under unprotected condition.

Sr. No.	Cotton Hybrids	Average per cent damage in green fruiting bodies due to bollworm complex	
		F ₁	F ₂
1	4220	3.25 (1.87)	4.14 (2.38)
2	4225	3.37 (1.93)	4.32 (2.48)
3	4255	3.67 (2.11)	4.62 (2.65)
4	4256	2.70 (1.55)	3.66 (2.10)
5	4253	3.68 (2.11)	4.80 (2.75)
6	4258	3.36 (1.93)	4.26 (2.44)
7	4233	2.29 (1.31)	3.50 (2.01)
8	4234	2.96 (1.70)	3.92 (2.25)
9	4239	14.04 (8.07)	15.32 (8.81)
10	4247	2.32 (1.33)	3.50 (2.01)
11	4254	3.13 (1.80)	3.91 (2.24)
12	4223	3.68 (2.11)	4.78 (2.74)
13	4222	3.90 (2.24)	4.75 (2.72)
14	4237	3.47 (1.99)	4.31 (2.47)
15	4248	3.33 (1.91)	4.65 (2.66)
16	KDCH -621	14.05 (8.08)	15.24 (8.77)
17	KDCHH-9632	14.33 (8.24)	15.76 (9.10)
18	KDCHH-9810	13.95 (8.02)	16.20 (9.33)
19	MECH-6301	3.53 (2.02)	4.39 (2.52)
20	NHH-44	3.81 (2.19)	4.74 (2.71)
21	MECH-162	3.78 (2.17)	4.75 (2.72)
22	Proagro-144	2.87 (1.65)	3.58 (2.05)
23	MECH-184	3.39 (1.95)	4.42 (2.54)
24	PHH-316 NBt	27.03 (15.68)	28.97 (16.84)
25	Bunny NBt	19.12 (11.02)	20.26 (11.69)
26	NHH-44-NBt	17.36 (9.99)	18.32 (10.56)
27	Rasi-2-NBt	15.70 (9.03)	16.76 (9.65)
28	MECH-184 NBt	20.81 (12.01)	21.71 (12.53)
	SE ±	0.12	0.24
	CD at 5%	0.35	0.71

Figures in parentheses are Arcsine transformed values.

Table 2. Yield of seed cotton (q/ha) of Bt and NBt cotton hybrids under unprotected condition.			
Sr.No.	Cotton Hybrids	Yield of seed cotton (q/ha)	
		F ₁	F ₂
1	4220	12.78	9.26
2	4225	6.85	6.19
3	4255	9.70	6.11
4	4256	11.95	8.93
5	4253	14.85	11.61
6	4258	10.46	8.56
7	4233	15.51	15.44
8	4234	10.08	13.98
9	4239	12.29	12.08
10	4247	5.56	8.64
11	4254	14.22	13.72
12	4223	8.64	11.49
13	4222	7.87	12.41
14	4237	15.24	13.36
15	4248	14.01	13.41
16	KDCH -621	6.43	3.05
17	KDCHH-9632	11.11	7.09
18	KDCHH-9810	7.75	4.91
19	MECH-6301	10.67	9.93
20	NHH-44	8.25	7.64
21	MECH-162	8.54	7.03
22	Proagro-144	5.74	4.67
23	MECH-184	8.58	10.21
24	PHH-316 NBt	10.29	10.65
25	Bunny NBt	12.20	10.78
26	NHH-44-NBt	6.31	6.49
27	Rasi-2-NBt	6.74	6.20
28	MECH-184 NBt	9.07	7.78
	SE \pm	0.89	0.66
	CD at 5%	2.59	1.93

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