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Field efficacy of various insecticides against pink bollworm *Pectinophora gossypiella* (Saunders) in cotton

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ABSTRACT: Field evaluation of insecticides against pink bollworm, *Pectinophora gossypiella* (Saund.) (Lepidoptera: Gelechiidae) in cotton revealed that spinosad (45% SC) @ 250 ml/ha was most effective against pink bollworm infestation followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha by recording lowest rosette flower incidence, larval population/20 bolls and locule damage at harvest. Highest yield was also realized in spinosad (45% SC) @ 250 ml/ha followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha.

Key words: Cotton, insecticide, pink bollworm, yield

India occupies largest area and third place in the production of cotton in the global scenario. Major constraint in attaining high production of seed cotton is damage inflicted by insect pests. About 96 insect pests attack cotton crop and the pink bollworm, *Pectinophora gossypiella* (Saunders) is the most important cotton pest in the world. Green and Lyon (1989) and Amin and Gergis (2006) reported high loss (20-40%) in cotton seed yield is due to pink bollworm. It is distributed in all most all cotton growing states of the country and has caused millions of the rupees of damage. It is oligophagous pest, feeds on cotton, okra, and allied plants. This insect was a serious concern for cotton in India about 30 years ago. There were very few reports of any major damage by pink bollworm to cotton since 1982 in the country. During 2014, severe damage to bolls by pink bollworm and yield-losses were observed in *Bt*-cotton in many regions of Gujarat and some parts of Andhra Pradesh, Telangana and Maharashtra. More concerning is the fact that the worm is damaging Bollgard-II *Bt* cotton which contains two genes (cry1Ac+cry2Ab) that were supposed to be highly effective in controlling the pest (Kranthi, 2015). Newer chemistries of pesticides have raised the hopes for better management of dreaded pest world wide. The present work could be useful to farmers for the better management of cotton bollworms especially pink bollworm infesting cotton green bolls in the fields.

MATERIALS AND METHODS

The field experiments were conducted to evaluate the insecticides against the pink bollworm in *Bt* cotton during summer (February to July) and winter (August-January) season 2018-2019 at Cotton Research Station, Srivilliputtur. The experiment was laid out using cotton variety (SVPR 5) in a Randomized Block Design with ten treatments and three replications. Recommended agronomic practices were carried out. The treatments imposed were

indoxacarb (14.5% SC) @ 500 ml/ha, chlorantraniliprole (18.5% SC) @ 150 ml/ha, profenophos (50% EC) @ 2500ml/ha, emamectin benzoate (5% SG) @ 220 g/ha, spinosad (45% SC) @ 220 ml/ha, chlorpyriphos (20 % EC) @ 1250 ml/ha, triazophos (40% EC @ 2500 ml/ha, Bacillus thuringiensis @ 2g/lit, azadirachtin (0.03%) @ 500 ml/ha and untreated check. Two sprayings were given *i.e.*, on 45 and 80 day after sowing. Observations were made from ten randomly selected plants in each plot. The pre-treatment count was made a day before each spray. Post treatment counts were made after one week for rosette flower. The incidence of rosette flower damage was observed in 50 flowers from randomly selected plant and the percentage was worked out. The population of pink bollworm larvae/20 green bolls and number of locule damage at harvest was observed on 90, 100 and 120 DAS from pre and post treatments. The plot yield was also recorded and expressed as quintals per ha. The data obtained from field experiments were analyzed in a randomized block design by 'F' test for significance as described by Panse and Sukhatme (1958). Critical difference values were calculated at 5% probability level and the treatment mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

During summer 2018, the pre-treatment observations showed that the percentage of rosette flower ranged from 9.30 to 12.33 per cent on 45 days after sowing. In post treatment count, the lowest percentage of rosette flower incidence (1.11%) was recorded in plots treated with spinosad (45% SC) @ 250 ml/ha. It was followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha, chlorpyriphos (20% EC) 1250 ml/ha and triazophos (40% EC) @ 2500 ml/ha with 1.33, 2.65 and 2.67 percent rosette flower incidence, respectively. All the treated plots were significantly superior in their performance over untreated plots (11.11 %) (Table 1). During winter 2018-19, the pre-treatment observations showed that the percentage of rosette flower ranged from 11 to 13.33 per cent on 45 days after sowing. In post treatment count, the lowest percentage of rosette flower incidence (1.57%) was observed in plots treated with spinosad (45% SC) @ 250 ml/ha. It was followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha, emamectin benzoate (5% SG) @220 g/ha and indoxacarb 14.5% SC @ 500 ml/ha with 1.93, 2.00 and 2.33 percent rosette flower incidence, respectively. All the treated plots were significantly superior in their performance over untreated plots (13.25 %) (Table 2). Parmer and Patel (2016) reported that the insecticides namely, profenophos (50% EC), cypermethrin (25% EC), alpha cypermethrin 10% EC, spinosad (45% SC), emamectin benzoate 5% SG, deltamethrin (1%)+ triazophos (35% EC), chlorpyriphos (16%) + alpha cypermethrin 1% EC, fenpropethrin (30%) EC, chlorpyriphos (50%) + cypermethrin (5% EC) were found very effective for control of pink bollworm.

During summer 2018, the pre-treatment observation showed that the population of pink bollworm larvae ranged from 3.41 to 12.36 larvae/20 bolls. Low mean population of pink bollworm was recorded in treatment of spinosad (45% SC) @ 250 ml/ha (1.33 larvae/20 bolls) and it was followed by profenophos (50% EC) @ 2500 ml/ha (1.55 larvae/20 bolls), chlorantraniliprole

(18.5% SC) @ 150 ml/ha (1.78 larvae/20 bolls) and triazophos (40% EC) @ 2500 ml/ha (1.67 larvae/20 bolls) as against (8.82 larvae /20 bolls) in control (Table 1). During winter 2018-19, the mean population of pink bollworm larvae was low in spinosad (45% SC) @ 250 ml/ha (1.67 larvae/ 20 bolls), followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha (1.89 larvae/20 bolls), emamectin benzoate (5% SG) @ 220g/ha (2.11 larvae/20 bolls) and triazophos (40% EC) @ 2500 ml/ha (2.55 larvae/20 bolls) when compared to untreated check (10.52 larvae /20 bolls) (Table 2). In both summer and winter season, locule damage was lowest in plots treated with spinosad (45% SC) @ 250 ml/ha (1.25 and 1.75 per cent, respectively), followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha, emamectin benzoate (5% SG) @ 220 g/ha, triazophos 40 EC @ 2500 ml/ha (Table 1 and 2). Rani *et al.* (2010) reported that deltamethrin 1% EC + triazophos (35% EC) at the rate of 360 g a.i/ha was the best followed by triazophos (40% EC) (400 g a.i/ha), deltamethrin (10% EC) (25 g a.i/ha), thiodicarb (75% SG) (562 g a.i/ha) and lamda cyhalothrin 5 EC (25 g a.i/ha) for the control of pink bollworm. Thiamethoxam (25%) WDG (40 g/ ha) was the most effective insecticide followed by chlorantraniliprole (20%) SC and spinetoram (12% SC) for the control of pink bollworm (Sabry *et al.*, 2014).

In both summer and winter season, the highest seed cotton yield (1678 and 1742 kg/ha) was recorded in spinosad (45 % SC) @ 250 ml/ ha, followed by chlorantraniliprole (18.5% SC) @ 150 ml/ha (1523 and 1621 kg/ha, respectively) when compared to untreated check (843 and 925 kg/ha, respectively) (Table 1 and 2). These results agree with those obtained by Gopalswamy *et al.* (2000) who indicated that Beta-cyfluthrin (24.11%), spinosad (25.33%) and indoxacarb (26.43%) were promising for control of pink bollworm. According to Patil *et al.* (2009), both thiodicarb (70 SP) (750 g a.i/ha) as well as profenophos (50 EC) (500 g a.i/ha) effectively controlled pink bollworm by registering significantly lower per cent locule damage of 8.88 and 9. 50, respectively.

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Table 1. Efficacy of insecticide against pink bollworm during Summer 2018 (February to July)

No.	Treatments	Rosette damage / 50 flower (%)			Pink bollworm larvae/20 bolls DAS			**Mean**	Locule damge at harvest (%)	Yield (kg/ha)
		Pre treatment (45 DAS)	After one week	Pre Treatment (80 DAS)	90	100	120			
T1	Indoxacarb (14.5% SC) @ 500ml/ha	10.23bc(3.20)	4.00^{ad}(2.00)	7.50^{f}(2.74)	4.00^{e}(2.00)	2.33^{f}(1.53)	3.00^{f}(1.73)	**3.11**	3.58^{f}(1.89)	1448^{e}(38.05
T2	Chlorantraniliprole (18.5% SC) @ 150 ml/ha	11.67^{d}(3.42)	1.33^{a}(1.15)	3.41^{a}(1.85)	1.33^{a}(1.15)	1.33^{c}(1.15)	2.67^{e}(1.63)	**1.78**	2.00^{b}(1.41)	1523^{b}(39.03)
T3	Profenophos (50% EC) @ 2500 ml/ha	10.65^{c}(3.26)	3.33^{c}(1.82)	4.52^{c}(2.13)	2.33^{b}(1.53)	1.00^{b}(1.00)	1.33^{a}(1.15)	**1.55**	3.83^{g}(1.96)	1312^{d}(36.22)
T4	Emamectin benzoate (5% SG) @ 220 g/ha	9.87^{b}(3.14)	4.67^{e}(2.16)	6.11^{d}(2.47)	2.67^{e}(1.63)	1.67^{d}(1.29)	2.33^{d}(1.53)	**2.22**	3.58^{f}(1.89)	1248^{e}(35.22)
T5	Spinosad (45% SC) @ 220 ml/ha	11.65^{d}(3.41)	1.11^{a}(1.05)	3.65^{b}(1.91)	2.33^{b}(1.53)	0.33^{a}(0.59)	1.33^{a}(1.15)	**1.33**	1.25^{a}(1.12)	16.78^{a}(40.96)
T6	Chlorpyriphos (20%) EC @ 1250 ml/ha	9.30^{a}(3.05)	2.65^{b}(1.63)	7.36^{f}(2.71)	3.67^{d}(1.92)	2.00^{e}(1.41)	3.00^{f}(1.73)	**2.89**	2.67^{c}(1.63)	1125^{f}(33.54)
T7	Triazophos (40% EC) @ 2500 ml/ha	11.67^{d}(3.42)	2.67^{b}(1.63)	6.59^{e}(2.57)	2.33^{b}(1.53)	1.00^{b}(1.00)	1.67^{b}(1.29)	**1.67**	2.67^{c}(1.63)	1423^{c}(37.75)
T8	*Bacillus thuringiensis* @ 2g/lit	12.33^{c}(3.51)	3.33^{c}(1.82)	5.95^{d}(2.44)	3.67^{d}(1.92)	2.00^{e}(1.41)	2.00^{c}(1.41)	**2.56**	2.83^{d}(1.68)	1400^{c}(37.42)
T9	Azadirachtin (0.03%) @ 500 ml/ha	12.00^{de}(3.46)	5.67^{f}(2.38)	7.31^{f}(2.70)	4.00^{e}(2.00)	1.67^{d}(1.29)	3.00^{f}(1.73)	**2.89**	3.33^{e}(1.82)	1232^{e}(35.10)
T10	Untreated control	10.67^{e}(3.27)	11.11^{g}(3.33)	12.36^{g}(3.52)	7.00^{f}(2.65)	9.23^{g}(3.04)	10.23^{g}(3.20)	**8.82**	8.17^{h}(2.86)	843^{g}(29.03)
	SE.D	0.215	0.131	0.027	0.042	0.031	0.052		0.049	0.424
	CD (P=0.05)	0.450	0.277	0.057	0.090	0.066	0.110		0.104	0.892

DAS : Days after sowing

Table 2. Efficacy of insecticide against pink bollworm during Winter 2018-2019 (August – January)

No.	Treatments	Rosette damage / 50 flower (%)			Pink bollworm larvae/20 bolls DAS			**Mean**	Locule damge at harvest (%)	Yield (kg/ha)
		Pre treatment (45 DAS)	After one week	Pre Treatment (80 DAS)	90	100	120			
T1	Indoxacarb (14.5%) SC @ 500ml/ha	12.67^{d}(3.56)	2.33^{c}(1.53)	8.50^{e}(2.92)	5.00^{e}(2.24)	3.33^{g}(1.82)	4.00^{g}(2.00)	**4.11**	3.67^{f}(1.92)	1523^{c}(39.03)
T2	Chlorantraniliprole (18.5 % SC) @ 150 ml/ha	13.33^{e}(3.65)	1.93^{b}(1.39)	6.52^{c}(2.55)	2.33^{a}(1.53)	1.00^{a}(1.00)	2.33^{d}(1.53)	**1.89**	2.58^{b}(1.61)	1621^{b}(40.26)
T3	Profenophos (50% EC) @ 2500 ml/ha	11.00^{a}(3.32)	2.67^{d}(1.63)	7.45^{d}(2.73)	3.67^{c}(1.92)	2.67^{f}(1.63)	2.33^{d}(1.53)	**2.89**	3.42^{g}(1.85)	1432^{d}(37.84)
T4	Emamectin benzoate (5% SG) @ 220 g/ha	13.33^{e}(3.65)	2.00^{b}(1.41)	7.33^{d}(2.71)	3.33^{b}(1.82)	1.33^{b}(1.15)	1.67^{b}(1.29)	**2.11**	3.00^{f}(1.73)	1322^{e}(36.36)
T5	Spinosad (45% SC) @ 220 ml/ha	12.00^{bc}(3.46)	1.57^{a}(1.25)	4.30^{a}(2.07)	2.33^{a}(1.53)	1.67^{c}(1.29)	1.00^{a}(1.00)	**1.67**	1.75^{a}(1.32)	1742^{a}(41.74)
T6	Chlorpyriphos (20% EC) @ 1250 ml/ha	11.00^{a}(3.32)	2.67^{d}(1.63)	5.25^{b}(2.29)	2.33^{a}(1.53)	2.67^{f}(1.63)	3.67^{f}(1.92)	**2.89**	3.83^{c}(1.96)	1235^{f}(35.14)
T7	Triazophos (40% EC) @ 2500 ml/ha	12.67^{bd}(3.56)	3.21^{e}(1.79)	6.44^{c}(2.54)	3.33^{b}(1.82)	2.33^{e}(1.53)	2.00^{c}(1.41)	**2.55**	3.42^{c}(1.85)	1565^{c}(39.56)
T8	*Bacillus thuringiensis* @ 2g/lit	12.00^{bc}(3.46)	3.67^{f}(1.92)	8.35^{e}(2.89)	2.33^{b}(1.53)	3.67^{h}(1.92)	3.00^{e}(1.73)	**3.00**	4.00^{d}(2.00)	1534^{c}(39.17)
T9	Azadirachtin (0.03%) @ 500 ml/ha	11.67^{b}(3.42)	3.67^{f}(1.92)	10.55^{f}(3.25)	4.67^{d}(2.16)	2.00^{d} (1.41)	3.67^{f}(1.92)	**3.45**	4.17^{e}(2.04)	1370^{e}(37.01)
T10	Untreated control	12.33^{cd}(3.51)	13.25^{g}(3.64)	10.25^{f}(3.20)	10.32^{f}(3.21)	10.55^{i} (3.52)	10.68^{h}(3.27)	**10.52**	9.83^{h}(3.14)	925^{g}(30.41)
	SE.d	0.199	0.074	0.201	0.110	0.097	0.102		0.107	0.406
	CD (P=0.05)	0.418	0.157	0.423	0.232	0.204	0.214		0.225	0.853

DAS : Days after sowing

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