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### **Bio-efficacy of different group of insecticides against the major sucking pests complex of Bt-Cotton crop**

**Jagadish Baraskar and VK Paradkar**

#### **Abstract**

The present experiments were conducted to evaluate different group of insecticide molecules as foliar application for their bio-efficacy against major sucking pests of Bt-Cotton crop at JNKVV, Zonal Agricultural Research Station Chandangaon Chhindwara during Kharif-2017 & Kharif-2018 with seven treatments and three replications. Over all two spray were carried out during both years and thus the data obtained revealed that the insecticide molecule Flonicamid 50 % WG@ 150 g/ha was found best for managing the major sucking pest viz. Aphids, jassids, whitefly and thrips of Bt-cotton crop followed by Thiamethoxam 25% WG @ 200 g/ha, Diafenthiuron 50% WP @ 600 g/ha and Fipronil 5% SC @1000 ml/ha were also found effective against the major sucking pests of Bt-cotton crop.

**Keywords:** Bio-efficacy, Insecticides, Bt-Cotton, Sucking Pests, Flonicamid.

#### **Introduction**

Cotton is an important fibre crop of global significance, which is, cultivated in tropical and sub-tropical regions of more than seventy countries the world over. The major producers of cotton are China, India, USA, Pakistan, Uzbekistan, Argentina, Australia, Greece, Brazil, Mexico, and Turkey. Cotton is a commercial fibre crop and is cultivated on 76.1 lac hectares with a production of 28.5 lac tones; the productivity of the crop is only 374 kg lint per hectare. It is grown across 68 countries in about 33.98 million hectare with a productivity of 622 kg/ha. Amongst various causes of low yield, losses due to insect-pests are one of the important factor. Insect pest attack is one of the most important limiting factors in the successful cultivation of this crop. Mathews, about 1326 species of insects on cotton worldwide, out of them the whitefly, *Bemisia tabaci* (Hemiptera: Aleyrodidae) is widely distributed polyphagous pest along with other sucking pests like Aphids, Jassids and Thrips in tropical and sub-tropical regions of India cotton is high value fibre crop that face considerable economic losses due to consistent damage caused by whitefly. According to Biradar and Venilla (2008). Bt cotton succumb to yield loss due to the sap feeders (*i.e.* leafhoppers, aphids, thrips, whiteflies, mealy bugs) spread throughout the growing season, right from seedling emergence to harvest, as the biotic potential of sucking pests being high, they are a potential threat to Bt cotton. To protect the crop from the attack of sucking pests farmers depends generally on the chemicals which are environmentally hazardous. In this view there is a scope of utilizing the newer chemistry molecules such as Pyridincarboxamide and Neonicotinoides which are required in small quantity to control the insect pests and are comparatively environmental safe and economically effective for control of sucking pests in cotton ecosystem. Flonicamid is a novel insecticide belongs to class Pyridincarboxamide which have systemic and translaminar action in plant. Flonicamid has no negative impact on beneficial insects.

#### **Material and Methods**

The present experiment was conducted at JNKVV, Zonal Agricultural Research Station, Chhindwara for consecutive two seasons during Kharif 2017 and kharif 2018. The experiment was laid in Randomised Block Design in three replications and seven treatments including control with a view to estimate the bio-efficacy of different group of insecticide molecules against major sucking pests of Bt-Cotton (SURPASS BG II). In the treatments different group

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of insecticides viz. Flonicamid 50% WG, Thiamethoxam 25% WG, Diafenthiuron 50% WP, Bifenthrin 10% EC, Fipronil 5% SC, and Profenofos 50% EC were used against sucking pests in Cotton. All recommended package of practices were applied to maintain good plant stand throughout the crop period. Two round spraying were done during the crop seasons by using 500 litres of spray solution per hectare with high volume knapsack sprayer against sucking pests like Aphids, Jassids, Thrips and Whitefly. The data of target pests were recorded from randomly selected five plants in each plot. Observations of total number of aphids, thrips, jassid and whitefly were recorded from three, upper middle and lower young leaves of each plant per plot. First count was taken one day before first spray and post treatment counts were recorded on 3, 7 and 14 days after application.

### Results and Discussion

The results of the field experiments conducted to evaluate the bio-efficacy of the different group of insecticides against major sucking pest complex of Bt-Cotton crop are presented in Table 1 to 4. Significant difference was recorded among the treatment after 3, 7 and 14 days.

#### Efficacy of various treatments on aphid population during Kharif-2017 & Kharif-2018

The field data observation shows that, the overall efficacy of different group of insecticides against aphid (*Aphis gossypii* Glover) in cotton has been presented in the table-1. All the treatments were found superior over control in controlling the aphids population. On the basis of the mean the minimum population 4.67 & 2.51 was observed in T4 Flonicamid 50% WG @ 150 g/ha during first and second spray in first year, followed by treatments like T3 Thiamethoxam 25% WG @200 g/ha (4.89), T2 Diafenthiuron 50% WP @600g/ha (5.00), T1 Fipronil 5% SC @1000 ml/ha (6.06) and T6 Profenofos 50% EC @1500 ml/ha (7.23) were found at par with each as compared to control in first spray during second spray the treatment T3 Thiamethoxam 25% WG @200 g/ha (2.77) & T2 Diafenthiuron 50% WP @600g/ha (2.80) were at par with treatment T4 Flonicamid 50% WG @ 150 g/ha. The second year study revealed, the overall efficacy different group of insecticides against aphids in cotton has been presented in the table-1 which revealed that treatment T3 was found significantly superior (5.55) over rest of the treatments and also at par with each other i.e. T4 (5.60), T2 (5.74), T1 (7.90), T6 (9.20) and T5 (9.69) in first spray, during second spray the treatment T4 Flonicamid 50% WG @ 150 g/ha (2.75) was found significantly superior over other group of insecticides/treatments i.e. T3 Thiamethoxam 25% WG @200 g/ha (2.98), and T2 Diafenthiuron 50% WP @600g/ha (3.18) also were at par with each other in second spray. The another treatment were found also effective against the aphids population T1 (4.74), T6 (6.34) and T5 (6.62). The present findings are in conformity with the Ghelani (2014) [6], Bharpoda T. M (2014) [2], Gourkhede (2015), Nemade *et al.* (2017) [15] and kalyan *et al.* (2017) [11] hence, confirm the present findings in this respect.

#### Efficacy of various treatments on jassid population during Kharif-2017 & Kharif-2018

The overall efficacy of different group of insecticides in cotton against jassids (*Amrasca biguttula biguttula* Ishida) has been presented in the table-2 which revealed the minimum population (6.57) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha which is significantly superior over rest

of the treatments during first spray the another treatments followed by T3 Thiamethoxam 25% WG @200 g/ha (7.26) and T2 Diafenthiuron 50% WP @600g/ha (7.41) were found effective and also at par with each other. During second spray on the basis of the mean population the lowest population of jassids (3.83) was observed in the treatment T4 Flonicamid 50% WG @ 150 g/ha which is significantly superior over rest of the treatments followed by the treatments T3 Thiamethoxam 25% WG @200 g/ha (4.24) and T2 Diafenthiuron 50% WP @600g/ha (4.79) and T1 Fipronil 5% SC @1000 ml/ha (5.26) were found effective as compare to control. The second year study revealed, the overall efficacy different group of insecticides against jassid in cotton has been presented in the table-2 which revealed that the lowest population (5.67) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha over rest of the treatments and also found at par with each other with T3 Thiamethoxam 25% WG @200 g/ha (5.86), T2 Diafenthiuron 50% WP @600g/ha (6.08) and T1 Fipronil 5% SC @1000 ml/ha (7.83) in first spray. Same results were found during the second spray i.e. lowest population (3.58) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha over rest of the treatments and also found at par with each other with T3 Thiamethoxam 25% WG @200 g/ha (3.90), T2 Diafenthiuron 50% WP @600g/ha (4.22) and T1 Fipronil 5% SC @1000 ml/ha (5.22). The present results are comparable with the observations of Kumar and Dhawan (2011) [3] who reported that flonicamid 50WG were effective against cotton leafhopper. Similar observations were also made by Chandi *et al.* (2016) [3] and Nemade *et al.* (2017) [15], Shivanna *et al.* (2011) [21], Ramalakshmi *et al.* (2012) [18] and Bharpoda T. M (2014) [2].

#### Efficacy of various treatments on thrips population during Kharif-2017 & Kharif-2018

The overall efficacy of different group of insecticides against Thrips (*Thrips tabaci* Lindemann) in cotton has been presented in the table-3 which revealed the minimum population (3.17) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha which is significantly superior over rest of the treatments and also at par with T3 Thiamethoxam 25% WG @200 g/ha (3.61), T2 Diafenthiuron 50% WP @600g/ha (3.67), T1 Fipronil 5% SC @1000 ml/ha (6.61) and T6 Profenofos 50% EC @1500 ml/ha (7.24) during first spray. During second spray on the basis of the mean population the lowest population of Thrips (2.99) was observed in the treatment T4 Flonicamid 50% WG @ 150 g/ha which is significantly superior over rest of the treatments and also at par with T3 Thiamethoxam 25% WG @200 g/ha (3.31), T2 Diafenthiuron 50% WP @600g/ha (3.41), T1 Fipronil 5% SC @1000 ml/ha (5.35) and T6 Profenofos 50% EC @1500 ml/ha (6.62) as compare to control. The second year study revealed, the overall efficacy different group of insecticides against thrips in cotton has been presented in the table-3 which revealed that minimum population (5.56) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha over rest of the treatments and followed by with T3 Thiamethoxam 25% WG @200 g/ha (5.86) and T2 Diafenthiuron 50% WP @600g/ha (6.50) and also at par with each other. The another treatments also found effective as compare to control i.e. T1 Fipronil 5% SC @1000 ml/ha (7.19) in first spray. During the second spray minimum population (3.40) was found in the treatment T4 Flonicamid 50% WG @ 150 g/ha over rest of the treatments and also found at par with each other with T3 Thiamethoxam 25% WG @200 g/ha (3.59), T2 Diafenthiuron 50% WP @600g/ha (3.89) and T1 Fipronil 5% SC @1000

ml/ha (4.92). The findings on the efficacy of flonicamid 50 WG, diafenthiuron 50 WP and fipronil 5 SC, are confirming with those of earlier worker Rohini *et al.* (2011)<sup>[19]</sup>, Ghelani (2014)<sup>[6]</sup>, Gourkhede (2015) and Nemade *et al.* (2017)<sup>[15]</sup>

### Efficacy of various treatments on whitefly population during Kharif-2017 & Kharif-2018

The efficacy of different group of insecticides against whitefly (*Bemisia tabaci* Gennadius) in cotton has been presented in the table-4 which revealed the minimum population (4.25) was found in the treatment T4 Fonicamid 50% WG @ 150 g/ha which is significantly superior over rest of the treatments and also at par with T2 Diafenthiuron 50% WP @600g/ha (4.75), T3 Thiamethoxam 25% WG @200 g/ha (4.80), T1 Fipronil 5% SC @1000 ml/ha (6.01) and T6 Profenofos50 % EC @1500 ml/ha (7.64)during first spray. During second spray on the basis of the mean population the lowest population of whitefly (2.32) was observed in the treatment T4 Fonicamid 50 % WG @ 150 g/ha which is significantly superior over rest of the treatments and also at par with T3 Thiamethoxam 25% WG @200 g/ha (2.40) and T2 Diafenthiuron 50% WP @600g/ha (2.88). the another treatments found effective which were T1 Fipronil 5% SC @1000 ml/ha (4.34) and T6 Profenofos50 % EC @1500 ml/ha (5.43)and T5 Bifenthrin 10% EC @ 800 ml/ha as compare to control. The second year study revealed, the efficacy different group of insecticides against whitefly in

cotton has been presented in the table-4 which revealed that minimum population (6.18) was found in the treatment T4 Fonicamid 50% WG @ 150 g/ha over rest of the treatments and also found at par with T3 Thiamethoxam 25% WG @200 g/ha (6.73), T2 Diafenthiuron 50% WP @600g/ha (7.25) and T1 Fipronil 5% SC @1000 ml/ha (10.80) in first spray. During second spray minimum population (3.52) was found in the treatment T4 Fonicamid 50 % WG @ 150 g/ha over rest of the treatments and also found at par with each other with T3 Thiamethoxam 25% WG @200 g/ha (3.89) and T2 Diafenthiuron 50% WP @600g/ha (4.24) treatments also found effective followed by T6 Profenofos50 % EC @1500 ml/ha (6.32) and T1 Fipronil 5% SC @1000 ml/ha (6.56). The Present findings regarding efficacy of flonicamid 50 WG, diafenthiuron 50 WP and fipronil 5 SC, is comparable with that of Rohini *et al.* (2011)<sup>[19]</sup>, Ghelani (2014)<sup>[6]</sup>, Gourkhede (2015) and Nemade *et al.* (2017)<sup>[15]</sup> who recorded lowest population of whiteflies. Shreekanth *et al.* (2011) and Zala *et al.* (2014)<sup>[28]</sup> who reported that diafenthiuron 50 WP is highly effective against the whiteflies.

### Conclusion

On the basis of present study, it is concluded that two sprays of flonicamid 50 WP @ 150 g/ha, thiamethoxam 25% WG @200 g/ha, difenthiuron 50 WP @ 600 g/ha and Fipronil 5% SC @1000 ml/ha were found very effective in controlling major sucking pests of Bt-cotton.

**Table 1:** Bio-efficacy of different insecticides against aphids on Cotton during Kharif-2017 (First Season) & Kharif-2018 (Second Season)

Treatments No. & Name	Dose (g/ml /ha)	Kharif-2017 (First Season)										Kharif-2018 (Second Season)									
		Before spray	First Spray				Second Spray				Before spray	First Spray				Second Spray					
			3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		
T1. Fipronil 5% SC	1000	19.32	7.22 (2.77)	4.89 (2.32)	5.83 (2.51)	6.06 (2.56)	3.37 (1.96)	3.13 (1.90)	3.67 (2.04)	3.39 (1.97)	12.45	8.13 (2.93)	7.69 (2.86)	7.87 (2.89)	7.90 (2.90)	4.78 (2.29)	4.31 (2.19)	5.12 (2.37)	4.74 (2.29)		
T2. Difenthiuron 50% WP	600	20.56	6.56 (2.65)	3.44 (1.98)	4.67 (2.27)	5.00 (2.34)	3.21 (1.92)	2.22 (1.64)	2.97 (1.86)	2.80 (1.81)	14.87	6.21 (2.59)	5.86 (2.52)	5.15 (2.37)	5.74 (2.50)	3.87 (2.09)	2.67 (1.78)	3.01 (1.87)	3.18 (1.92)		
T3.Thiamethoxam 25% WG	200	19.44	6.44 (2.63)	3.33 (1.95)	4.57 (2.25)	4.89 (2.32)	2.98 (1.86)	2.45 (1.71)	2.88 (1.83)	2.77 (1.80)	13.98	6.33 (2.61)	5.13 (2.37)	5.19 (2.38)	5.55 (2.46)	3.51 (2.00)	2.47 (1.72)	2.97 (1.86)	2.98 (1.87)		
T4. Fonicamid 50 % WG	150	21.98	6.22 (2.59)	3.22 (1.92)	4.03 (2.12)	4.72 (2.28)	2.71 (1.79)	2.01 (1.58)	2.80 (1.81)	2.51 (1.73)	15.02	6.92 (2.72)	4.90 (2.32)	4.98 (2.34)	5.60 (2.47)	3.22 (1.92)	2.21 (1.64)	2.81 (1.81)	2.75 (1.80)		
T5. Bifenthrin 10% EC	800	20.54	10.11 (3.25)	7.13 (2.76)	7.67 (2.85)	8.30 (2.96)	7.12 (2.76)	4.69 (2.27)	6.65 (2.67)	6.15 (2.57)	14.93	10.33 (3.29)	8.87 (3.06)	9.87 (3.22)	9.69 (3.19)	6.61 (2.66)	6.22 (2.59)	7.04 (2.74)	6.62 (2.67)		
T6. Profenophos 50 % EC	1500	22.41	8.96 (3.07)	5.74 (2.49)	6.99 (2.73)	7.23 (2.78)	6.43 (2.63)	4.90 (2.32)	6.01 (2.55)	5.78 (2.50)	15.32	10.7 (3.34)	8.02 (2.91)	8.89 (3.06)	9.20 (3.11)	6.19 (2.58)	6.01 (2.55)	6.81 (2.70)	6.34 (2.62)		
T7. Control (untreated)	-	20.50	22.29 (4.77)	23.90 (4.93)	25.30 (5.07)	23.83 (4.93)	26.27 (5.17)	27.50 (5.29)	27.31 (5.27)	26.27 (5.17)	14.78	23.27 (4.87)	24.40 (4.98)	24.03 (4.95)	23.90 (4.94)	26.79 (5.22)	27.67 (5.30)	27.67 (5.30)	27.38 (5.28)		
S.Em ±	-	-	0.28	0.16	0.20	0.21	0.07	0.08	0.07	0.07	-	0.43	0.23	0.39	0.35	0.21	0.12	0.17	0.16		
CD @ 5%	-	NS	0.84	0.48	0.61	0.64	0.23	0.24	0.22	0.23	NS	1.21	0.66	1.17	1.01	0.60	0.34	0.48	0.47		

Figures in parentheses are  $\sqrt{x+0.5}$  transformed values  
NS= No Significant, DAA= Day after application

**Table 2:** Bio-efficacy of different insecticides against jassids on Cotton during Kharif-2017(First Season) & Kharif-2018 (Second Season)

Treatments No. & Name	Dose (g/ml /ha)	Kharif-2017 (First Season)										Kharif-2018 (Second Season)									
		Before spray	First Spray				Second Spray				Before spray	First Spray				Second Spray					
			3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		
T1. Fipronil 5% SC	1000	20.34	11.09 (1.81)	8.21 (1.67)	9.68 (1.73)	9.66 (3.19)	6.99 (1.57)	4.27 (1.55)	4.51 (1.59)	5.26 (2.40)	15.60	8.13 (1.85)	7.34 (1.83)	8.01 (1.84)	7.83 (2.89)	6.23 (1.67)	4.27 (1.64)	5.17 (1.69)	5.22 (2.39)		
T2. Difenthiuron 50% WP	600	18.31	9.07 (1.77)	6.13 (1.57)	7.03 (1.66)	7.41 (2.81)	6.26 (1.55)	4.07 (1.46)	4.05 (1.53)	4.79 (2.30)	13.00	8.01 (1.75)	5.11 (1.73)	5.13 (1.69)	6.08 (2.57)	4.67 (1.60)	3.97 (1.51)	4.03 (1.54)	4.22 (2.17)		
T3.Thiamethoxam 25% WG	200	17.98	8.56 (1.77)	6.33 (1.56)	6.9 (1.65)	7.26 (2.79)	5.23 (1.53)	3.84 (1.48)	3.65 (1.52)	4.24 (2.17)	12.20	7.33 (1.76)	5.03 (1.69)	5.21 (1.69)	5.86 (2.52)	4.23 (1.58)	3.63 (1.49)	3.83 (1.53)	3.90 (2.10)		
T4. Fonicamid 50 % WG	150	19.34	8.32 (1.75)	5.27 (1.55)	6.12 (1.62)	6.57 (2.66)	4.33 (1.51)	3.57 (1.44)	3.59 (1.52)	3.83 (2.08)	15.67	7.12 (1.79)	4.92 (1.68)	4.97 (1.68)	5.67 (2.48)	3.77 (1.55)	3.23 (1.46)	3.73 (1.52)	3.58 (2.02)		
T5. Bifenthrin 10% EC	800	21.00	14.67 (1.93)	9.57 (1.80)	12.34 (1.83)	12.19 (3.56)	9.62 (1.80)	7.11 (1.66)	7.98 (1.78)	8.24 (2.95)	13.23	12.33 (1.94)	10.87 (1.88)	11.87 (1.92)	11.69 (3.49)	9.23 (1.77)	8.63 (1.75)	9.63 (1.80)	9.16 (3.11)		
T6. Profenophos 50 % EC	1500	22.67	11.6 (1.89)	8.71 (1.73)	10.63 (1.79)	10.31 (3.29)	8.67 (1.76)	5.85 (1.68)	6.14 (1.74)	6.89 (2.71)	16.56	10.27 (1.96)	8.78 (1.84)	10.01 (1.88)	9.69 (3.19)	8.66 (1.75)	7.90 (1.74)	8.91 (1.78)	8.49 (3.00)		

T7. Control (untreated)	-	21.40	17.2 (2.29)	21.66 (2.33)	24.13 (2.36)	21.00 (4.64)	24.73 (2.38)	26.35 (2.40)	27.47 (2.40)	26.18 (5.16)	14.65	19.22 (2.31)	21.4 (2.34)	22.53 (2.33)	21.05 (4.64)	23.17 (2.39)	23.47 (2.40)	24.78 (2.40)	23.81 (4.93)
S.Em ±	-	-	0.13	0.21	0.15	0.16	0.19	0.25	0.10	0.18	-	0.19	0.21	0.23	0.21	0.16	0.28	0.10	0.18
CD @ 5%	-	NS	0.04	0.07	0.05	0.05	0.06	0.08	0.03	0.05	NS	0.56	0.60	0.61	0.59	0.45	0.08	0.03	0.56

Figures in parentheses are  $\sqrt{x+0.5}$  transformed values

NS= No Significant, DAA= Day after application

**Table 3:** Bio-efficacy of different insecticides against thrips on Cotton during *Kharif-2017* (First Season) & *Kharif-2018* (Second Season)

Treatments No. & Name	Dose (g/ml /ha)	<i>Kharif-2017</i> (First Season)										<i>Kharif-2018</i> (Second Season)									
		Before spray	First Spray				Second Spray				Before spray	First Spray				Second Spray					
			3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		
T1. Fipronil 5% SC	1000	18.94	6.96 (2.73)	5.85 (2.51)	7.02 (2.74)	6.61 (2.67)	5.20 (2.38)	4.92 (2.32)	5.94 (2.53)	5.35 (2.42)	14.32	8.67 (3.02)	6.21 (2.59)	6.69 (2.68)	7.19 (2.77)	5.45 (2.43)	4.33 (2.19)	4.97 (2.33)	4.92 (2.33)		
T2 .Difenthiuron 50% WP	600	18.02	5.03 (2.35)	3.14 (1.90)	2.83 (1.82)	3.67 (2.04)	2.02 (1.58)	3.15 (1.91)	5.06 (2.35)	3.41 (1.98)	12.91	7.81 (2.88)	5.67 (2.48)	6.03 (2.55)	6.50 (2.65)	4.23 (2.17)	3.56 (2.01)	3.89 (2.09)	3.89 (2.10)		
T3.Thiamethoxam 25% WG	200	16.08	4.26 (2.18)	2.68 (1.78)	2.96 (1.86)	3.61 (2.03)	2.42 (1.70)	2.35 (1.68)	5.15 (2.37)	3.31 (1.95)	16.34	6.69 (2.68)	5.01 (2.34)	5.89 (2.52)	5.86 (2.52)	4.11 (2.14)	3.25 (1.93)	3.42 (1.97)	3.59 (2.02)		
T4. Flonicamid 50 % WG	150	16.29	4.14 (2.15)	2.49 (1.72)	2.89 (1.84)	3.17 (1.92)	1.91 (1.55)	2.12 (1.61)	4.95 (2.33)	2.99 (1.87)	14.76	6.45 (2.63)	4.89 (2.32)	5.33 (2.41)	5.56 (2.46)	4.01 (2.12)	3.03 (1.87)	3.17 (1.91)	3.40 (1.97)		
T5. Bifenthrin 10% EC	800	19.85	8.78 (3.04)	6.85 (2.71)	10.98 (3.38)	8.87 (3.06)	8.84 (3.05)	7.01 (2.74)	9.45 (3.15)	8.43 (2.99)	15.98	10.34 (3.29)	8.33 (2.97)	10.32 (3.28)	9.66 (3.19)	8.32 (2.96)	6.67 (2.67)	7.03 (2.74)	7.34 (2.80)		
T6. Profenophos 50 % EC	1500	19.05	7.67 (2.85)	5.8 (2.50)	8.25 (2.95)	7.24 (2.78)	6.92 (2.72)	5.05 (2.35)	7.89 (2.89)	6.62 (2.67)	16.01	11.23 (3.42)	7.62 (2.84)	9.33 (3.13)	9.39 (3.14)	7.97 (2.91)	6.01 (2.55)	6.83 (2.70)	6.94 (2.73)		
T7. Control (untreated)	-	16.10	16.84 (4.16)	19.23 (4.44)	19.05 (4.42)	18.04 (4.31)	20.45 (4.57)	21.87 (4.72)	22.05 (4.74)	21.46 (4.69)	13.09	17.67 (4.26)	23.33 (4.88)	24.45 (4.99)	21.82 (4.72)	25.32 (5.08)	26.43 (5.18)	26.89 (5.23)	26.21 (5.17)		
S.Em ±	-	-	0.34	0.27	0.28	0.29	0.27	0.34	0.48	0.36	--	0.06	0.09	0.06	0.07	0.12	0.32	0.45	0.29		
CD @ 5%	-	NS	1.05	0.84	0.85	0.91	0.84	1.04	1.49	1.12	NS	0.19	0.30	0.19	0.22	0.32	0.64	1.21	0.72		

Figures in parentheses are  $\sqrt{x+0.5}$  transformed values

NS= No Significant, DAA= Day after application

**Table 4:** Bio-efficacy of different insecticides against whitefly on Cotton during *Kharif-2017*(First Season) & *Kharif-2018* (Second Season)

Treatments No. & Name	Dose (g/ml /ha)	<i>Kharif-2017</i> (First Season)										<i>Kharif-2018</i> (Second Season)									
		Before spray	First Spray				Second Spray				Before spray	First Spray				Second Spray					
			3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		3 DAA	7 DAA	14 DAA	Mean	3 DAA	7 DAA	14 DAA	Mean		
T1. Fipronil 5% SC	1000	13.46	6.01 (2.55)	4.12 (2.14)	7.90 (2.89)	6.01 (2.55)	4.92 (2.32)	4.12 (2.14)	3.97 (2.11)	4.34 (2.20)	16.90	11.27 (3.43)	10.23 (3.27)	10.89 (3.37)	10.80 (3.36)	8.13 (2.93)	5.32 (2.41)	6.23 (2.59)	6.56 (2.66)		
T2 .Difenthiuron 50% WP	600	12.87	5.28 (2.40)	3.91 (2.1)	5.05 (2.35)	5.28 (2.40)	3.65 (2.03)	2.15 (1.62)	2.85 (1.83)	2.88 (1.84)	16.32	8.36 (2.97)	6.17 (2.58)	7.23 (2.78)	7.25 (2.78)	6.21 (2.59)	3.01 (1.87)	3.5 (2.00)	4.24 (2.18)		
T3.Thiamethoxam 25% WG	200	12.21	5.15 (2.37)	3.77 (2.06)	5.48 (2.44)	5.15 (2.37)	2.90 (1.84)	2.12 (1.61)	2.19 (1.64)	2.40 (1.70)	14.69	7.89 (2.89)	5.84 (2.51)	6.47 (2.64)	6.73 (2.69)	5.67 (2.48)	2.78 (1.81)	3.23 (1.93)	3.89 (2.10)		
T4. Flonicamid 50 % WG	150	13.87	5.05 (2.35)	2.98 (1.86)	4.72 (2.28)	5.05 (2.35)	2.75 (1.80)	2.08 (1.60)	2.12 (1.61)	2.32 (1.68)	15.89	7.87 (2.89)	4.78 (2.29)	5.89 (2.52)	6.18 (2.58)	4.63 (2.26)	2.65 (1.77)	3.27 (1.94)	3.52 (2.00)		
T5. Bifenthrin 10% EC	800	11.98	6.14 (2.57)	5.65 (2.47)	7.23 (2.78)	6.14 (2.57)	6.12 (2.57)	4.89 (2.32)	5.87 (2.52)	5.63 (2.48)	17.32	13.27 (3.71)	11.97 (3.53)	12.21 (3.56)	12.48 (3.60)	9.67 (3.18)	8.21 (2.95)	7.01 (2.74)	8.29 (2.96)		
T6. Profenophos 50 % EC	1500	12.32	7.67 (2.85)	6.59 (2.66)	8.65 (3.02)	7.67 (2.85)	5.89 (2.52)	4.76 (2.29)	5.64 (2.47)	5.43 (2.44)	16.78	12.21 (3.56)	10.61 (3.33)	11.37 (3.44)	11.40 (3.45)	6.93 (2.72)	7.79 (2.87)	4.23 (2.17)	6.32 (2.61)		
T7. Control (untreated)	-	12.90	17.01 (4.18)	18.05 (4.30)	18.61 (4.37)	17.01 (4.18)	19.15 (4.43)	20.45 (4.57)	21.06 (4.64)	20.22 (4.55)	15.23	20.23 (4.55)	21.27 (4.66)	23.29 (4.87)	21.60 (4.70)	24.89 (5.03)	25.67 (5.11)	26.89 (5.23)	25.82 (5.13)		
S.Em ±	-	-	0.27	0.26	0.20	0.27	0.09	0.16	0.08	0.11	-	0.32	0.28	0.27	0.29	0.16	0.18	0.20	0.18		
CD @ 5%	-	NS	0.82	0.79	0.62	0.82	0.30	0.48	0.26	0.34	NS	0.88	0.86	0.80	0.84	0.45	0.50	0.60	0.51		

Figures in parentheses are  $\sqrt{x+0.5}$  transformed values

NS= No Significant, DAA= day after application

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