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MB Jadhav
Cotton Research Unit,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

PW Nemade
Cotton Research Unit,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

SB Kumre
Cotton Research Unit,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

JS Ingole
Cotton Research Unit,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Correspondence
PW Nemade
Cotton Research Unit,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Estimation of spray frequency for management of bollworm complex damage in Bt cotton

MB Jadhav, PW Nemade, SB Kumre and JS Ingole

Abstract
The present investigation was carried out at the research farm of Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* 2017-18. The field experiment was laid out in Randomized Block Design with seven treatments and three replications. The results revealed that among the different treatments minimum green fruiting bodies damaged was recorded in treatment T1 i.e. 11.99 per cent where total 7 sprays were given starting from 55 DAE whereas, maximum 37.82 per cent was recorded in untreated control. Also the study revealed that overall minimum bollworm damaged was recorded in treatment T1 i.e. 12.33 per cent whereas, maximum 67.98 per cent was recorded in untreated control at the time of harvest. But on the basis of ICBR, treatment T3 (5 Sprays of Chlorantraniliprole 9.3% + Lamda Cyhalothrin 4.6% ZC @ 0.5 ml/L starting at 55 DAE with an interval of 15 days) was most cost effective treatment with highest ICBR (1:3.43) with net monetary return of Rs 46,996/ha. Maximum seed cotton yield (21.09 q/ha) was also recorded in treatment T1 whereas minimum 2.65 q/ha was recorded in untreated control.

Keywords: Bollworm complex, Bt cotton, green fruiting bodies, chlorantraniliprole, lamda cyhalothrin

Introduction
Cotton the "white gold" is one of the most important fiber crop of India. It plays prominent role in the National and International economy. It is grown mainly for its fiber, used in the manufacture of cloth for mankind (Paslawar and Deotalu, 2015) [12]. Cotton, the most important commercial crop of India ranks first in acreage in the world. In India cotton is cultivated on 105.00 lakh ha. with average productivity of 68 kg lint per ha. In Maharashtra cotton crop is grown on 38.06 lakh ha with production of 83.25 lakh bales and productivity of 398.00 kg/ha. Approximately 62 per cent of India's Cotton is produced on rain-fed areas and 38 per cent on irrigated land. In terms of productivity, India ranks poorly compared to USA & China during 2016-17, (Anonymous, 2017) [1]. Major constraint in attaining high production of seed cotton is the damage inflicted by insect pests. Insect pest problems in agriculture have shown a considerable shift during first decade of twenty-first century due to ecosystem and technological changes. The global losses due to insect pests were 10.8 per cent towards the beginning of this century, whereas in India, the crop losses are around 17.5 per cent at present. In terms of monetary value, the Indian agriculture currently suffers an annual loss of about Rs 8, 63,884 million due to insect pests (Dhaliwal *et al*. 2010) [5]. Production depends mainly on the timely arrival of monsoon, distribution of rainfall and management interventions. However, pink bollworm in central Maharashtra may cause yield losses albeit to a minor extent. The intensity of pink bollworm was more in the irrigated tracts of central Maharashtra. Last year, pink bollworm damage was high in Jalgaon and severe in Dhule and Nadurbar. Yield losses in these districts could have been close to 20-25 per cent due to the boll damage in the second-third pickings of cotton, which was estimated at 40,000 bales worth US$ 12 million in the three districts. The state may contribute 8.0 m bales this year from an area of 3.6 to 3.8 m hectares.

Materials and Methods
Field experiment was laid out in Randomized Block Design (RBD) with seven treatments replicated thrice. The treatment included spray of ready mix formulation Chlorantraniliprole 9.3% + Lamda Cyhalothrin 4.6% ZC @ 0.5 ml/L with T_1 - 1st spray at 55 DAE & subsequent spray was given at 15 days interval up to 145 DAE, T_2 - 1st spray at 70 DAE & subsequent spray was given at 15 days interval up to 145 DAE, T_3 - 1st spray at 85 DAE & subsequent

spray was be given at 15 days interval up to 145 DAE, T_4 - 1st spray at 100 DAE & subsequent spray was given at 15 days interval up to 145 DAE, T_5 - 1st spray at 115 DAE & subsequent spray was given at 15 days interval up to 145 DAE, T_6 - 1st spray at 130 DAE & subsequent spray was given at 15 days interval up to 145 DAE and T_7 Control. The plot size was 6.3 m X 6.0 m and spacing was 90 x 60 cm. Sowing of seeds was done on 04th July 2017 by dibbling 2 seeds per hill at the depth of about 3-4 cm at a distance of 60 cm which was then covered with soil carefully Before sowing, Bt cotton seeds treated with imidacloprid 70 WS @ 10gm/kg seeds.

Periodical observations were taken to record the incidence of bollworms at weekly interval w.e.f. from square formation. For recording the observations, five plants were selected randomly from each net plot. For recording the observations, total green fruiting bodies i. e. squares, flowers and those damaged by bollworms were counted from randomly selected five plants in each net plot and per cent bollworm complex damage was worked out. Boll damage, loculi damage of bollworm complex and individual boll damage was recorded at 10 days interval w.e.f. from 90 DAE. For recording the observations on incidence of bollworm complex, 20 matured green bolls from randomly selected plants were plucked from each plot at 90,100,110,120,130,140,150,160 and 170 days after emergence. These green bolls were observed for *H. armigera* and *E. vittella* damage and then dissected for pink bollworm damage. At the time of dissecting bolls the numbers of bolls damaged by bollworm complex were counted. The data thus, obtained was expressed in terms of per cent green boll damage. Observation on open boll damage and loculi damage were also undertaken. The data thus generated were statistically analyzed by using Randomized Block Design.

Results

The data presented in Table 1 indicated that the per cent mean green fruiting bodies damage due to bollworm complex from 45 DAE to 164 DAE were ranges from 11.99-37.82 per cent in which minimum mean green fruiting bodies damage was recorded in treatment T_1 (11.99%) whereas, maximum mean (37.82%) mean total fruiting bodies damage was observed in control treatment (T_7). The next best treatment was T_2 (20.25%) which was at par with T_3 (23.33%) followed by T_4 (26.74%), T_5 (31.58%) and T_6 (34.19%).

Table 1: Effects of different treatments on per cent green fruiting bodies damage due to bollworm complex.

	Treatment	45 DAE	52 DAE	59 DAE	66 DAE	73 DAE	80 DAE	87 DAE	94 DAE	101 DAE
T1	1st spray at 55 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	0.00 (0.00)*	0.00 (0.00)*	0.16 (0.23)*	0.46 (0.68)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	7.13 (15.20)*	4.91 (2.20)**
T2	1st spray at 70 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	0.00 (0.00)	0.84 (0.91)	0.52 (0.72)	0.80 (0.88)	0.29 (0.44)	0.43 (0.66)	2.02 (1.42)	16.28 (23.72)	10.28 (3.18)
T3	1st spray at 85 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	1.08 (1.04)	0.55 (0.61)	0.50 (0.71)	0.30 (0.45)	0.45 (0.67)	0.43 (0.65)	2.33 (1.52)	22.23 (28.08)	11.58 (3.39)
T4	1st spray at 100 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	0.72 (0.69)	0.86 (0.93)	0.52 (0.72)	0.63 (0.78)	0.44 (0.67)	0.29 (0.44)	2.93 (1.67)	24.16 (29.40)	16.27 (4.03)
T5	1st spray at 115 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	1.08 (1.04)	0.84 (0.91)	0.51 (0.72)	0.77 (0.87)	0.46 (0.67)	0.46 (0.68)	3.47 (1.85)	25.95 (30.58)	18.21 (4.26)
T6	1st spray at 130 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	0.00 (0.00)	0.86 (0.93)	0.00 (0.00)	0.92 (0.96)	0.45 (0.67)	0.45 (0.67)	3.26 (1.78)	27.05 (31.29)	22.35 (4.72)
T7	Control	1.09 (1.04)	0.85 (0.92)	0.51 (0.71)	0.74 (0.85)	0.46 (0.68)	0.46 (0.68)	4.11 (2.02)	30.63 (33.59)	20.29 (4.48)
F test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±		0.13	0.12	0.09	0.10	0.08	0.08	0.15	0.22	1.60
CD at5%		0.40	0.36	0.27	0.30	0.26	0.26	0.48	0.69	4.93
CV %		41.04	26.89	28.19	21.90	26.74	26.69	18.23	10.35	10.11

	Treatment	108 DAE	115 DAE	122 DAE	129 DAE	136 DAE	143 DAE	150 DAE	157 DAE	164 DAE	C. Mean
T1	1st spray at 55 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	11.65 (19.87)**	18.62 (25.48)**	20.63 (26.93)**	23.48 (28.86)**	23.39 (28.86)**	26.69 (31.01)**	26.93 (31.16)**	24.56 (29.56)**	27.37 (31.44)**	11.99 (20.27)**
T2	1st spray at 70 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	20.83 (27.04)	26.65 (30.97)	32.38 (34.61)	38.81 (38.51)	40.95 (39.74)	41.85 (40.29)	47.18 (43.37)	41.71 (40.19)	42.71 (40.78)	20.25 (26.74)
T3	1st spray at 85 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	34.37 (35.81)	40.62 (39.54)	42.60 (40.71)	43.40 (41.18)	42.48 (40.65)	43.59 (41.30)	42.72 (40.81)	46.45 (42.94)	44.41 (41.77)	23.33 (28.89)
T4	1st spray at 100 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	36.23 (36.98)	39.99 (39.20)	43.94 (41.49)	49.75 (44.85)	47.30 (43.44)	51.57 (45.90)	53.14 (46.81)	56.38 (48.68)	56.28 (48.62)	26.74 (31.14)
T5	1st spray at 115 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	38.03 (38.02)	48.17 (43.95)	48.88 (44.36)	53.78 (47.19)	55.88 (48.42)	63.17 (52.72)	69.30 (56.51)	69.54 (56.62)	70.08 (56.99)	31.58 (34.2)
T6	1st spray at 130 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	39.06 (38.62)	49.30 (44.59)	54.87 (47.80)	64.70 (53.61)	67.78 (55.48)	70.04 (56.92)	72.07 (58.27)	68.87 (56.19)	73.57 (59.18)	34.19 (35.79)
T7	Control	42.50 (40.67)	54.78 (47.77)	61.54 (51.72)	71.71 (58.05)	73.00 (58.87)	72.29 (58.42)	76.80 (61.44)	82.66 (65.67)	86.40 (68.98)	37.82 (37.95)
F test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±		2.03	2.28	2.46	2.64	2.63	2.72	2.79	2.87	2.97	1.44

CD at5%	6.26	7.02	7.57	8.12	8.11	8.38	8.61	8.85	9.15	4.44
CV %	10.39	10.17	10.35	10.23	10.11	10.10	10.01	10.25	10.35	16.78

(Note: Fig. In parentheses, * Square root transformation**,** ** arc sintransformation, DAE-Day after emergence, C mean-cumulative mean**)**

The data presented in Table 2 indicated that the treatment T_1 was found consistently significant over rest of the treatments from 90 DAE to 170 DAE. The per cent mean green boll damage due to bollworm complex from 90 DAE to 170 DAE were ranges from 10.19-59.26. Among the treatments, maximum 64.26 per cent mean green boll damage was observed in control treatment (T_7). The per cent mean green boll damage in T_1 (10.19%) was significantly at par with T_2 (21.67%), followed by T_3 (33.41%), T_4 (45.74%), T_5 (54.81%) and T_6 (59.26%).

Table 2: Effects of different treatments on per cent green boll damage due to bollworm

	Treatment	90 DAE	100 DAE	110 DAE	120 DAE	130 DAE	140 DAE	150 DAE	160 DAE	170 DAE	C. Mean
T1	1st spray at 55 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	6.67 (2.54)*	6.67 (5.16)*	8.33 (16.60)**	10.00 (18.43)**	13.33 (21.14)**	13.33 (20.76)**	10.00 (18.05)**	10.0 (18.05)**	13.33 (20.45)**	10.19 (18.61)**
T2	1st spray at 70 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	20.00 (4.47)	20.00 (4.47)	15.00 (22.02)	20.00 (26.57)	21.67 (27.52)	21.67 (27.52)	20.00 (26.45)	26.7 (30.95)	30.00 (33)	21.67 (27.74)
T3	1st spray at 85 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	20.00 (4.45)	28.33 (5.32)	25.00 (29.93)	30.00 (33.08)	32.33 (34.64)	36.67 (37.20)	41.67 (40.17)	41.7 (40.18)	45.00 (42.12)	33.41 (35.31)
T4	1st spray at 100 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	20.00 (4.45)	23.33 (4.82)	30.00 (33.00)	40.00 (39.21)	41.67 (40.18)	56.67 (48.87)	61.67 (51.81)	66.7 (54.83)	71.67 (57.98)	45.74 (42.56)
T5	1st spray at 115 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	20.00 (4.45)	28.33 (4.82)	31.67 (34.23)	41.67 (40.20)	46.67 (43.09)	78.33 (62.48)	83.33 (65.95)	80.0 (63.93)	83.33 (65.95)	54.81 (47.76)
T6	1st spray at 130 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	21.67 (4.65)	28.33 (5.31)	36.67 (37.22)	41.67 (40.11)	56.67 (48.87)	86.67 (68.66)	88.33 (70.50)	83.3 (66.26)	90.00 (75)	59.26 (50.34)
T7	Control	21.67 (4.65)	26.67 (5.32)	36.67 (37.20)	48.33 (44.04)	58.33 (49.83)	93.33 (78.10)	98.33 (85.69)	96.7 (83.86)	98.33 (85.69)	64.26 (53.28)
F test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±		0.27	0.45	2.46	1.80	2.36	3.78	2.81	3.78	4.64	2.48
CD at5%		0.84	1.37	7.59	5.54	7.27	11.64	8.65	11.64	14.30	7.65
CV %		11.12	16.60	14.20	9.02	10.79	13.33	9.49	12.79	14.80	12.46

The data presented in Table 3 indicated that the treatment T_1 proved its efficacy over rest of the treatments by recording minimum loculi damage starts from 90 DAE to 170 DAE. The per cent mean data on loculi damage due to bollworm complex from 90 DAE to 170 DAE were ranges from 6.42-26.71 among the treatments. However, maximum 28.07 per cent mean loculi damage was recorded in control treatment (T_7). The per cent mean loculi damage in T_1 (6.42%) was significantly at par with T_2 (11.41%), T_3 (15.05%), T_4 (19.43%), T_5 (22.6%) and T_6 (26.71%).

Table 3: Effect of different treatments on per cent loculi damage due to bollworm complex

	Treatment	90 DAE	100 DAE	110 DAE	120 DAE	130 DAE	140 DAE	150 DAE	160 DAE	170 DAE	C. Mean
T1	1st spray at 55 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	2.45 (1.53)*	2.85 (1.37)*	4.92 (2.21)*	8.44 (2.90)*	8.41 (2.89)*	6.68 (2.52)**	7.15 (14.92)**	8.34 (16.45)**	8.49 (16.24)**	6.42 (2.53)*
T2	1st spray at 70 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	5.35 (2.24)	7.76 (2.76)	9.65 (3.08)	11.66 (3.40)	10.06 (3.16)	10.89 (3.29)	15.55 (23.21)	13.64 (21.56)	17.94 (24.83)	11.41 (3.38)
T3	1st spray at 85 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	5.28 (2.27)	8.98 (2.99)	9.21 (3.01)	13.59 (3.65)	13.31 (3.64)	14.73 (3.83)	21.98 (27.95)	24.52 (29.56)	23.84 (29.12)	15.05 (3.88)
T4	1st spray at 100 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	6.85 (2.65)	10.78 (3.28)	9.32 (3.05)	15.62 (3.93)	15.42 (3.91)	20.42 (4.52)	28.25 (32.09)	32.47 (34.72)	35.74 (36.68)	19.43 (4.41)
T5	1st spray at 115 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	6.05 (2.45)	10.74 (3.27)	8.42 (2.90)	15.91 (3.97)	17.92 (4.21)	28.35 (5.32)	33.50 (35.34)	41.25 (39.94)	41.27 (39.96)	22.6 (4.75)
T6	1st spray at 130 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	6.85 (2.62)	10.14 (3.17)	9.80 (3.13)	17.53 (4.18)	18.57 (4.30)	33.55 (5.77)	44.92 (42.06)	49.87 (44.93)	49.13 (44.50)	26.71 (5.17)
T7	Control	6.43 (2.52)	10.53 (3.24)	8.91 (2.96)	17.41 (4.16)	20.94 (4.56)	34.19 (5.83)	47.22 (43.40)	51.84 (46.04)	55.14 (47.96)	28.07 (5.30)
F test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±		0.219	0.311	0.179	0.260	0.221	0.285	2.17	2.265	2.39	0.92
CD at 5%		0.675	0.958	0.550	0.801	0.682	0.877	6.70	6.978	7.38	2.84
CV %		16.33	18.77	10.65	12.03	10.06	11.11	12.03	11.774	12.13	12.77

The ICBR of different treatments are presented in Table 4. It indicated that the treatment T_3 - was most cost effective in the order to merit with highest ICBR (1:3.43) with net monetary return of Rs 46,996/ha followed by T_2 - with ICBR (1:3.25) with net monetary return of Rs 53,501/ha and T_1- with ICBR (1:3.15) and highest net monetary return of Rs 60,481/ha. The next effective treatment was T_4 - with ICBR (1:2.09) and T_5 - with ICBR of (1:1.83). However, among the insecticides treatment T6 - recorded the lowest ICBR (1:0.23) with lowest net monetary return of Rs.1742 and found least cost effective

treatment. And also The data presented in Table 4 indicated that the seed cotton yield in different treatments was ranged from 4.22-21.09 q/ha. The highest yield of seed cotton yield in cotton T_1 (21.09 q/ha). In untreated control plot, the lowest seed cotton yield (2.65 q/ha) was recorded.

Table 4: Incremental cost benefit ratio, yield of seed cotton and per cent avoidable loss of the different treatments

Sr. No.	Treatments	Cost of the treatments			Total cost (Rs/ha) (A)	Yield (qtl/ha)	Increased yield over control (qtl/ha)	Increased yield over control (Rs/ha) (B)	Net monetory return (Rs/ha) (B-A)	ICBR
		Cost of insecticides (Rs/ha)	Labour charges (Rs/ha)	Equipment charges (Rs.)						
1	1st spray at 55 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	15750	3080	350	19180	21.09	18.44	79661	60481	1:3.15
2	1st spray at 70 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	13500	2640	300	16440	18.84	16.19	69941	53501	1:3.25
3	1st spray at 85 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	11250	2200	250	13700	16.70	14.05	60696	46996	1:3.43
4	1st spray at 100 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	9000	1760	200	10960	10.49	7.84	33869	22909	1:2.09
5	1st spray at 115 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	6750	1320	150	8220	8.04	5.39	23285	15065	1:1.83
6	1st spray at 130 DAE & subsequent spray will be given at 15 days interval up to 145 DAE	4500	880	100	5480	4.22	1.57	6782	1302	1:0.23
7	Control	-	-	-	-	2.65	-	-	-	-

Sale price of cotton - @ Rs, 4320/q.
Labour charges for one day/ha - @ Rs, 220/labour
Charges for hiring sprayer- @ Rs, 50/day, Ampligo 150 ZC (combination of chlorantranilipole 9.3% + lambdacyhalothrin 4.6% ZC)–Rs.9000/lit

Discussions

The present study was supported by, Dhawan *et al*. (2009) [6] who reported that chlorantraniliprole @ 30 g a.i. per ha was the most effective treatment for the control of bollworm complex on cotton. Similarly Prasad and Rao (2010) [13] who reported that chlorantraniliprole @ 40 g a.i. per ha recorded lowest square damage inflicted by bollworm complex. Choudhary *et al*. (2016) [4] showed that chlorantraniliprole was the best treatment in the control of bollworm complex. Kumar and Sarada (2015) [1] recorded lowest *H. armigera* larvae per 10 plants in t0e plots treated with Chlotraniliprole 20% SC, as against untreated control plot with 93.9 per cent reduction of *H. armigera* population, respectively

The present findings are more or less parallel to Jindal *et al*. (2007) [8] who observed that chlorantranilipole 20 SC was effective treatment recording lowest boll damage (29.37%). Also, Dhawan *et al*. (2009) [6] who observed that chlorantranilipole 30 g a.i./ha had significantly lowest infestation of bollworm complex with minimum damage to boll. Bajya *et al*. (2015) [2] reported that Ampligo 150 ZC (combination of chlorantranilipole 9.3%+ lambda cyhalothrin 4.6% ZC) in cotton gave significant reduction of per cent damage in bolls attacked by bollworm complex in cotton during Kharif 2011 and 2012.

The present findings are more or less parallel to Dhawan *et al*. (2009) [6] who observed that chlorantranilipole 30 g a.i./ha had significantly lowest infestation of bollworm complex with minimum damage to locule. Also, Bajya *et al*. (2015) [2] observed that Ampligo 150 ZC (combination of chlorantranilipole 9.3% + lambda cyhalothrin 4.6% ZC) was highly effective in significant reduction of per cent damage on squares, bolls and loculi attacked by bollworm complex in cotton during *Kharif* 2011 and 2012.

The present study supported by Dhawan *et al*. (2009) [6] who reported that seed cotton yield was significantly higher in chlorantraniliprole. Bajya *et al*. (2015) [2] who reported that Ampligo 150 ZC (combination of chlorantranilipole 9.3% + lambda cyhalothrin 4.6% ZC) in cotton gave significant reduction of per cent damage on squares, bolls and loculi as well as high yield during Kharif 2011 and 2013. The findings are superior in reducing larval population of bollworms, per cent bollworm damage and recorded higher seed cotton yield than untreated control.

The present investigation, the treatment T_3 - found most cost effective in the order to merit with highest ICBR (1:3.43) followed by T_2 - with ICBR (1:3.25) and T_1 - with ICBR (1:3.15) where as the highest net monetary return of Rs 60,481/ha obtained from treatment T_1. The findings of the study are more in support of the statement made by Kranthi *et al*. (2015) [9] wherein he stated that damage was more for second and subsequent pickings which considered more with T_2 and T_3 in present study. Where ICBR is more and also per cent avoidable losses is comparable with T_1. Also the study was in line with Mitali *et al*. (2008) [11] reported that lambda-cyhalothrin @15 g a.i. ha−1 showed maximum cost-benefit ratio of 1:4.73. The results recorded by Govindan *et al*. (2010) [7], Sreekanth *et al*. (2014) [15], Kumar and Sarada (2015) [11],

Basavanneppa and Balikai (2016) [3] and Shukla *et al*. (2016) [14] against bollworms complex supported the present findings.

Conclusions

The minimum green fruiting bodies damage was recorded in treatment T1 i.e. 11.99 per cent whereas; maximum 37.82 per cent was recorded in untreated control. From the present study it was observed that overall minimum bollworm damaged was recorded in treatment T1 i.e. 12.33 per cent whereas, maximum 67.98 per cent was recorded in untreated control at the time of harvest. But on the basis of ICBR, treatment T3 (5 Sprays of Chlorantraniliprole 9.3% + Lamda Cyhalothrin 4.6% ZC @ 0.5 ml/L starting at 55 DAE with an interval of 15 days) was most cost effective treatment with highest ICBR (1:3.43) with net monetary return of Rs 46,996/ha. Maximum seed cotton yield (21.09 q/ha) was recorded in treatment T1 whereas minimum 2.65 q/ha was recorded in untreated control.

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