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BIO-EFFICACY OF DIFFERENT NOVEL INSECTICIDES AGAINST COTTON SUCKING PESTS IN COTTON

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ABSTRACT
The bio-Efficacy of certain novel insecticides against cotton sucking pests was studied during *kharif* 2011-12 at Regional Agricultural Research Station, Lam, Guntur. Test hybrid was RCH-2. Among different insecticides tested, imidacloprid 70% WG @ 21g a.i. ha^{-1} was effective against aphids with a reduction of population upto 69.4% over control at 10 DAT. Fipronil 5% SC @ 50 g a.i. ha^{-1} and fipronil 80% WG @ 50 g a.i. ha^{-1} were effective in managing leafhopper with a population reduction of 70.9% and 67.6% respectively. Fipronil 5% SC @ 50g a.i. ha^{-1} was also found effective in suppressing thrips population to the extent of 76.7% at 10 DAT. Maximum reduction in whitefly population upto 76.3% was recorded in acephate 75% SP @ 750 g a.i.ha^{-1} treated plot. Seed cotton yield ranged from 13.5 to 7.2 q/ha, highest yield was recorded in fipronil 5% SC @ 50 g a.i. ha^{-1} (13.5 q/ha) followed by fipronil 80% WG @ 50 g a.i. ha^{-1} (13.4 q/ha). Lowest yield was recorded in untreated control (7.2 q/ha). Recent results suggests a number of insecticides for a successful management strategy of sucking pest complex in cotton.

INTRODUCTION

Cotton is an important fiber crop of global significance cultivated in more than seventy countries. India thus enjoys the distinction of being the earliest country in the world to domesticate and to utilize its fibre to manufacture fabric (Mayee *et al.*, 2004). In India cotton ecosystem harbours about 162 insect pest species and the monetary value of estimated yield losses due to insect pests has been estimated to be Rs 3,39,660 million annually (Dhaliwal *et al.*, 2010). Among the sap feeders, aphids-*Aphis gossypii* (Glover), Leafhoppers-*Amrasca biguttulabiguttula* (Ishida), thrips -*Thripstabaci* (Linn) and whitefly - *Bemisiatabaci*are deadly pests. The estimated loss due to sucking pests complex was up to 21.20 per cent (Dhawan *et al.*, 1988).

Several potent insecticides have been recommended for managing sucking pests, but the use of insecticides have resulted in the development of resistance, resurgence, secondary pest out breaks, disruption of natural enemy complex and environmental pollution (Dhaliwal and Arora, 2001). Now-a-days, numbers of new molecules are introduced in the market and those are not only effective but also cost effective and less toxic to the existing natural enemies of the pests. Therefore, the present investigation was conducted to evaluate the efficacy of different insecticides against sucking insect pests infesting *Bt.* cotton.

MATERIALS AND METHODS

The experiment was laid out in Randomized Block Design with ten treatments including control and replicated thrice with plot size of 6.3 m × 5.4 m. Standard agronomic practices were adopted to raise a good crop of cotton. *Bt.* cotton hybrid RCH-2BG-II was selected for this experiment. Treatment particulars are presented in Table 1.

Seed treatment

For delinted seed, 5 ml of gum per kg seed was evenly distributed through thorough shaking in a polythene bag into which 5 g of imidacloprid 70 WS was added for uniform coating over the seed. The treated seeds were shade dried for about 10 minutes and used for sowing.

Application of treatments

Insecticidal solutions with desired concentrations were prepared (Table 1) and sprayed using a hand compression knapsack high volume sprayer, during morning hours. A total of three sprays were given during the course of season at ten days interval. The first spraying was given at 60 DAS when the incidence of sucking pest population was sufficiently built up in the experimental plots.

Recording observations

Theincidence of sucking pests *viz.*, aphids, leafhoppers, whiteflies and thrips were recorded by counting the number

of nymphs and adults per three leaves, per plant on five randomly selected plants per plot at 3, 7and 10 days after treatment. The seed cotton yield from each plot was recorded twice separately in kg/plot and converted into q/ha.

RESULTS AND DISCUSSION

Leaf hopper

When the per cent reduction of population was considered at 10 DAT (Table 3, Figure 1), the highest reduction was observed in fipronil 5% SC @ 50 g a.i. ha^{-1} (70.9%) was the most effective treatment followed by fipronil 80% WG @ 50 g a.i. ha-1 (67.6%), diafenthiuron 50% WP @ 375 g a.i. ha^{-1} (65.9%) and buprofezin 25% SC @150 g a.i. ha^{-1}(59.4%) which were on par with each other. The next best treatments were acephate 75% SP @ 750 g a.i. ha^{-1} (53.0%), imidacloprid 70% WG @ 21 g a.i. ha^{-1} (50.0%), spiromesfin 240 SC @ 40 g a.i. ha^{-1} (46.0%), spirotetramat 150 OD @ 90 g a.i. ha^{-1} (42.6%) which were on par with each other. The least effective treatment is thiacloprid 21.7% SC @ 24 g a.i. ha^{-1} (37.2%) which was significantly different from all other treatments.

The treatment fipronil 5% SC @ 50 g a.i. ha^{-1} has recorded the lowest population of leafhoppers with highest percent reduction in leafhopper population during first, second and third spray at 10 DAT was 61.9 %, 72.4% and 78.2% respectively (Table 2). It is at par with fipronil 80% WG, diafenthiuron 50% WP and buprofezin 25% SC. It may be due to fipronil is a contact, stomach and systemic which acts as potent blocker of the GABA regulated chloride channel (Walunj *et al.*, 2000). Singh *et al.*, (2002) and Singh *et al.*, (2007) reported that fipronil @ 50 g a.i. ha^{-1}at fortnightly interval was found to be the best treatment against the leafhopper. Fipronil was most effective and leafhopper reduction of 72.32% was recorded on cotton in fipronil 5% SC @ 50 g a.i. ha^{-1} treated plot at 14 days after spray (Neelima, 2010). Fipronil 5% SC @ 40g a.i.ha^{-1} is the best treatment in controlling the leafhopper i.e 3.5/three leaves (Prasadarao *et al.*, 2011). Fipronil 5% SC recorded least number of leafhoppers 1.58 per three leaves (Zanwar *et al.*, 2012). Kalyan *etal.*, (2012) also found similar results at 3rd and 7th days after sprays.

Aphids

The per cent reduction of aphid population at 10 DAT (Table 3, Figure 2) indicated that imidacloprid 70% WG @21 g a.i. ha^{-1} (69.4%) was the most effective treatment followed by diafenthiuron 50% WP @ 375 g a.i. ha^{-1}(66.2%), fipronil 5% SC @ 50 g a.i.ha^{-1} (62.1%), fipronil 80% WG @ 50 g a.i. ha^{-1} (60.1%), acephate 75% SP @ 750 g a.i. ha^{-1} (56.4%), thiacloprid 21.7% SC @ 24 g a.i. ha^{-1} (52.7%), spirotetramat 150 OD @ 90 g a.i. ha^{-1} (50.6%), spiromesfin 240 SC @ 40 g a.i. ha^{-1} (49.0%) and buprofezin 25% SC @150 g a.i. ha^{-1} (44.7%).

It is clearly evident from the results, the treatment imidacloprid 70% WG @ 21 g a.i. ha^{-1} has recorded the lowest population of aphids with highest percentage reduction during first, second and third spray 57.0 %, 70.7% and 80.0% respectively (Table-2) . Imidacloprid is a chloronicotinyal insecticide exhibiting both systemic and contact activity primarily against sucking insects. It has a novel mode of action, binding to nicotinergic acetylcholine receptor. The observations in confirmity with findings of Ameta and Sharma (2005),who reported that imidacloprid 70% WG at 35 g a.i. ha^{-1} caused the highest reduction in the population of aphids in cotton at 1, 3, 5 and 7 days after first and second spray. Cent per cent mortality of aphids was observed up to 7 and 9 DAT when imidacloprid 17.8% SL was applied at 25 g a.i. ha^{-1} Suganthy *et al.* (2009). Imidacloprid (Confidor 350 SC) @ 26.25 ga.i. $ha^{-1}$was found superior in reducing the population of aphids 18.60 to 5.81/three leaves at three days after first application (Udikeri *et al.*, 2010). Naveen *et al.* (2010) reported that two sprays of imidacloprid 70 WG (Admire) @ 40 g/ha rendered very good protection of crop against the early season sucking pests. Bharpoda *et al.*, (2014) revealed that imidacloprid 17.8 SL @ 0.008% and difenthiuron 50 WP @ 0.05% were found most effective chemicals than the rest of the insecticidal treatments.

Thrips

Per cent reduction of thrips population at 10 DAT (Table 3, Figure 3), indicated highest reduction in fipronil 5% SC @ 50 g a.i.ha^{-1} (76.7%) followed by fipronil 80% WG @ 50 g a.i. ha^{-1} (74.5%) and acephate 75% SP @ 750 g a.i. ha^{-1} (71.6%). The next best treatments were imidacloprid 70% WG @ 21 g a.i. ha^{-1} (69.0%), spirotetramat 150 OD @ 90 g a.i. ha^{-1} (67.0%), spiromesfin 240 SC @ 40 g a.i. ha^{-1}(64.7%) and thiacloprid 21.7% SC @ 24 g a.i. ha^{-1} (60.8%).The treatments, diafenthiuron 50% WP @ 375 g a.i. ha^{-1} and buprofezin 25% SC @150 g a.i. ha^{-1} recorded a reduction of 57.5% and 54.3% respectivly.

Per cent reduction in observed during first, second and third spray at 10 DAT was 64.1%, 76.7% and 88.6% respectively (Table 2). These findings conformity with that Mau *et al.* (1998) reported that fipronil @ 0.01% was highly effective against *T. tabaci* infesting onion. Kadam and Dethe (2002) findings revealed that fipronil 5 SC at the rate of 40 to 60 g a.i. ha^{-1} when applied as a schedule of four sprays at an interval of 15 days by initiating the first spray 4 weeks after transplanting, was effective in lowering the thrips count to 3.32-9.63 as against a count of 13.44-23.43 in untreated control in chilli. Rupal and Dethe (2002) reported that four sprays of fipronil 5 SC @ 40-60 g a.i. ha^{-1} gave 91.2 % mortality of *S. dorsalis* in chilli. Jadhav *et al.* (2004) indicated that fipronil 5 SC @ 100 g a.i. ha^{-1} resulted in 2.2 leafhoppers per leaf and 1.2 thrips per leaf at seven days after application in chilli. Ghosh *et al.* (2009) reported that fipronil 5 SC @ 75 g a.i. ha^{-1} gave 88.8 % mortality of *S. dorsalis* in chilli. Patil *et al.* (2009) recorded that fipronil 5% SC @ 800g/ ha registered least number of thrips (8.47 / 3 leaves) and significantly highest seed cotton yield of 27.23 q/ ha (2007) and 27.50 q/ha (2008) was harvested. Information of fipronil agents cotton thrips is limited,however these findings corroborate with findings on thrips of other crops like onion and chilli. (Rohini, 2010) reported that fipronil 5 SC at 0.01% effective against thrips population. Fipronil 5% SC recorded least number of thrips 3.51 per three leaves in cotton (Zanwar *et al.*, 2012).

Whitefly

Per cent reduction of Whiteflies population at 10 DAT (Table 3) indicated the highest reduction of 76.2% observed in

Table 1: Particulars of insecticides used

S. No.	Chemical name	Chemical class	a.i. ha^{-1}
T_1	Diafenthiuron 50% WP	Thiourea	375
T_2	Fipronil 5%SC	Phenylpyrazole	50
T_3	Spirotetramat150 OD	Ketoenols	90
T_4	Imidacloprid 70% WG	Neonicotinoids	21
T_5	Fipronil 80% WG	Phenylpyrazole	50
T_6	Buprofezin 25% SC	Insect growth regulator	150
T_7	Spiromesifen 240 SC	Spirocyclictetronic acids	40
T_8	Thiacloprid 21.7% SC	Neonicotinoids	24
T_9	Acephate 75% SP	Organophosphate	750

Table 2: Percent reduction of cotton sucking pests 10 days after treatment (DAT) over the control during first, second and third sprays

Treatments	First spray				Second spray				Third spray			
	Leafhopper	Aphids	Thrips	Whiteflies	Leafhopper	Aphids	Thrips	Whiteflies	Leafhopper	Aphids	Thrips	Whiteflies
T_1 Diafenthurion50%WP	54.6 (47.75)^{ab}	55.3 (48.09)^{ab}	47.5 (43.61)^{a}	22.4 (28.25)^{de}	69.4 (56.40)^{a}	65.9 (54.34)^{ab}	56.0 (47.4)^{bc}	46.8 (43.14)^{c}	72.9 (58.83)^{abc}	77.0 (61.51)^{ab}	69.0 (56.19)^{ef}	68.5 (55.93)^{d}
T_2 Fipronil 5% SC	61.9 (51.96)^{a}	53.3 (47.01)^{ab}	64.1 (53.28)^{a}	43.7 (41.40)^{bc}	72.4 (58.44)^{a}	60.8 (51.39)^{abc}	76.7 (61.3)^{a}	64.9 (53.80)^{ab}	78.2 (62.19)^{a}	73.2 (58.98)^{abc}	88.6 (70.31)^{a}	82.7 (65.57)^{ab}
T_3 Spirotetramat 150OD	27.7 (31.41)^{de}	42.8 (40.83)^{ab}	54.2 (47.42)^{a}	12.5 (20.74)^{e}	46.5 (43.00)^{bc}	48.7 (44.27)^{bc}	67.9 (55.5)^{ab}	34.2 (34.68)^{d}	51.3 (45.70)^{de}	59.8 (50.79)^{def}	78.5 (62.43)^{bcd}	64.7 (53.56)^{d}
T_4 Imidacloprid 70% WG	38.7 (38.47)^{bcde}	57.0 (49.12)^{a}	55.4 (48.25)^{a}	29.2 (32.75)^{cd}	51.6 (45.94)^{bc}	70.7 (57.34)^{a}	69.0 (56.2)^{ab}	52.7 (46.57)^{bc}	58.8 (50.46)^{bcde}	80.0 (63.56)^{a}	81.1 (64.24)^{abcd}	71.4 (57.71)^{cd}
T_5 Fipronil 80% WG	56.2 (48.67)^{ab}	50.7 (45.40)^{ab}	60.6 (51.27)^{a}	37.2 (37.59)^{bc}	71.1 (57.08)^{a}	58.8 (50.13)^{abc}	75.5 (60.4)^{a}	61.9 (51.98)^{ab}	75.4 (60.44)^{ab}	70.6 (57.24)^{abcd}	86.3 (68.27)^{ab}	78.6 (62.55)^{bc}
T_6 Buprofezin25%SC	49.3 (44.64)^{abc}	37.6 (37.78)^{b}	43.2 (41.09)^{b}	52.5 (46.44)^{ab}	59.9 (50.79)^{ab}	43.7 (41.23)^{c}	54.28 (47.48)^{c}	72.7 (58.53)^{a}	68.1 (55.68)^{abcd}	51.5 (45.89)^{f}	63.8 (53.01)^{f}	86.8 (68.93)^{ab}
T_7 Spiromesfin 240SC	32.5 (34.24)^{cde}	41.6 (40.15)^{ab}	52.7 (46.54)^{a}	48.5 (44.14)^{ab}	48.7 (44.29)^{bc}	48.2 (43.98)^{bc}	62.3 (52.4)^{abc}	68.1 (55.67)^{a}	55.8 (48.34)^{cde}	57.5 (49.40)^{ef}	75.4 (60.03)^{cde}	85.4 (67.77)^{ab}
T_8 Thiacloprid 21.7% SC	24.1 (29.33)^{e}	44.3 (41.74)^{ab}	50.3 (45.19)^{a}	17.6 (24.84)^{de}	40.8 (39.69)^{c}	50.8 (45.46)^{bc}	56.0 (48.6)^{bc}	43.7 (41.39)^{cd}	47.2 (43.40)^{e}	63.3 (52.74)^{cdef}	73.5 (59.02)^{def}	66.4 (54.78)^{d}
T_9 Acephate 75% SP	42.6 (40.75)^{bcd}	47.2 (43.35)^{ab}	58.9 (50.17)^{a}	63.6 (52.90)a	55.1 (47.99)^{b}	53.9 (47.30)^{abc}	73.5 (59.3)^{a}	74.2 (59.53)^{a}	60.6 (51.34)^{bcde}	67.6 (55.34)^{bcde}	83.1 (65.76)^{abc}	90.4 (72.10)^{a}
T_{10}Control(untreated)												
F-TEST	Sig	Sig	sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SEm	3.50	3.10	3.58	1.60	1.44	3.33	3.13	1.54	1.89	1.30	1.13	1.18
CD (P=0.05)	10.42	9.22	10.6	8.23	7.41	9.90	9.30	7.95	9.74	6.72	5.84	6.11

*Figures in parentheses are square root transformed values, **Figures in parentheses are angular transformed values, Numbers followed by same superscript are not statistically different. Sig - Significant, NS - Non significant, DAT - Days after treatment

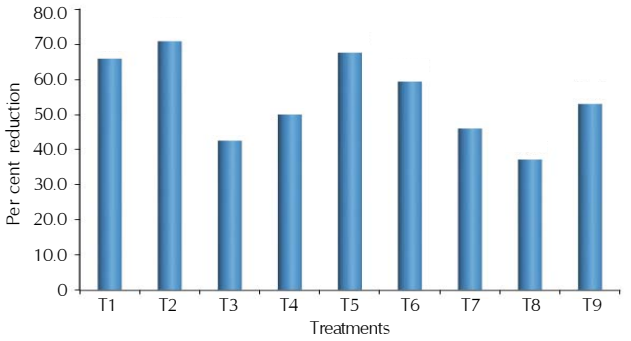
Table 3: Mean percent reduction of cotton sucking pests 10 DAT over the control

Treatments	Leafhopper	Aphid	Thrips	Whiteflies
T_1 Diafenthurion50%WP	65.9(54.43)^{a}	66.2(54.67)^{ab}	57.5(49.41)^{ef}	46.3(42.70)^{de}
T_2 Fipronil 5% SC	70.9(57.50)^{a}	62.1(52.17)^{bc}	76.7(61.70)^{a}	64.0(53.62)^{abc}
T_3 Spirotetramat 150 OD	42.6(40.63)^{de}	50.6(45.39)^{def}	67.0(55.20)^{cd}	37.6(37.06)^{e}
T_4 Imidacloprid 70% WG	50.0(45.01)^{cd}	69.4(56.69)^{a}	69.0(56.50)^{bc}	51.4(45.85)^{ed}
T_5 Fipronil 80% WG	67.6(55.48)^{a}	60.1(50.93)^{c}	74.5(60.15)^{ab}	59.4(50.77)^{bc}
T_6 Buprofezin 25%SC	59.4(50.51)^{b}	44.7(41.95)^{f}	54.3(47.48)^{f}	70.6(57.82)^{ab}
T_7 Spiromesfin 240% SC	46.0(42.68)^{de}	49.0(44.44)^{ef}	64.7(53.79)^{cde}	67.5(55.87)^{ab}
T_8 Thiacloprid 21.7% SC	37.2(37.43)^{g}	52.7(46.57)^{de}	60.8(51.39)^{de}	42.8(40.41)^{de}
T_9 Acephate 75% SP	53.0(46.78)^{c}	56.4(48.74)^{cd}	71.6(58.16)^{abc}	76.3(61.60)^{a}
T_{10} Control(untreated)				
F-TEST	Sig	Sig	Sig	Sig
SEm	0.72	0.69	0.85	0.74
CD(P=0.05)	3.70	3.56	4.41	3.83

*Figures in parentheses are square root transformed values, **Figures in parentheses are angular transformed values, Numbers followed by same superscript are not statistically different, Sig - Significant, NS - Non significant, DAT - Days after treatment

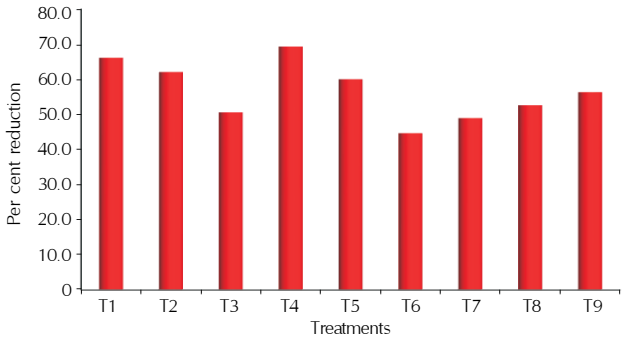
acephate 75% SP @ 750 g a.i. ha^{-1} followed by buprofezin 25% SC @150 g a.i. ha^{-1}(70.6%) and spiromesfin 240 SC @ 40 g a.i. ha^{-1} (67.5%). The next best treatments were fipronil 5% SC @ 50 g a.i. ha^{-1}(64.0%), fipronil 80% WG @ 50 g a.i. ha^{-1} (59.4), imidacloprid 70% WG @ 21 g a.i. ha^{-1} (51.4%) and diafenthiuron 50% WP @ 375 g a.i. ha^{-1} (46.3%). Treatment with Thiacloprid 21.7% SC @ 24 g a.i. ha^{-1} and spirotetramat150 OD @ 90 g a.i. ha^{-1}has recorded less than 40% reduction.

Acephate 75% SP @750 g a.i. ha^{-1} was the effective treatment. Reduction in whiteflies population during first, second and third spray at 10 DAT recorded 63.6%, 74.2% and 90.4% respectively (Table 2). This is may be due to acephate is a systemic insecticide used to control sucking and biting insects



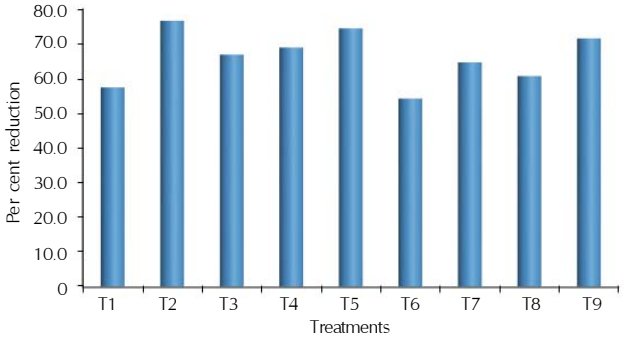
T1- Diafenthiuron 50% WP-375 g a.i. ha^{-1}, T2 - Fipronil 5% SC- 50 g a.i. ha^{-1}, T3 - Spirotetramat 150% OD- 90 g a.i. ha^{-1}, T4 - Imidacloprid 70% WG-21 g a.i. ha^{-1}, T5 - Fipronil 80% WG-50 g a.i. ha^{-1}, T6 - Buprofezin 25% SC-150 g a.i. ha^{-1}, T7 - Spiromesfin 240% SC- 40 g a.i. ha^{-1}, T8 - Thiacloprid 21.7% SC- 24 a.i. ha^{-1}, T9 - Acephate 75% SP-750 g a.i. ha^{-1}

Figure 1: Mean per cent reduction of leafhoppers over control at 10 days after treatment



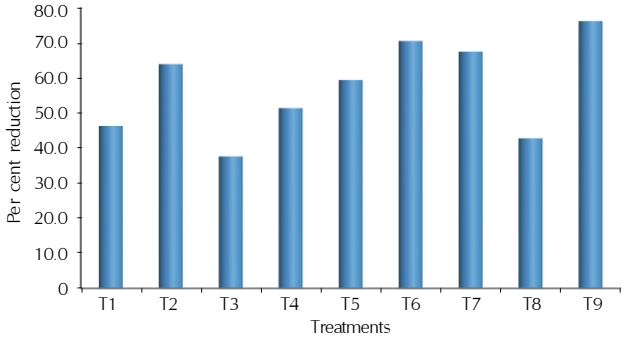
T1- Diafenthiuron 50% WP-375 g a.i. ha^{-1}, T2 - Fipronil 5% SC- 50 g a.i. ha^{-1}, T3 - Spirotetramat 150% OD- 90 g a.i. ha^{-1}, T4 - Imidacloprid 70% WG-21 g a.i. ha^{-1}, T5 - Fipronil 80% WG-50 g a.i. ha^{-1}, T6 - Buprofezin 25% SC-150 g a.i. ha^{-1}, T7 - Spiromesfin 240% SC- 40 g a.i. ha^{-1}, T8 - Thiacloprid 21.7% SC- 24 a.i. ha^{-1}, T9 - Acephate 75% SP-750 g a.i. ha^{-1}

Figure 2: Mean per cent reduction of aphids over control at 10 days after treatment



T1- Diafenthiuron 50% WP-375 g a.i. ha^{-1}, T2 - Fipronil 5% SC- 50 g a.i. ha^{-1}, T3 - Spirotetramat 150% OD- 90 g a.i. ha^{-1}, T4 - Imidacloprid 70% WG-21 g a.i. ha^{-1}, T5 - Fipronil 80% WG-50 g a.i. ha^{-1}, T6 - Buprofezin 25% SC-150 g a.i. ha^{-1}, T7 - Spiromesfin 240% SC- 40 g a.i. ha^{-1}, T8 - Thiacloprid 21.7% SC- 24 a.i. ha^{-1}, T9 - Acephate 75% SP-750 g a.i. ha^{-1}

Figure 3: Mean per cent reduction of thrips over control at 10 days after treatment



T1- Diafenthiuron 50% WP-375 g a.i. ha^{-1}, T2 - Fipronil 5% SC- 50 g a.i. ha^{-1}, T3 - Spirotetramat 150% OD- 90 g a.i. ha^{-1}, T4 - Imidacloprid 70% WG-21 g a.i. ha^{-1}, T5 - Fipronil 80% WG-50 g a.i. ha^{-1}, T6 - Buprofezin 25% SC-150 g a.i. ha^{-1}, T7 - Spiromesfin 240% SC- 40 g a.i. ha^{-1}, T8 - Thiacloprid 21.7% SC- 24 a.i. ha^{-1}, T9 - Acephate 75% SP-750 g a.i. ha^{-1}

Figure 4: Per cent reduction of whiteflies over control at 10 days after treatment

Table 4: Seed cotton yield

Treatments	Yield (q/ha)
T_1 Diafenthurion50%WP	12.7
T_2 Fipronil 5% SC	13.5
T_3 Spirotetramat 150 OD	9.3
T_4 Imidacloprid 70% WG	11.1
T_5 Fipronil 80% WG	13.4
T_6 Buprofezin25%SC	12.2
T_7 Spiromesfin 240 SC	10.1
T_8 Thiacloprid 21.7% SC	8.6
T_9 Acephate 75% SP	11.4
T_{10} Control (untreated)	7.2
F-TEST	Sig
SEm	0.40
CD(P = 0.05)	2.07

by contact or ingestion. Organophosphates such as acephate bind to and inhibit the enzyme acetylcholinesterase (AChE) in nervous system. It was at par with buprofezin 25% SC and spiromesfin 240 SC. These observations are in conformity with Sakalbale *et al.* (1991) who reported that triazophos 0.05%, acephate 0.05% and amitraz 0.05% were superior to untreated check in reducing the population of *B.tabaci* on cotton. Sarangdevot *et al.* (2006) revealed that two applications of acephate @1.5 g/L at three weeks interval was the most effective against aphid, jassid and whiteflies in brinjal. Nadeem *et al.* (2011) concluded that buprofezin was the most effective insecticide against nymphal population of whitefly where nymphal population of *B. tabaci*was 0.2/leaf after 24h spray as compared to 1.9/leaf in control. Buprofezin 0.025% was most effective in reducing nymphal population of white fly (kendappa *et al.*, 2004). Wale and chandele (2010) reported that spiromesifen 240 SC in the range of 120-150 g a.i. $ha^{-1}$was found most effective for the control of whiteflies and mites in brinjal. Yadav *et al.*, (2014) found similar results with buprofezin having 46.5% population reduction capacity.

Seed cotton yield

The seed cotton yield ranged from 7.2 q/ha to 13.5 q/ha presented in Table 4. Highest seed cotton yield was recorded in fipronil 5% SC @ 50 g a.i. ha^{-1}(13.5 q/ha). The next best treatments were fipronil 80% WG @ 50 g a.i. ha^{-1}(13.4 q/ha) followed by diafenthiuron 50% WP @ 375 g a.i. ha^{-1} (12.7 q/ha), buprofezin 25% SC @ 150 g a.i. ha^{-1} (12.2 q/ha),

acephate75% SP @ 750 g a.i. ha^{-1} (11.4 q/ha) and imidacloprid 70% WG @ 21 g a.i. ha^{-1} (11.1 q/ha). Lowest seed cotton yield 7.2 q/ha was recorded in untreated control which significantly inferior over rest of the treatments except thiacloprid 21.7% SC @ 24 g a.i. ha^{-1} (8.6 q/ha).

CONCLUSIONS

The bio-efficacy of different insecticides against cotton sucking pests was studied. All the treatments were significantly superior over untreated check. Among the tested insecticides, imidacloprid 70% WG @ 21g a.i. ha^{-1} was effective against aphids, fipronil 5% SC @ 50g a.i. $ha^{-1}$and fipronil 80% WG @ 50 g a.i. ha^{-1}effective against leafhopper. Fipronil 5% SC @ 50g a.i. ha^{-1} was found to be effective against thrips. Acephate 75% SP @ 750 g a.i. ha^{-1} was effective against whiteflies.

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