



Bioefficacy of insecticides against sucking pests in *Bt* cotton

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ABSTRACT : Investigations was carried out to assess the bio efficacy of insecticides against sucking pest in *Bt* cotton using different chemical component, NSKE and some biopesticide during 2014-2015 and 2015-2016 under irrigated conditions at Cotton Research Station, Srivilliputtur. In the field experiment I and II, the population of sucking pest of two spraying, Flonicamid 50 WG @ 100 g a.i./ha (leaf hopper-1.12 /3leaves and 1.18 /3leaves); (thrips-1.48/3leaves and 0.81 /3 leaves); (whitefly-0.9 /3 leaves and 0.97 /3leaves), was found to be effective against the sucking pests followed by Buprofezin 25 SC @250 g a.i./ha (leaf hopper-1.83 /3leaves and 2.40 /3 leaves); (thrips-0.98 /3leaves and 0.89 /3leaves); (whitefly-1.03 /3 leaves and 1.04 /3 leaves) and Diafenthiuron 50 WP@ 300 g a.i./ha (leaf hopper-1.98 /3leaves and 3.20 /3 leaves), (thrips-1.12/3leaves and 1.37 /3 leaves) ; (whitefly-0.92 /3 leaves and 1.19 /3 leaves) compared to the untreated check and the cotton *kapas* yield was also highest in Flonicamid 50 WG @ 100 g a.i./ha (11.98 q/ha and 14.58 q/ha) and statistically *on par* with Diafenthiuron 50 WP@300 g a.i./ha (13.68 q/ha and 13.90 q/ha), Buprofezin 25 SC @250 g a.i./ha (12.17 q/ha and 13.57 q/ha), followed by other treatment over the untreated check (7.63 q/ha and 7.88 q/ha) for the sucking pests in *Bt* cotton.

Key words : Bio pesticide, botanicals, *Bt* cotton, insecticides, sucking pests

Cotton is unanimously designated as “King of fibres” as it tops the table depicting the statistics of fibre crops. As a leading commercial crop it is grown world wide. 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 estimated loss due to sucking pests is up to 21.20 per cent. While, Chavan *et al.*, (2010) reported 28.13 per cent avoidable yield loss due to major sucking pests in cotton. Among the various insect pests listed, aphid, jassid, thrips and whitefly are the major sucking pests of *Bt* cotton and limiting the profitable cultivation. Newer chemistries of

pesticides have raised the hopes for better management of dreaded pest world wide. Hence, the present study was conducted to bio-efficacy of different insecticides against sucking insect pests of *Bt* cotton including jassid, whitefly, and thrips.

MATERIALS AND METHODS

Two field experiments were conducted to evaluate the newer insecticides against the sucking pest in *Bt* cotton during 2014-2015 and 2015-2016 at Cotton Research Station, Srivilliputtur. The experiment was laid out using cotton hybrid (RCH2BG II) in a randomized block design with eight treatments and three

replications with a 5 x 4 square meter plots. Untreated seeds were sown at 90x60 cm spacing. Recommended agronomic practices were carried out. In this bioefficacy study, the treatment was imposed the Buprofezin 25 SC @250 g a.i./ha, Flonicamid 50 WG @ 75 g a.i./ha, Flonicamid 50 WG @ 100 g a.i./ha, Fipronil 5 SC @ 87.5 g a.i./ha, Fipronil 5 SC @ 50 g a.i./ha, NSKE 5%, Diafenthiuron 50 WP@300 g a.i./ha, *Lecanicillium (Verticillium) lecanii*@5g/l, *Metarhizium anisopliae*@5g/l and Untreated check. Two rounds of sprayings were given. Observations were made on the population of leafhopper, whitefly, thrips and natural enemies before spraying and one week after each spraying. The plot yield was also recorded and expressed as q/ha. The data obtained from field experiments were analysed in a Simple randomized block design by 'F' test for significance. Critical difference values were calculated at 5 per cent probability level and the treatment mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

With regard to leaf hopper in the field experiment I, the Flonicamid 50 WG@ 100 g ai/ha was found to be effective after a week of first spraying. It was followed by Fipronil 5SC @ 87.5 g ai/ha and next to which were Buprofezin 25 SC @ 1000 g ai/ha and Flonicamid 50 WG @ 75 g ai/ha. Whereas after second spraying, Flonicamid 50 WG@ 100 g ai/ha, Diafenthiuron 50WP @ 300 g ai/ha, Fipronil 5SC @ 87.5 g ai/ha, Flonicamid 50 WG @ 75 g ai/ha, Fipronil 5 SC @ 50 g ai/ha and Buprofezin 25 SC @ 1000 g ai/ha were statistically on par with each other

against leafhopper. Mean of two sprayings showed that, Flonicamid 50 WG@ 100 g ai/ha was effective, which was followed by Fipronil 5SC @ 87.5 g ai/ha, Buprofezin 25 SC @ 1000 g ai/ha, Flonicamid 50 WG @ 75 g ai/ha, and Diafenthiuron 50WP @ 300 g ai/ha (Table 1). With regard to leafhopper in the field experiment II, the Flonicamid 50 WG@ 100 g ai/ha was found to be effective after a week of first and second spraying. It was followed by Flonicamid 50 WG@ 75 g ai/ha and next to which were Buprofezin 25 SC @ 1000 g ai/ha and NSKE (5%). Mean of two sprayings showed that, Flonicamid 50 WG@ 100g ai/ha was highly effective, which was followed by Flonicamid 50 WG@ 75g ai/ha, Buprofezin 25 SC @ 1000 g ai/ha, NSKE@5% and Diafenthiuron 50WP @ 300 g ai/ha compared with the untreated check (Table 3). Khattak *et al.*, (2006) found that Confidor 200 SL was significantly more effective against jassid than Polo at 24 h and 72 h after spray.

With regard to thrips in the field experiment I, after first spraying, the *Lecanicillium lecanii* 5g/l was highly effective. It was followed by Diafenthiuron 50 WP @ 300 g ai/ha and next to which was Buprofezin 25 SC @ 250 g a.i/ ha. Whereas after second spraying, Buprofezin 25 SC @ 250 g a.i/ ha was highly effective, which was *on par* with *Lecanicillium lecanii* 5g/lit, Flonicamid 50 WG@ 100 g ai/ha, NSKE 5%, Fipronil 5 SC @ 87.5 g ai/ha and 50 g ai/ha and *Metarhizium anisopliae* 3 g/l. Mean of two sprayings showed that *Lecanicillium lecanii* 5g/l, Buprofezin 25 SC @ 250 g a.i/ ha and Diafenthiuron 50 WP @ 300 g ai/ha were highly effective. With regard to thrips in the field experiment II, after first spraying the *Lecanicillium lecanii* 5g/lit was highly effective.

Table 1. To study the efficacy of insecticides against sucking pest (leaf hopper, thrips and whitefly) in *Bt* cotton (Field experiment I)

Treatment	Dose	Leaf hopper population (No./3 leaves)#				Thrips population (No./3 leaves)#				Whitefly population (No./3 leaves)#			
		Active ingredient (g a.i./ha)	Formulation	First Spray	Second Spray	First Spray	Second Spray	First Spray	Second Spray	First Spray	Second Spray	First Spray	Second Spray
		Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray
		Means of two sprays		Means of two sprays		Means of two sprays		Means of two sprays		Means of two sprays		Means of two sprays	
T1 -Buprofezin 25% SC	250	5.00 (2.24)	2.17 (1.47) c	6.43 (2.54)	1.50 (1.22) b	2.33 (1.53)	0.87 (0.93) c	1.50 (1.22) b	1.10 (1.05) a	2.47 (1.57)	1.50 (1.22) abc	2.90 (1.70)	0.57 (0.75) a
T2 -Fonicamid 50% WG	75	5.03 (2.24)	2.27 (1.51) c	6.40 (2.53)	1.47 (1.21) ab	2.40 (1.55)	1.67 (1.23) f	2.03 (1.15) ab	2.03 (1.42) b	2.47 (1.57)	1.57 (1.25) bcd	2.43 (1.56)	0.57 (0.75) a
T3 -Fonicamid 50% WG	100	5.40 (2.32)	1.33 (1.53) a	6.43 (2.54)	0.90 (0.94) a	2.33 (1.53)	1.40 (1.18) e	1.43 (1.20) a	1.43 (1.20) ab	2.47 (1.57)	1.43 (1.20) ab	2.70 (1.64)	0.37 (0.61) a
T4 -NSKE	0.05	5.93 (2.44)	4.83 (2.19) f	6.37 (2.52)	1.77 (1.33) bc	2.33 (1.53)	1.07 (1.03) d	1.53 (1.24) b	1.53 (1.24) b	2.67 (1.57)	1.47 (1.21) abc	2.50 (1.58)	0.67 (0.82) a
T5 -Diafenthiuron 50% WP	300	6.10 (2.47)	2.67 (1.63) d	6.73 (2.59)	1.30 (1.14) ab	2.33 (1.53)	0.77 (0.89) b	1.47 (1.24) b	1.47 (1.24) b	2.43 (1.54)	1.33 (1.15) ab	2.33 (1.53)	0.50 (0.71) a
T6 -Lecanicillium <i>lecanii</i>	5 g/1	6.57 (2.56)	5.57 (2.36) g	6.53 (2.55)	2.30 (1.52) cd	2.33 (1.53)	0.47 (0.69) a	1.63 (1.28) b	1.23 (1.11) ab	2.53 (1.59)	1.97 (1.40) d	2.73 (1.65)	0.40 (0.63) a
T7 - <i>Metarhizium anisopliae</i>	3g/1	5.00 (2.24)	4.67 (2.16) f	6.27 (2.50)	2.87 (1.69) d	2.30 (1.52)	1.47 (1.21) e	2.07 (1.44) a	1.73 (1.32) ab	2.50 (1.58)	1.83 (1.35) cd	3.00 (1.63)	0.33 (0.57) a
T8 -Untreated control	-	4.93 (2.22)	6.37 (2.52) h	6.27 (2.50)	3.10 (1.76) e	2.33 (1.53)	4.87 (1.37) g	4.57 (1.60) c	4.93 (2.22) c	2.37 (1.54)	2.83 (1.68) e	2.67 (1.73)	3.40 (1.84) b
SED		0.16	0.02	0.06	0.13	0.04	0.03	0.08	0.16	0.04	0.07	0.14	0.11
CD (P=0.5)		NS	0.039**	0.115**	0.283**	0.21	NS	0.051**	0.336**	0.216**	NS	0.151**	NS
CV %		8.03	1.26	2.64	12.25	3.16	2.59	7.26	14.82	3.16	6.90	10.42	22.57
													19.02

NS - Not significant
 * - Significant at P=0.05
 ** - Significant at P=0.01
 Mean of 3 replications

In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
 Values in parentheses are transformed values "X+0.5"
 # - Mean of 10 plants

Table 2. Effect of insecticides on cotton *kapas* yield (Field experiment I)

Insecticides	Active ingredient (g a.i./ha)	Formulation	Mean yield of cotton <i>kapas</i> (q/ha)	Gross income (Rs./ha)	Increase in income over control	Cost of insecticides/ha (two sprays)	Application cost	Total cost	C:B ratio
T1 -Buprofezin 25 SC	250	1000	12.17 (3.49)abc	38944	14528	3024	2500	5524	2.63
T2 - Flonicamid 50 WG	75	150	11.87 (3.45)bc	37984	13568	2750	2500	5250	2.58
T3 - Flonicamid 50 WG	100	200	11.98 (3.46)abc	38336	13920	3680	2500	6180	2.25
T4 -NSKE	5 %	25 kg	10.02 (3.16)d	32064	7648	1092	2500	3592	2.13
T5 -Diafenthiuron 50WP	300	600	13.68 (3.7)a	43776	19360	4320	2500	6820	2.84
T6 - <i>Lecanicillium (Verticillium) lecanii</i>		2.5 kg/ha (5 g/lit)	8.44 (2.91)e	27008	2592	-	-	-	-
T7 - <i>Metarhizium anisopliae</i>		1.5 kg/ha (3g/lit)	8.23 (2.87)e	26336	1920	-	-	-	-
T8 - Untreated control		-	7.63 (2.76)e	24416	-	-	-	-	-
SED			0.12						
CD (p=0.05)			0.24**						
CV			4.35						

It was followed by Flonicamid 50 WG@ 100 g ai/ha, Buprofezin 25 SC @ 250 g a.i/ ha. Whereas after second spraying, Flonicamid 50 WG@ 100 g ai/ha and *Lecanicillium lecanii* 5g/l, was highly effective and next to followed by Buprofezin 25 SC @ 250 g a.i/ ha Diafenthiuron 50WP @ 300 g ai/ha, Flonicamid 50 WG@ 75 g ai/ha. Mean of two sprayings showed that, *Lecanicillium lecanii* 5g/lit was highly effective, which was followed by Flonicamid 50 WG@ 100 g ai/ha, Buprofezin 25 SC @ 1000 g ai/ha and Flonicamid 50 WG@ 75g ai/ha compared with other untreated check. These results agree with the investigations carried out by various scientists (Afzal *et al.*, 2001; Tayyib *et al.*, 2005; Shah *et al.*, 2007).

With regard to whitefly in the field experiment I, the Fipronil 5SC @ 87.5 g ai/ha, Diafenthiuron 50 WP @ 300 g ai/ha, Flonicamid 50 WG@ 100 g ai/ha, Neem Seed Kernel Extract

(5%) and Buprofezin 25 SC @ 250 g a.i/ ha were found to be highly effective. It was followed by Flonicamid 50 WG@ 75 g ai/ha Fipronil 5 SC @ 50 g ai/ha were effective after first spraying. Whereas after second spraying, all the treatments were on par with each other, they were significantly different from untreated check. Mean of two sprayings also exhibited the same trend

With regard to whitefly in the field experiment II and It also the Flonicamid 50 WG@ 100 g ai/ha and Buprofezin 25 SC @ 1000 g ai/ha was found to be effective after a week of first spraying and next to followed by Flonicamid 50 WG@ 75g ai/ha, Diafenthiuron 50WP @ 300 g ai/ha. Whereas second sprays, Flonicamid 50 WG@ 100 g ai/ha was effective and other treatments were *on par* with each other and they were significantly different from untreated

Table 3. To study the efficacy of insecticides against sucking pest (leaf hopper, thrips and whitefly) in *Bt* cotton (Field experiment II)

Treatment	Active ingredient (g a.i./ha)	Dose	Leaf hopper population (No./3 leaves)#						Thrips population (No./3 leaves)#						Whitefly population (No./3 leaves)#					
			First Spray		Second Spray		Means		First Spray		Second Spray		Means		First Spray		Second Spray		Means	
			Pre count	One week after spray	Pre count	One week after spray	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count	One week after spray	Pre count
T1 -Buprofezin 25% SC	250	1,000.0	5.12 (2.26)	2.40 (1.55)c	6.32 (2.51)	2.41 (1.55)c	2.41 (1.55)bc	2.35 (1.53)	0.45 (0.67)bc	1.55 (1.24)	1.33 (1.15)ab	0.89 (0.94)ab	2.81 (1.68)	1.23 (1.11)a	2.92 (1.71)	0.84 (0.92)ab	1.04 (1.02)ab			
T2 -Fonicamid 50% WG	75.0	150.00	4.41 (2.10)	1.45 (1.20)b	7.31 (2.70)	1.90 (1.38)b	1.68 (1.30)ab	2.28 (1.51)	0.71 (0.84)ef	1.56 (1.25)	1.83 (1.35)cd	1.27 (1.13)ab	2.92 (1.71)	1.42 (1.19)ab	3.04 (1.74)	0.91 (0.95)ab	1.17 (1.08)abc			
T3 -Fonicamid 50% WG	100.0	200.00	4.60 (2.14)	1.06 (1.03)a	6.07 (2.46)	1.30 (1.14)a	1.18 (1.09)a	2.48 (1.57)	0.41 (0.64)ab	1.73 (1.31)	1.20 (1.09)a	0.81 (0.90)ab	2.31 (1.52)	1.14 (1.07)a	2.81 (1.68)	0.79 (0.89)a	0.97 (0.98)a			
T4 -NSKE	0.05	25 kg	3.82 (1.95)	2.57 (1.60)cd	5.23 (2.29)	2.70 (1.64)cd	2.64 (1.62)c	2.40 (1.55)	0.80 (0.89)j	1.65 (1.28)	1.93 (1.39)cd	1.37 (1.17)b	2.80 (1.67)	1.92 (1.38)c	3.07 (1.75)	1.00 (1.00)b	1.46 (1.21)bc			
T5 -Diafenthiuron 50% WP	300.00	600.00	4.45 (2.11)	3.05 (1.75)de	6.40 (2.53)	3.20 (1.79)d	3.13 (1.77)cd	2.37 (1.54)	0.54 (0.73)cd	1.57 (1.25)	1.61 (1.27)bc	1.08 (1.04)ab	2.31 (1.52)	1.43 (1.19)ab	2.70 (1.64)	0.94 (0.97)ab	1.19 (1.09)abc			
T6 - <i>Lecanicillium lecanii</i>		5 g/lit	4.21 (2.05)	3.22 (1.79)e	6.13 (2.47)	3.23 (1.80)de	3.23 (1.80)cd	2.41 (1.55)	0.31 (0.56)a	1.67 (1.29)	1.24 (1.11)a	0.78 (0.88)a	2.71 (1.65)	1.57 (1.25)bc	3.14 (1.77)	1.34 (1.16)c	1.46 (1.21)bc			
T7 - <i>Metarhizium anisopliae</i>		3g/lit	5.02 (2.24)	3.41 (1.85)e	6.23 (2.49)	3.84 (1.96)e	3.63 (1.90)d	2.13 (1.46)	0.62 (0.79)de	1.39 (1.18)	1.72 (1.31)c	1.17 (1.08)ab	2.45 (1.56)	1.61 (1.27)bc	3.08 (1.75)	1.40 (1.18)c	1.51 (1.23)c			
T8 -Untreated control	-	-	4.11 (2.03)	6.43 (2.53)f	6.31 (2.51)	4.72 (2.17)f	5.58 (2.36)e	2.42 (1.56)	2.00 (1.41)g	1.70 (1.30)	2.13 (1.46)d	2.07 (1.44)c	2.98 (1.73)	3.20 (1.79)d	3.25 (1.80)	1.90 (1.38)d	2.55 (1.60)d			
SED			0.09	0.08	0.11	0.08	0.12	0.07	0.04	0.08	0.06	0.12	0.07	0.06	0.08	0.05	0.08			
CD (P=0.5)			NS	0.17**	NS	0.17**	0.27**	NS	0.09**	NS	0.12**	0.28**	NS	0.13**	NS	0.10**	0.20**			
CV (%)			5.40	5.90	5.51	5.71	6.95	5.47	6.46	8.05	5.50	11.30	5.63	5.97	5.50	5.72	7.22			

NS - Not significant in a column mean followed by a common letter are not significantly different by DMRT (P=0.05)

*. Significant at P=0.05

Values in parentheses are transformed values $\sqrt{X+0.5}$

**-. Significant at P=0.01

- Mean of 10 plants

Table 4. Effect of insecticides on cotton *kapas* yield (Field experiment II)

Insecticides	Active ingredient (g a.i./ha)	Formulation	Mean yield of cotton <i>kapas</i> (q/ha)	Gross income (Rs./ha)	Increase in income over control	Cost of insecticides/ha (two sprays)	Application cost	Total cost	C:B ratio
T1 -Buprofezin 25 SC	250	1000	13.57 (3.68)ab	47495	19915	3024	2500	5524	3.61
T2 - Flonicamid 50 WG	75	150	14.22 (3.77)ab	49770	22190	2750	2500	5250	4.23
T3 - Flonicamid 50 WG	100	200	14.58 (3.82)a	51030	23450	3680	2500	6180	3.79
T4 -NSKE	5 %	25 kg	12.15 (3.49)bc	42525	14945	1092	2500	3592	4.16
T5 -Diafenthiuron 50WP	300	600	13.90 (3.73)ab	48650	21070	4320	2500	6820	3.09
T6 - <i>Lecanicillium</i> (<i>Verticillium</i>) <i>lecanii</i>		2.5 kg/ ha (5 g/lit)	10.86 (3.30)cd	38010	10430	-	-	-	-
T7 - <i>Metarhizium anisopliae</i>		1.5 kg/ ha (3g/lit)	9.77 (3.13)de	34195	6615	-	-	-	-
T8 - Untreated control		-	7.88 (2.81)e	27580	-	-	-	-	-
SED			0.15						
CD (p=0.05)			0.32**						
CV (%)			5.32						

check. In the field experiment I and II, the highest cotton *kapas* yield was recorded in Flonicamid 50 WG@ 100 g ai/ha (11.98 q/ha and 14.58q/ha), Diafenthiuron 50 WP @ 300 g ai/ha (13.68 q/h and 13.90 q/ha), which was statistically *on par* with Buprofezin 25 SC @ 250 g a.i/ ha (12.17 and 13.67 q/ha) and Whereas, the untreated check recorded *kapas* yield (7.63 and 7.88 q/ha). Ghelani (2014) reported that the flonicamid 50 WG (0.02%) was found more effective against all major sucking pests *Bt* cotton. Lavekar *et al.*, (2004) reported that cotton sprayed with imidacloprid 200 SL reduced sucking pests population and gave the highest seed yield of 1651 kg/ha.

The Flonicamid 50 WG@ 100g ai/ha were found to be highly effective against sucking insect pests (leaf hopper, thrips and whitefly)

infesting *Bt* cotton and produced higher yield.

Our findings demonstrated that Confidor 200SL was highly effective against whitefly, jassid and thrips. These results agree with the investigations carried out by various scientists (Afzal *et al.*, 2001; Tayyib *et al.*, 2005; Shah *et al.*, 2007). These insecticides can be recommended for the management of sucking insect pests in *Bt* cotton looking to their effectiveness, economics and safety to the natural enemies. These findings matched more or less with the present findings. Hence, agriculturists, and farmers should have a clear understanding of the nature of the pesticides they apply and must endeavour to apply the pesticides according to the formulation and in the appropriate quantity so as to avoid distortion and destruction of the ecosystem.

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