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Bio-efficacy of diafenthiuron 25% + pyriproxyfen 5% SE against sucking insect pests of *Bt* Cotton

RK Thumar, PK Borad, NP Pathan, TM Bharpoda, MM Saiyad and HK Chaudhary

Abstract
A field studies were conducted for two consecutive *kharif* seasons (2014-2015 and 2015-2016) with a view to evaluate the bioefficacy of diafenthiuron 25% + pyriproxyfen 5% SE @ 500, 750, 1000, 1250 ml/ha, difenthiuron 50 WP @ 600 g/ha, pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha and pyriproxyfen 10% EC @ 1000 ml/ha (marketed sample) against sucking insects pests of cotton. On the basis of efficacy, diafenthiuron 25% + pyriproxyfen 5% SE (1000 and 1250 ml/ha) found relatively more effective against sucking insect pests *viz*., aphids, leafhoppers, whiteflies and thrips. These two doses of diafenthiuron 25% + pyriproxyfen 5% SE also reflected on cotton seed yield.

Keywords: Bioefficacy, sucking insect pests, Bt cotton

1. Introduction
Cotton is a soft, fluffy staple fiber that grows in a boll, or protective case, around the seeds of the cotton plants of the genus Gossypium in the family of Malvaceae. Cotton, the king of fibre reside one of the momentous and important cash crop exercising profound influence on economics and social affairs of the world. The word "cotton" derived from the Arabic word "*al qatan*" and popularly known as "White Gold". Cotton is one of the oldest fibre known to mankind. The total production of cotton in India was 30005 lakh bales with 415 kg/ha productivity in 12292 lakh hectares of land[3]. Among the variety of reasons of low yield, the magnitude of insect pests, which damage (average 5-10%) the cotton crop from sowing to maturity. The severe attack of insect pests causes heavy qualitative and quantitative yield losses varying from 40- 50 per cent [7]. Insecticides account for 60 per cent of total pesticides consumed in India, out of which natural pesticides (including botanicals) consumption is a meagre and only 2 per cent[1]. Introduction of *Bt* cotton has resulted in the suppression of major bollworms like *Helicoverpa*. However, year after year, the infestation of sucking pests is gradually increased. A wide range of insecticides have been proved as effective weapons in reducing the pest population. About 1326 species of insects have been reported on cotton worldwide, out of them, the whitefly (*Bemisia tabaci* Gennadius), leafhopper (*Amrasca biguttula biguttula* Ishida) and thrips (*Scirtothrips dorsalis* Hood) are widely distributed polyphagous pest in tropical and subtropical regions of India[8]. To combat these insect pests, various methods like cultural, mechanical, physical, biological and chemical are being used as components of integrated pest management. Among them, the chemical control is most popular weapon and practical way for the management of insect pest. Moreover, due to high pest incidence, the cotton crop is subjected to increased more number of spray applications. The chances of resistance problem increase year by year because of the repeated use of single insecticide. Combination of two insecticides having different mode of action play important role in delay the development of resistance. Therefore, the present investigation was undertaken to evaluate the efficacy of new molecule against sucking pests over the conventional insecticides.

2. Materials and Methods
Field experiment was conducted at Anand Agricultural University, Anand during two consecutive *kharif* seasons of 2014-15 and 2015-16 in Randomized Block Design with eight treatments and three replications to determine the bio-efficacy of diafenthiuron 25% + pyriproxyfen 5% SE by M/s GSP Crop Science Pvt. Ltd., Ahmedabad.

The treatments wise spray was applied on cotton when sucking insect pests reached to ETL using high volume sprayer. The observations on population of sucking pests (*A. gossypii*, *A. biguttula biguttula*, *B. tabaci* and *T. tabaci*) were recorded on five plants selected randomly in each plots. On each plant, three leaves were selected randomly from top, middle and bottom canopy and population counts were made before the first spray as well as on 5, 10 and 15 days after each spray. The data on populations of the sucking pests were subjected to square root transformation before statistical analysis to test the significance of treatment effects. The data on seed cotton yield were also recorded during first and second year of study and were summed up for further statistical analysis.

3. Results

3.1 Aphid, *A. gossypii*

The data on 5 DAS (days after spray), diafenthiuron 25% + pyriproxyfen 5% SE@ 1250 ml/ha proved to be the most effective (3.30/leaf) among all the insecticides evaluated at different doses and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE@ 1000 ml/ha (Table 1). The next better treatment was diafenthiuron 50 per cent WP (5.45/leaf) @ 600 g/ha. Diafenthiuron 25% + pyriproxyfen 5% SE @ 750 and 500 ml/ha were at par with each other in suppressing the population of aphid. Among the evaluated insecticides at 10 DAS, plots treated with diafenthiuron 25% + pyriproxyfen 5% SE@ 1250 ml/ha significantly reduced (4.52/leaf) the *A. gossypii* population except diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha (4.59) in cotton followed by diafenthiuron 50% WP (7.01/lea) @ 600 g/ha. Diafenthiuron 25% + pyriproxyfen 5% SE also @ 750 and diafenthiuron 25% + pyriproxyfen 5% SE @ 500 were mediocre in their effectiveness against aphids in cotton. More or less similar trend of effectiveness of different insecticides against aphid was observed at 15 DAS as it was found at 5 and 10 DAS.

The data on pooled over sprays and years (Table 1) clearly indicated that the lowest (4.38/leaf) aphid population was recorded in the plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha (4.65/leaf). The next order of better treatment was diafenthiuron 50% WP @ 600 g/ha (6.79/leaf). Rest of the two lower doses of diafenthiuron 25% + pyriproxyfen 5% SE and pyriproxyfen 10% EC @ 1000 ml/ha found equally effective against aphid. However, there was no significant difference between the two tested sources of pyriproxyfen 10% EC.

3.2 Leafhopper, *A. biguttula biguttula*

Significantly the lowest (4.17/leaf) population of leafhopper found in plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha than all the treatments except diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha at 5 DAS. The diafenthiuron 50% WP @ 600 g/ha stood next in order on its efficacy and by remained at par with two lower doses of diafenthiuron 25% + pyriproxyfen 5% SE *i.e.* 750 and 500 ml/ha. Pyriproxyfen 10 EC @ 1000 ml/ha (market sample) and pyriproxyfen 10 EC @ 1000 ml/ha (GSP sample) found equally effective. At 10 DAS, significantly lower leafhopper incidence was observed in plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha (5.21/leaf) than all the tested insecticides except 1000 ml/ha (5.60 /leaf). The next effective treatment was diafenthiuron 50% WP @ 600 g/ha (8.03 /leaf). Among the treatments, diafenthiuron 25% + pyriproxyfen 5% SE@ 750 and 500 ml/ha and pyriproxyfen 10% EC (1000 ml/ha) were at par with each other. The plots treated with pyriproxifen 10% EC @ 1000 ml/ha registered the highest (9.74/leaf) number of leaf hopper. At 15 DAS, more or less same trend of effect was observed as it observed at 10 DAS.

Looking to the data on pooled over sprays and years (Table 2), the highest effect was observed with the application of diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha as it recorded significantly the lowest (5.21 /leaf) leafhopper population and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha. The diafenthiuron 50% WP @ 600 g/ha was stood next in order of its effectiveness. The pyriproxyfen 10% EC (market sample), pyriproxyfen 10% EC (GSP sample) @ 1000 ml and diafenthiuron 25% + pyriproxyfen 5% SE @ 750 as well as 500 ml/ha found equally effective. The pyriproxyfen 10% EC @1000 ml/ha (market sample) treated plots registered the highest (9.61/leaf) number of leaf hoppers, and it was at par with pyriproxifen 10 EC @ 1000 ml/ha (GSP sample).

3.3 Whitefly, *B. tabaci*

The data on 5 DAS, both the doses of diafenthiuron 25% + pyriproxyfen 5% SE *i.e.* 1250 ml/ha (0.94/leaf) and 1000 ml/ha (1.22/leaf) proved significantly more effective and recorded lower population of whitefly (Table 3). The diafenthiuron 50% WP @ 600 g/ha (2.60/leaf) was next better treatment. Diafenthiuron 25% + pyriproxyfen 5% SE@ 750 ml/ha (3.19/leaf), diafenthiuron 25% + pyriproxyfen 5% SE@ 500 ml/ha (2.78/leaf), pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha (3.74/leaf) and pyriproxyfen 10% EC (market sample) @ 1000 ml/ha (3.78/leaf) found more or less equally effective against whiteflies infesting *Bt* cotton. Of the evaluated insecticides at 10 DAS, plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha revealed significantly the lowest (1.16 /leaf) population of whitefly and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha (1.43/leaf). The diafenthiuron 50% WP @ 600 g/ha (2.85/leaf) stood next best treatment and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE@ 500 ml/ha (3.00/leaf) in suppressing the population of whitefly in *Bt* cotton. The pyriproxyfen 10% EC (3.95/leaf) @ 1000 ml/ha (GSP sample) and pyriproxyfen 10% EC (market sample) @ 1000 ml/ha (4.04/leaf) were at par with each other. More or less similar trend of efficacy of different insecticides against whitefly was noticed at 15 DAS as it was observed at 5 and 10 DAS.

The data on pooled over sprays and years (Table 3) clearly revealed that the lowest (1.16/leaf) population of whitefly was recorded in plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha and it was at par with the diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha (1.40 /leaf) in suppressing the population of whitefly. The diafenthiuron 50% WP @ 600 g/ha (2.85/leaf) stood next in order on its effect. There was no significant difference between pyriproxyfen 10% EC (3.95/leaf) @ 1000 ml/ha (GSP sample) and pyriproxyfen 10% EC (market sample) @1000 ml/ha (4.04/leaf).

3.4 Thrips, *T. tabaci*

At 5 days after spraying, diafenthiuron 25% + pyriproxyfen 5% SE@ 1250 ml/ha proved significantly the most effective (3.66/leaf) among all the insecticides evaluated at different

dosages followed by diafenthiuron 25% + pyriproxyfen 5% SE@ 1000 ml/ha (Table 4). Moreover, these two doses were significantly superior to rest of the insecticidal treatments followed by diafenthiuron 50% WP (6.31/leaf) @ 600 g/ha. The diafenthiuron 25% + pyriproxyfen 5% SE@ 750 ml/ha (7.79 /leaf) and 500 ml/ha (7.34 /leaf) were at par with each other. Of the evaluated insecticides, pyriproxyfen 10% EC @1000 ml/ha (market sample) treated plots registered the highest (9.11/leaf) number of thrips and it was at par with pyriproxifen 10 EC @ 1000 ml/ha (GSP sample). Among the evaluated insecticides at 10 DAS, plots treated with diafenthiuron 25% + pyriproxyfen 5% SE@ 1250 ml/ha significantly reduced (5.07/leaf) the population of thrips except diafenthiuron 25% + pyriproxyfen 5% SE@ 1000 ml/ha (5.36/leaf) in checking the thrips incidence in cotton. The next better treatment was diafenthiuron 50% WP (8.32/leaf) @ 600 g/ha and it was at par with two lower doses of diafenthiuron 25% + pyriproxyfen 5% SE (500 and 750 ml/ha). The pyriproxyfen 10% EC (GSP sample) @ 1000 and 1000 ml/ha (market sample) found to be less effective as it recorded relatively higher (10.00 to 10.52/leaf) thrips population. More or less similar trend of effect of different insecticides against thrips was noticed at 15 DAS as it was recorded at 10 DAS.

Pooled over sprays and years data (Table 4) revealed that the lowest (5.12/leaf) population of was recorded in plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE@ 1000 ml/ha (5.45/leaf). The next order of better treatment was diafenthiuron 50% WP @ 600 g/ha (8.20/leaf). The two lower doses of diafenthiuron 25% + pyriproxyfen 5% SE @ 750 and 500 ml/ha found equally effective against thrips. The highest (10.52/leaf) population of thrips was noticed in plots treated with pyriproxyfen10% EC (market sample) and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 and 1000 ml/ha.

3.5 Effect on seed cotton yield

The highest seed cotton yield (Table 5) was recorded from plots treated with diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha (25.77 q/ha) in both the years as well as in pooled analysis and it was at par with diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha followed by diafenthiuron 50 WP @ 600 g/ha. Two lower doses of diafenthiuron 25% + pyriproxyfen 5% SE @ (500 and 750 ml/ha), pyriproxyfen 10% EC @ 1000 ml (GSP sample) and pyriproxyfen 10% EC @ 1000 ml/ha (market sample) yield equally as they were at par with each other during both the years as well as in pooled analysis.

Table 1: Bio-efficacy of different insecticides against aphids in *Bt* cotton (Pooled data of 2014-15 and 2015-16)

Sr. No.	Treatments	No. of aphids/leaf (days after spray)									
		Before spray		5		10		15		Pooled	
1	Diafenthiuron 25% + pyriproxyfen 5% SE@ 500 ml/ha	3.79 (13.86)		2.60 (6.26)		2.92 (8.03)		3.09 (9.05)		2.87 (7.74)	
2	Diafenthiuron 25% + pyriproxyfen 5% SE@ 750 ml/ha	3.77 (13.71)		2.62 (6.36)		2.94 (8.14)		3.10 (9.11)		2.88 (7.79)	
3	Diafenthiuron 25% + pyriproxyfen 5% SE@ 1000 ml/ha	3.75 (13.56)		2.03 (3.62)		2.30 (4.79)		2.49 (5.70)		2.27 (4.65)	
4	Diafenthiuron 25% + pyriproxyfen 5% SE@ 1250 ml/ha	3.72 (13.34)		1.95 (3.30)		2.24 (4.52)		2.44 (5.45)		2.21 (4.38)	
5	Diafenthiuron 50% WP @ 600 g/ha	3.91 (14.79)		2.44 (5.45)		2.74 (7.01)		2.92 (8.03)		2.70 (6.79)	
6	Pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha	3.89 (14.63)		2.70 (6.79)		2.98 (8.38)		3.21 (9.80)		2.97 (8.32)	
7	Pyriproxyfen 10% EC @ 1000 ml/ha (market sample)	3.90 (14.71)		2.76 (7.12)		3.02 (8.62)		3.23 (9.93)		3.00 (8.50)	
8	Untreated control	3.96 (15.18)		3.07 (8.92)		3.34 (10.66)		3.54 (12.03)		3.31 (10.56)	
ANOVA		S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)
Treatment (T)		0.09	NS	0.06	0.17	0.06	0.16	0.06	0.16	0.04	0.10
Period (P)		-	-	-	-	-	-	-	-	0.02	0.06
Spray (S)		-	-	0.04	0.10	0.03	0.09	0.03	0.10	0.02	0.06
Year (Y)		0.09	NS	0.03	0.17	0.02	0.10	0.03	0.16	0.02	0.14
P x S		-	-	-	-	-	-	-	-	0.04	0.11
P x Y		-	-	-	-	-	-	-	-	0.03	0.09
C. V.%		11.15		9.89		8.32		7.99		9.90	

Note: Figures in parentheses are retransformed values; these outside are $\sqrt{X + 0.5}$ transformed values

Table 2: Bio-efficacy of different insecticides against leaf hoppers in *Bt* cotton (Pooled data of 2014-15 and 2015-16)

Sr. No.	Treatments	No. of jassids/leaf (days after spray)									
		Before spray		5		10		15		Pooled	
1	Diafenthiuron 25% + pyriproxyfen 5% SE @ 500 ml/ha	4.04 (15.82)		2.77 (7.17)		3.11 (9.17)		3.33 (10.59)		3.07 (8.92)	
2	Diafenthiuron 25% + pyriproxyfen 5% SE @ 750 ml/ha	4.09 (16.23)		2.80 (7.34)		3.12 (9.23)		3.34 (10.66)		3.09 (9.05)	
3	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha	4.10 (16.31)		2.23 (4.47)		2.47 (5.60)		2.70 (6.79)		2.47 (5.60)	
4	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha	4.08 (16.15)		2.16 (4.17)		2.39 (5.21)		2.63 (6.42)		2.39 (5.21)	
5	Diafenthiuron 50% WP @ 600 g/ha	4.15 (16.72)		2.66 (6.58)		2.92 (8.03)		3.16 (9.49)		2.91 (7.97)	
6	Pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha	4.15 (16.72)		2.89 (7.85)		3.16 (9.49)		3.40 (11.06)		3.15 (9.42)	
7	Pyriproxyfen 10% EC @ 1000 ml/ha (market sample)	4.10 (16.31)		2.92 (8.03)		3.20 (9.74)		3.42 (11.20)		3.18 (9.61)	
8	Untreated control	4.19 (17.06)		3.27 (10.19)		3.54 (12.03)		3.69 (13.12)		3.50 (11.75)	
ANOVA		S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)
Treatment (T)		0.11	NS	0.06	0.16	0.06	0.17	0.06	0.17	0.04	0.11
Period (P)		-	-	-	-	-	-	-	-	0.02	0.07
Spray (S)		-	-	0.04	0.10	0.04	NS	0.03	0.10	0.02	0.07
Year (Y)		0.11	NS	0.05	0.28	0.01	0.09	0.01	0.04	0.02	0.13
P x S		-	-	-	-	-	-	-	-	0.04	0.12
P x Y		-	-	-	-	-	-	-	-	0.03	0.09
C. V.%		12.86		9.03		8.61		8.05		9.77	

Note: Figures in parentheses are retransformed values; those outside are $\sqrt{X+0.5}$ transformed values.

Table 3: Bio-efficacy of different insecticides against whiteflies in *Bt* cotton (Pooled data of 2014-15 and 2015-16)

Sr. No.	Treatment	No. of whitefly/leaf (days after spray)									
		Before spray		5		10		15		Pooled	
1	Diafenthiuron 25% + pyriproxyfen 5% SE @ 500 ml/ha	2.79 (7.28)		1.81 (2.78)		1.87 (3.00)		1.94 (3.26)		1.88 (3.03)	
2	Diafenthiuron 25% + pyriproxyfen 5% SE @ 750 ml/ha	2.59 (6.21)		1.92 (3.19)		1.98 (3.42)		2.04 (3.66)		1.98 (3.42)	
3	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha	2.65 (6.52)		1.31 (1.22)		1.39 (1.43)		1.45 (1.60)		1.38 (1.40)	
4	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha	2.75 (7.06)		1.20 (0.94)		1.29 (1.16)		1.39 (1.43)		1.29 (1.16)	
5	Diafenthiuron 50% WP @ 600 g/ha	2.70 (6.79)		1.76 (2.60)		1.83 (2.85)		1.90 (3.11)		1.83 (2.85)	
6	Pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha	2.58 (6.16)		2.06 (3.74)		2.11 (3.95)		2.17 (4.21)		2.11 (3.95)	
7	Pyriproxyfen 10% EC @ 1000 ml/ha (market sample)	2.62 (6.36)		2.07 (3.78)		2.13 (4.04)		2.19 (4.30)		2.13 (4.04)	
8	Untreated control	2.94 (8.14)		2.71 (6.84)		2.75 (7.06)		2.79 (7.28)		2.75 (7.06)	
ANOVA		S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)
Treatment (T)		0.12	NS	0.04	0.12	0.04	0.12	0.04	0.11	0.03	0.09
Period (P)		-	-	-	-	-	-	-	-	0.02	0.05
Spray (S)		-	-	0.03	0.07	0.03	0.07	0.02	0.07	0.02	0.05
Year (Y)		0.06	NS	0.02	NS	0.02	NS	0.01	0.07	0.02	0.11
T x Y		0.18	NS	0.04	NS	0.04	NS	0.04	NS	0.04	0.11
P x Y		-	-	-	-	-	-	-	-	0.02	0.07
C. V.%		11.65		9.93		9.44		8.67		10.64	

Note: Figures in parentheses are retransformed values; those outside are $\sqrt{X+0.5}$ transformed values.

Table 4: Bio-efficacy of different insecticides against thrips in *Bt* cotton (Pooled data of 2014-15 and 2015-16)

Sr. No.	Treatment	No. of thrips/leaf (days after spray)									
		Before spray		5		10		15		Pooled	
1	Diafenthiuron 25% + pyriproxyfen 5% SE @ 500 ml/ha	3.90 (14.71)		2.80 (7.34)		3.09 (9.05)		3.42 (11.20)		3.11 (9.17)	
2	Diafenthiuron 25% + pyriproxyfen 5% SE @ 750 ml/ha	3.90 (14.71)		2.88 (7.79)		3.15 (9.42)		3.43 (11.26)		3.15 (9.42)	
3	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha	3.87 (14.48)		2.12 (3.99)		2.42 (5.36)		2.78 (7.23)		2.44 (5.45)	
4	Diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha	3.83 (14.17)		2.04 (3.66)		2.36 (5.07)		2.69 (6.74)		2.37 (5.12)	
5	Diafenthiuron 50% WP @ 600 g/ha	3.96 (15.18)		2.61 (6.31)		2.97 (8.32)		3.26 (10.13)		2.95 (8.20)	
6	Pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha	3.93 (14.94)		3.03 (8.68)		3.24 (10.00)		3.48 (11.61)		3.25 (10.06)	
7	Pyriproxyfen 10% EC @ 1000 ml/ha (market sample)	3.96 (15.18)		3.10 (9.11)		3.32 (10.52)		3.54 (12.03)		3.32 (10.52)	
8	Untreated control	3.99 (15.42)		3.37 (10.86)		3.60 (12.46)		3.84 (14.25)		3.61 (12.53)	
ANOVA		S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±.	CD (5%)	S. Em. ±	CD (5%)	S. Em. ±.	CD (5%)
Treatment (T)		0.10	NS	0.06	0.18	0.07	0.19	0.07	0.18	0.04	0.12
Period (P)		-	-	-	-	-	-	-	-	0.03	0.07
Spray (S)		-	-	0.04	0.11	0.04	0.12	0.04	0.11	0.03	0.07
Year (Y)		0.11	NS	0.02	NS	0.03	NS	0.05	NS	0.03	NS
P x Y		-	-	-	-	-	-	-	-	0.04	0.10
C. V.%		13.21		9.77		9.54		8.37		10.56	

Note: Figures in parentheses are retransformed values; those outside are $\sqrt{X + 0.5}$ transformed values

Table 5: Effect of different insecticides applied at different doses on seed cotton yield

Treatments	Seed cotton yield (q/ha)		
	2014 -15	2015 – 16	Pooled
Diafenthiuron 25% + pyriproxyfen 5% SE @ 500 ml/ha	17.84	16.60	17.22
Diafenthiuron 25% + pyriproxyfen 5% SE @ 750 ml/ha	17.91	16.27	17.09
Diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 ml/ha	25.69	21.68	23.68
Diafenthiuron 25% + pyriproxyfen 5% SE @ 1250 ml/ha	26.47	25.08	25.77
Diafenthiuron 50% WP @ 600 g/ha	23.97	20.00	21.99
Pyriproxyfen 10% EC (GSP sample) @ 1000 ml/ha	19.05	16.79	17.98
Pyriproxyfen 10% EC @ 1000 ml/ha (market sample)	19.04	15.81	17.43
Untreated control	12.38	11.03	11.70
ANOVA			
S. Em. ±	1.26	0.91	0.76
C. D. at 5%	3.63	2.62	2.16
C. V.%	14.47	13.36	14.02

4. Discussions

Diafenthiuron 50 WP @ 500 g/ha was one of the treatment showed excellent performance in managing the population of whitefly (*B. tabaci*) [6]. Maximum mean seed cotton yield of 3101 kgha^{-1} with the highest net profit of Rs. 51,381 ha^{-1} was obtained in difenthiuron 50 WP @ 300 g a.i. /ha against jassids and whiteflies infesting *Bt* cotton[4].

Pyriproxyfen (61.54%) showed maximum mortality of whiteflies followed by imidacloprid (58.79%); acetamiprid (58.24%) after 24 hours of spraying. Pyriproxyfen (77.39%) exhibited maximum mortality followed by diafenthiuraon (75.62%); imidacloprid (75.27%) and acetamiprid (74.91%) after 48 hours [2]. Diafenthiuron 50 WP @ 312 g a.i./ha was the most promising treatment in reducing population of whiteflies (*B. tabaci*), jassids (*Empoasca kerri*) and flower thrips (*Caliothrips indicus*) after both sprays followed by spiromesifen 240 SC @ 150 g a.i./ha as compared to standard checks thiamethoxam 25 WG @ 25g a.i./ha and triazophos 40 EC @ 500 g a.i./ha in green gram[5]. Above findings of the earlier researchers are in close proximity with the present conclusion.

In the absence of work relevant to present study, the findings regarding bio-efficacy of diafenthiuron 25% + pyriproxyfen 5% SE@ against sucking insect pest in *Bt* cotton could not be compared and discussed with the present findings.

5. Conclusion

In present investigation, diafenthiuron 25% + pyriproxyfen 5% SE @ 1000 and 1250 ml/ha were found relatively more effective against sucking insect pests *viz*., aphids, leafhoppers, whiteflies and thrips in *Bt* cotton. Two doses of diafenthiuron 25% + pyriproxyfen 5% SE (1250 and 1000 ml/ha) also gave highest seed cotton yield.

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7. References

1. Agnihotri NP. Pesticide consumption in agriculture in India – an update. Pesticide Research Journal. 2000;

12:150-155.
2. Ahmad I, Bhutta K, Shraf A, Ahmad M, Iqbal MF, Hussain M, *et al*. Efficacy of insecticides used for controlling whitefly in cotton. International Journal of Current Research in Chemistry and Pharmaceutical Sciences. 2014; 1(8):01-03.
3. Anonymous. Area, production and productivity of cotton in India. India stat, 2016. http://www.indiastat.com.
4. Kalyan RK, Saini DP, Meena BM, Pareek A, Naruka P. Evaluation of new molecules against jassids and whiteflies of *Bt* cotton. Journal of Entomology and zoology studies. 2017; 5(3):236-240.
5. Kharel S, Singh PS, Singh SK. Efficacy of newer insecticides against sucking insect pests of greengram [*Vigna radiata* (L.) Wilczek]. International Journal of Agriculture, Environment and Biotechnology. 2016; 9(6):1081-1087.
6. Meenu, Dahiya KK. Efficacy of some insecticides against whitefly (*Bemisia tabaci*). International Journal of Applied and Natural Science. 2017; 6(2):1-4.
7. Naqvi KM. Crop protection to boost up cotton production. In: Seminar on Cotton Production. Four Brotheres Frams Pvt. Limited, Pakistan. 1976, 119-125.
8. Puri SN, Sharma OP, Murthy KS, Sheo Raj. Hand Book on Diagnosis and Integrated Management of Cotton Pests. 1998, 1-5.