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Management of *Pectinophora gossypiella* (Saunders) (Gelechiidae: Lepidoptera) on Transgenic Cotton using Newer Insecticides

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ABSTRACT

A field experiment was conducted to evaluate the efficacy of certain insecticides against *P. gossypiella* during *kharif, 2018* at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh.The treatments under study include eight insecticides *viz.,* emamectin benzoate, flubendiamide, chlorantraniliprole, chlorantraniliprole + lambda cyhalothrin, deltamethrin, NSKE 5 %, profenophos and cypermethrin along with one untreated control. Three sprays were given at 10 days interval and the data collected at three, seven and ten days after spraying.The results of pooled efficacy of three sprays revealed that chlorantraniliprole + lambda cyhalothrin was effective in the control of *P. gossypiella* which recorded 86.05, 85.18, 69.48, 79.49 and 79.41 per cent reduction over control in terms of larval population for 20 bolls, per cent green boll and locule damage, per cent open boll and open boll locule damage, respectively followed by cypermethrin with per cent reduction of 82.81, 80.88, 61.56, 74.35 and 71.55 over control in terms of larval population for 20 bolls, per cent green boll and locule damage, per cent open boll and open boll locule damage, respectively. Chlorantraniliprole + lambda cyhalothrin recorded highest seed cotton yield (kg ha^{-1}) of 3786 with an increase of 64.32 per cent over control and cost benefit ratio of 1.04 followed by cypermethrin 25 EC (3662, 58.94 & 0.99) when compared to untreated control (2304).

Key words: *Chlorantraniliprole + lambda cyhalothrin, Cotton and Pectinophora gossypiella.*

Cotton (*Gossypium hirsutum* L) is a fibre, feed and food crop. Cotton is one of the most important cash crops playing a key role in Indian economy and is unanimously designated as king of fibre crops. It is an important raw material for the Indian textile industry and plays a key role in national economy in terms of both employment generation and foreign exchange.

In India the crop occupied in 10.5 m ha with a production of 35.1 million bales and productivity of 568 kg ha^{-1} of lint. In Andhra Pradesh the crop covered in an area of 0.551 m ha with a production of 20 lakh bales and 688 kg ha^{-1} productivity during 2018-19 (AICCIP, Annual Report, 2018-19).

Cotton, being long duration crop of tropics with succulent leaves, soft and nutritious fruiting bodies is prone to pest attack at all the stages of crop growth. Main losses in cotton production are due to its susceptibility to about 162 species of insect pests and a number of diseases (Manjunath, 2004). Among insect pests, bollworms and sucking pests are major.

The pink bollworm is considered as one of the most destructive pests of cotton globally and is found in nearly all cotton growing regions of the world. The assessment of economic threshold level and yield loss is difficult for initiation of management practices for pink bollworm, since the larval presence or damage is not visible unless bolls are opened. The entire larval development of pink bollworm will be completed internally in the infested boll itself hence it is not vulnerable to the activity of natural enemies and also to insecticides due to its concealed nature.

The pink bollworm was alone responsible for 20-90 % yield loss in cotton before the introduction of *Bt* cotton. After the introduction of *Bt* cotton in 2002 in India, the incidence of pink bollworm has gradually declined and it was negligible during the last decade. Surveys conducted by central Institute of Cotton Research (CICR), Nagpur during 2012-14 in some cotton growing districts of Gujarat reported the survival of pink bollworm on BG II (Cry 1 Ac + Cry 2 Ab) cotton.

Generally, the incidence of pink bollworm was observed from middle of the crop season and seriously damaging the seed cotton in the late pickings. However, the incidence of *P. gosssypiella* was noticed on Bollgard II hybrids in various cotton growing districts of Andhra Pradesh since 2015-2016 (AICCIP 2015-16 and 2016-17) and then onwards farmers were spraying insecticides.

MATERIAL AND METHODS

The present investigation was carried out at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh, during *kharif,* 2018.The *Bt* cotton hybdrid Jaadoo BG II was sown at a spacing of 105 cm between rows and 60 cmwithin the row.

Eight insecticides *viz.,* T_1: emamectin benzoate 5 SG, T_2: flubendiamide 39.35 SC, T_3: chlorantraniliprole

Table 1. Pooled efficacy of various treatments against pink bollworm infesting cotton during *kharif*, 2018

Treatments	Larval population (no/20bolls)				Per cent green boll damage				Per cent green boll locule damage			
	3	7	10	%	3	7	10	%	3	7	10	%
	DAS*	DAS*	DAS*	ROC	DAS#	DAS#	DAS#	ROC	DAS #	DAS#	DAS#	ROC
T_1:Emamectin benzoate 5% SG	1.06	1.52	1.88	72.29	7.91	8.57	10.54	78.27	4.38	6.1	7.86	50.53
	(1.03)b	(1.23)c	(1.37)c		(16.33)cd	(17.02)b	(18.94)b		-12.08	(14.30)bc	(16.28)c	
T_2:Flubendiamide 39.35% SC	1.26	1.36	1.85	72.6	7.87	9.19	10.87	77.51	5.17	7.02	8.54	46.87
	(1.12)c	(1.17)c	(1.36)c		(16.29)c	(17.65)bc	(19.25)b		-13.14	(15.36)c	(16.99)c	
T_3:Chlorantraniliprole 18.5% SC	1.02	1.19	1.64	75.75	6.63	8.05	10.02	79.08	4.9	5.99	7.43	53.48
	(1.01)b	(1.09)bc	(1.28)bc		(14.92)bc	(16.48)b	(18.45)b		-12.79	(14.17)b	(15.82)bc	
T_4:Chlorantraniliprole + lambda cyhalothrin	0.48	0.79	0.9	86.05	4.61	5.35	6.98	85.18	2.78	4.03	4.67	69.48
	(0.69)a	(0.89)a	(0.95)a		(12.40)a	(13.37)a	(15.32)a		-9.6	(11.58)a	(12.48)a	
T_5:Deltamethrin 2.8% EC	1.03	1.41	1.91	72.08	9.57	10.23	13.04	72.16	8.48	10.45	12.35	24.95
	(1.01)b	(1.19)c	(1.38)c		(18.02)de	(18.65)cd	(21.17)c		-16.93	(18.86)c	(20.57)d	
T_6: NSKE 5%	1.06	1.47	2.04	70.35	11.09	12.63	15.69	67.51	9.07	11.43	13.25	19.56
	(1.03)b	(1.21)c	(1.43)c		(19.45)e	(20.82)d	(23.33)c		-17.53	(19.76)c	(21.35)d	
T_7:Profenophos 50%EC	1.16	1.52	2.03	70.5	11.81	9.21	16.36	65.9	8.4	11.46	12.88	21.71
	(1.08)c	(1.23)c	(1.42)c		(20.10)e	(17.67)b	(23.86)c		-16.85	(19.79)c	(21.03)d	
T_8: Cypermethrin 25% EC	0.69	0.96	1.15	82.81	5.21	7.05	9.06	80.88	3.53	5.02	5.93	61.56
	(0.83)ab	(0.98)ab	(1.07)ab		(13.19)ab	(15.40)ab	(17.52)ab		-10.83	(12.95)ab	(14.09)ab	
T_9: Untreated control	5.89	6.89	7.9	-	40.63	45.79	50.41	-	13.25	14.98	16.55	-
	(2.43)d	(2.62)d	(2.81)d		(39.60)f	(42.58)e	(45.23)d		-21.35	(22.77)d	(24.00)e	
CD (P=0.05)	0.22	0.16	0.24		2.04	2.95	3.02		1.89	1.64	2.18	
CV	11.15	13.68	10.85		14.01	15.47	12.99		12.57	11.53	12.35	

Values in parenthesis are arc sine transformation
DAS = Day after spraying
% ROC = Per cent reduction over control
NS = Non significant
The values in a column followed by the same letter are not significantly differed (LSD test; *P*=0.05)

18.5 SC, T_4: chlorantraniliprole + lambda cyhalothrin (Ampligo) 14.6 ZC, T_5: deltamethrin 2.8 EC, T_6: NSKE 5%, T_7: profenophos 50 EC, T_8: cypermethrin 25 EC and an untreated control (T_9) were included in the trial. The spraying of the insecticides was initiated coinciding with initiation of pink bollworm activity during last week of November and sprayings were repeated at 10 days interval and a total of three sprays were given during the study. The sucking pests were controlled by spraying of imidacloprid 17.8 SL @ 20 g a.i. ha^{-1} at 60 and 90 DAS. The control of *Helicoverpa* and *Spodoptera* management was taken up uniformly in all the treatments with insecticidal spray of spinosad 45 SC @ 75 g a.i. ha^{-1} at 60 & 90 days and was not effective against pink bollworm.

For recording of data on pink bollworm incidence, 20 bolls were collected randomly from each plot and observed in the laboratory through destructive sampling by cutting the bolls carefully with a knife. The pre-treatment count was taken before first spraying for taking decision to initiate imposition of treatments and subsequently post treatment count was recorded after three, seven and ten days of each spray application. The number of larvae per 20 bolls, per cent green boll damage and per cent green boll locule damage were recorded. Observations on per cent open boll damage, per cent open locule damage and number of good opened bolls were taken at harvest.

RESULTS AND DISCUSSION

The efficacy of various insecticides on incidence of pink bollworm infesting transgenic cotton was evaluated in terms of suppressed larval population, reduction of green boll damage and green boll locule damage during *kharif*, 2018. The pooled mean of three sprays was presented in Table 1.

Effect of treatments on larval population of pink bollworm

The pooled mean larval population (no./20 bolls) from the Table 1 inferred that all the treatments were significantly superior over control with a range of 72.08-86.05 per cent reduction over control. Among all the treatments, T_4 (Chlorantraniliprole + lambda cyhalothrin 14.6% ZC) and T_8 (Cypermethrin 25% EC) found most effective in suppressing the larval population (no./20bolls) with 0.48 & 0.69, 0.79 & 0.96 and 0.90 & 1.15 at 3, 7 and 10 DAS, respectively. The efficacy of various treatments with respect to per cent reduction of larval population over control represents T_4>T_8>T_3>T_2e"T_1>T_7>T_6>T_5 with 86.05, 82.81, 75.75, 72.60, 72.29, 70.50, 70.35 and 72.08 per cent, respectively.

These observations were in concurrence with reports of Bajya*et al.* (2015) who reported that chlorantraniliprole + lambda cyhalothrin was effective in checking the larval population of PBW which recorded 89.90 per cent reduction over control. Dhawan *et al.* (1991) reported lowest per cent green boll damage due to action of cypermethrin on bollworms.

Effect of treatments on green bolls and locules

The per cent green boll damage and green boll locule damage reduction also followed the similar trend as in case with larval population reduction of pink bollworm infesting transgenic cotton. The lowest green boll damage was recorded in T_4 (4.61, 5.35 & 6.98) and T_8 (5.21, 7.05 & 9.06) as against highest in untreated control (40.63, 45.79 & 50.41) at 3,7 and 10 DAS, respectively. Similarly, with respect to green boll locule damage also T_4 and T_8 had registered lowest per cent damage with 2.78 & 3.53 at 3 DAS, 4.03 & 5.02 at 7 DAS and 4.67 & 5.93 at 10 DAS, respectively.

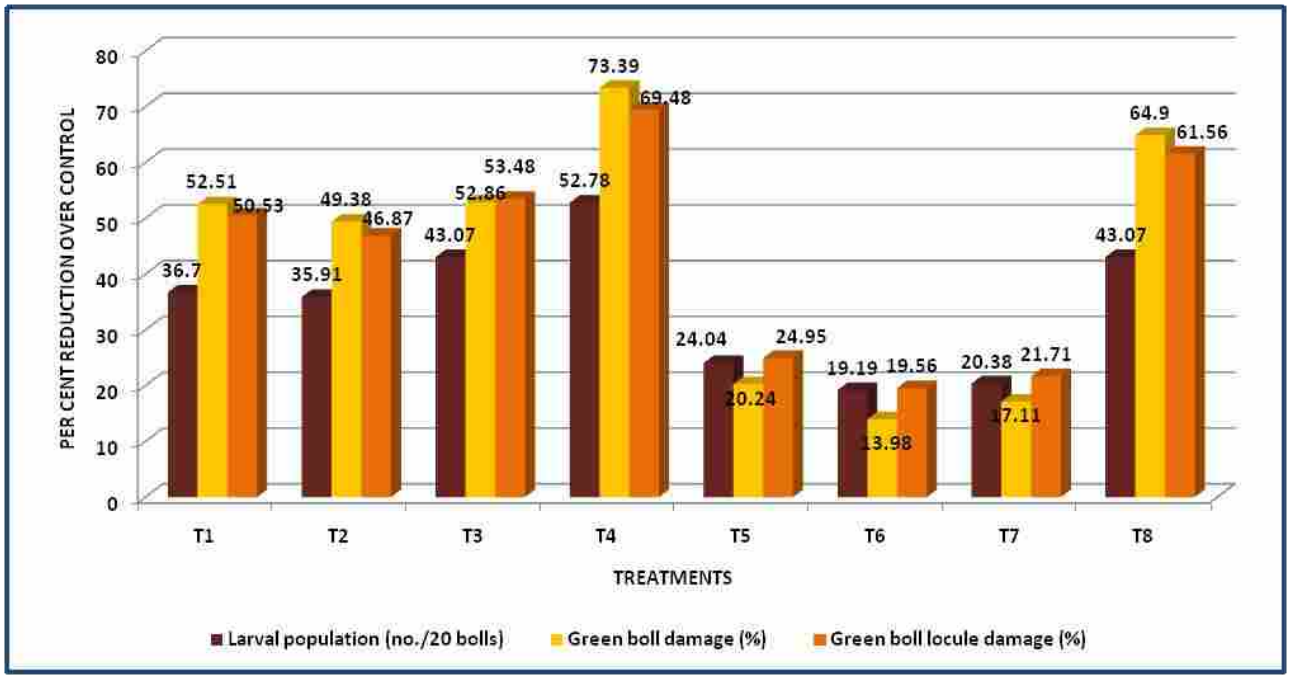
The per cent reduction of green boll damage and green boll locule damage also found to be comparatively minimum in T_4 (85.18 & 69.48) and T_8 (80.88 & 61.56). The next superior treatments in order of per cent reduction of green boll damage was T_3 (79.08) followed by T_1 (78.27), T_2 (77.51), T_5 (72.16), T_6 (67.51) and T_7 (65.90) but found at par to each other. Whereas, the per cent reduction of green boll locule damage by pink boll worm in transgenic cotton represent the order T_3 (53.48) > T_1 (50.53) > T_2 (46.87) > T_5 (24.97) > T_7 (21.71)> T_6 (19.56) (Fig. 4.8).

Chlorantraniliprole + lambda cyhalothrin recorded 89.00 per cent reduction over control which was effective in reducing the per cent green boll damage (Bajya*et al.,* 2015)

Effect of treatments on yield parameters

The influence of various treatments on yield parameters was recorded at time of harvest for which per cent open boll damage and open boll locule damage was recorded and presented in the Table 2. The open boll and locule damage was least in T_4 (13.33 & 8.93) followed by T_8 (16.67 & 12.34), T_3 (23.33 & 17.87), T_1 (33.33 & 21.94), T_2 (36.67 & 21.32), T_5 (40.00 & 20.00), T_7 (43.33 & 22.15), T_6 (50.00 & 29.34) and T_9 (65.00 & 43.37). The T_4 and T_8 had recorded highest per cent reduction of open boll and locule damage with 79.49 & 74.35 and 79.41 & 71.55 per cent, respectively followed by T_3 (64.11 & 58.80) >T_1 (48.72 & 49.41) >T_2 (43.58 & 50.84) >T_5 (38.46 & 46.11) >T_6 (23.08 & 32.35), respectively.

The present findings are in agreement with those of Bajya *et al.* (2015) who reported that there was significant reduction in per cent open boll and open boll locule damage due to PBW. The present findings were in agreement with the findings of Dhawan



$T_{1:}$Emamectin benzoate 5% SG ; $T_{2:}$Flubendiamide 39.35% SC; $T_{3:}$Chlorantraniliprole 18.5% SC;
$T_{4:}$Chlorantraniliprole + lambda cyhalothrin :Ampligo 14.6% ZC); $T_{5:}$Deltamethrin 2.8% EC; $T_{6:}$ NSKE 5%;
$T_{7:}$Profenophos 50%EC and $T_{8:}$ Cypermethrin 25% EC

Fig 1. Pooled efficacy of various treatments against pink bollworm infesting cotton during *kharif*, 2018

Table 2. Efficacy of various treatments on open boll and locule damage by pink bollworm in transgenic cotton during *kharif*, 2018

Treatments	At harvest			
	Open boll damage	%ROC	Open boll locule damage	%ROC
$T_{1:}$Emamectin benzoate 5% SG	33.33	48.72	21.94	49.41
	(35.26)d		(27.93)c	
$T_{2:}$Flubendiamide 39.35% SC	36.67	43.58	21.32	50.84
	(37.27)d		(27.50)c	
$T_{3:}$Chlorantraniliprole 18.5% SC	23.33	64.11	17.87	58.8
	(28.88)c		(25.01)bc	
$T_{4:}$Chlorantraniliprole + lambda cyhalothrin (Ampligo) 14.6% ZC	13.33 (21.41)a	79.49	8.93 (17.39)a	79.41
$T_{5:}$Deltamethrin 2.8% EC	40	38.46	20	46.11
	(39.23)e		(26.56)c	
$T_{6:}$ NSKE 5%	50	23.08	29.34	32.35
	(45.00)f		(32.80)d	
$T_{7:}$Profenophos 50%EC	43.33	33.34	22.15	48.93
	(41.17)e		(28.08)c	
$T_{8:}$ Cypermethrin 25% EC	16.67	74.35	12.34	71.55
	(24.10)b		(20.57)ab	
$T_{9:}$ Untreated control	65	-	43.37	-
	(53.73)g		(41.19)e	
CD (P=0.05)	3.73		5.87	
CV	11.96		12.38	

Table 3. Influence of various treatments on yield parameters of transgenic cotton during *kharif*, 2018

Treatments	At harvest	
	Good opened boll per plant	Yield ($Kg\ ha^{-1}$)
T_1:Emamectin benzoate 5% SG	35.20 (5.93)b	3248b
T_2:Flubendiamide 39.35% SC	35.13 (5.93)b	3216bc
T_3:Chlorantraniliprole 18.5% SC	38.93 (6.24)a	3473b
T_4:Chlorantraniliprole + lambda cyhalothrin (Ampligo) 14.6% ZC	42.33 (6.51)a	3786a
T_5:Deltamethrin 2.8% EC	34.60 (5.88)c	3100c
T_6: NSKE 5%	29.70 (5.45)c	3052c
T_7:Profenophos 50%EC	33.73 (5.81)c	2819d
T_8: Cypermethrin 25% EC	40.93 (6.40)ab	3662a
T_9: Untreated control	22.40 (4.73)d	2304e
CD (P=0.05)	1.21	320.7
CV	5.21	5.96

Values in parenthesis are square root transformations
The values in a column followed by the same letter are not significantly differed (LSD test; p =0.05)

Table 4. Influence of treatments on yield of cotton *kharif* 2018

Treatments	Yield ($Kg\ ha^{-1}$)	Per cent increase	Total cost of	Gross returns	Net returns	C:B ratio
T_1:Emamectin benzoate 5% SG	3248	40.97	68500	178640	110140	1.61
T_2:Flubendiamide 39.35% SC	3216	39.58	73600	176880	103280	1.4
T_3:Chlorantraniliprole 18.5% SC	3473	50.73	73000	191015	118015	1.62
T_4:Chlorantraniliprole + lambda cyhalothrin (Ampligo) 14.6% ZC	3786	64.32	77500	208230	130730	1.69
T_5:Deltamethrin 2.8% EC	3100	34.54	66500	170500	104000	1.56
T_6: NSKE 5%	3052	32.46	68500	167860	99360	1.45
T_7:Profenophos 50%EC	2819	22.35	67600	155045	87445	1.29
T_8: Cypermethrin 25% EC	3662	58.94	76000	201410	125410	1.65
T_9: Untreated control	2304	-	64500	126835	62335	0.97

et al. (1991) who recorded lowest per cent open boll damage in cypermethrin treatment.

The good opened bolls in transgenic cotton as influenced by reduced per cent damage by pink bollworm due to various treatments was presented in Table 3. The order of good opened bolls per plants as influenced by various treatments represents T_4 (42.33) > T_8 (40.93) >T_3 (38.93) >T_1 (35.20) >T_2 (35.13) >T_5 (34.60) >T_7 (33.73) >T_9 (22.40). It was clearly evident from the Table 4.12 that the yield was also significantly superior in T_4 (3786) and found on par with T_8 (3662). The next better treatments with respect to yield (kg ha^{-1}) was T_3 (3473) followed by T_1 (3248), T_2 (3216), T_5 (3100), T_6 (3052), T_7 (2819) and T_9 (2304). It was clearly evident from the Table 4 that the C:B ratio was superior in T_4 (1.69) followed by T_8 (1.65). The next better treatments with respect to C:B ratio were T_3 (1.62) followed by T_1 (1.61), T_5 (1.56), T_6 (1.45), T_2 (1.40), T_7 (1.29) and T_9 (0.97).

The above discussed results were in confirmation with the findings of Lingappa*et al.* (2001) who reported cypermethrin recorded highest number of good opened bolls per plant.

Maximum seed cotton yield was obtained from cotton, applied with chlorantraniliprole + lambda cyhalothrin which was significant to other treatments (Murali*et al.,* 2012). Lingappa*et al.* (2001) reported that cypermethrin was found effective in control of bollworms and recorded highest seed cotton yield.

CONCLUSION

Highest per cent reduction of larval population of PBW over control was recorded in chlorantraniliprole + lambda cyhalothrin (86.05) followed by cypermethrin which had recorded 82.81 per cent.The highest per cent reduction of green boll and green boll locule damage over control was recorded in chlorantraniliprole + lambda cyhalothrin (85.18 &69.48) and cypermethrin (80.88 & 61.56).The highest percent reduction of open boll and open locule damage was recorded in chlorantraniliprole + lambda cyhalothrin (79.49 & 74.35) followed by cypermethrin (79.41 & 71.55). The highest number of GOB/plant and the corresponding seed cotton yield (kg ha^{-1}) was maximum in chlorantraniliprole + lambda cyhalothrin (42.33 & 3786) and cypermethrin (40.93 & 3473) treated plots with C: B ratio of 1.69 and 1.65, respectively.

LITERATURE CITED

AICCIP- Annual Report, 2015-16. *http://aiccip; Cicr.org.in*

AICCIP- Annual Report, 2016-17. *http://aiccip; Cicr.org.in*

AICCIP- Annual Report, 2018-19. *http://aiccip; Cicr.org.in*

Bajya D R, Baheti H S and Raza S K 2015 Field efficacy of newer insecticide formulation Ampligo 150 ZC against bollworm complex in cotton. *Journal of Cotton Research and Development.* 29(1): 94-98.

Dhawan A K, Simwat G S and Sidhu A S 1991 Judicious use of synthetic pyrethroids for management of bollworm complex on Asiatic cotton (*Gossypium arboreum)* in Punjab. *Indian Journal of Agricultural Sciences.* 61(1): 62-64.

Lingappa S, Udikeri SS and Hegde RN 2001 Field evaluation of deltamethrin formulations (decis tab and 1.8 EC) against cotton insect pests. *Pestology.*25(2): 12-14.

Manjunath T M 2004 *Bt* cotton in India: The technology wins as the controversy wanes. *http://www.Monsanto.co.uk/news/ukshowlib.html?wid=8478*

Murali RKB, Rajavel DS, Suresh K, Jayaraj J and Palanisamy N 2012 Efficacy of Ampligo 150 ZC (Chlorantraniliprole 9.6 % + Lambda cyhalothrin 4.6 %) against bollworm complex in cotton. *Pestology*. 36(6): 55-58.

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