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Evaluation of recommended insecticides against sucking pests of *Bt* cotton

PR Zanwar and LT Shelke

Abstract
The trial laid out in factorial randomized design (FRBD) with three replication. The two factors included seven chemicals including untreated control as a factor one and two label claim and university recommendation dose of each chemicals/insecticides applied against sucking pests as second factor for revalidation. The results indicated that the recommendation dose of acephate @ 750 g a.i./ha (0.32 aphids/three leaves) and label claim dose of diafenthuron @300 g a.i./ha (0.39 aphids/three leaves) significantly superior over all other dosage against aphids. acetamiprid 20 SP @ 20 g a.i./ha was found significantly superior in lowering the population of jassid (4.30 jassids /three leaves, recommended dose of fipronil 5 SC @ 50 g a.i./ha recorded significantly lowest population of thrips (3.22 thrips / three leaves) and doses of diafenthuron 50 WP and fipronil 5 SC were recorded significantly least number (3.38 and 3.62 whiteflies / three leaves) respectively, maximum seed cotton yields of 10.87 and 10.24 q/ha were recorded in the university recommended dosages of fipronil 5SC @ 50 g a.i./ha and acephate 75 SP @ 750 g a.i./ha respectively.

Keywords: Aphids, jassid, thrips and whiteflies, insecticides, acephate, fipronil etc.

Introduction
Cotton (*Gossypium hirsutum* L.) is one of the most commercially important fiber crops in the world. It is an important raw material for the Indian textile industry and plays a key role in the national economy in terms of both employment generation and foreign exchange. In India, cotton is cultivated in 119.78 lakh hectare with a production of 365 lakh bale of seed cotton (Anonymous, 2013) [6]. Insect pest attack is one of the most important limiting factors in the successful cultivation of this crop. Amongst various causes of low yield, losses due to insect pests are one of the important factors in cotton. Many insect pests are encountered on cotton crop from germination to harvesting. Among the important key pests of cotton the sucking pests *viz.*, leafhopper, *Amrasca Amrasca devastans* Distant, aphid, *Aphis gossypii* (Glover), whitefly *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci* (Linnman) cause severe damage and serious threat to the crop at early stage of the crop growth andcan also affect the crop stand and yield of cotton. Some sucking pests are cosmopolitan, polyphagus, widely distributed in tropical, subtropical and temperate regions and are also vectors for a number of viral diseases in large number of plants (Serdar, 1999) [7]. Therefore chemical control is necessary to keep the population of sucking pests below ETL. In the present study, some new insecticides have been used to test their efficacy against the sucking pests (Zanwar, 2012) [8].
Insecticides come in a variety of forms and have proven to be efficient in lowering pest populations. Cotton growers in India rely extensively on synthetic pesticides to control pests and the crop uses almost 20% of the country's total insecticides. In comparison to traditional insecticides, the usage of neonicotinoids for the management of sucking pests has increased with the introduction of transgenic cotton. However, the widespread use of organophosphates, carbamates and synthetic pyrethroids has resulted in a slew of issues, including pest comeback, resistance, and the annihilation of natural adversaries (Bajya *et al*., 2016) [10]. The control of the bollworm complex in *Bt* cotton has been neglected as a result of transgenic cotton. Pink bollworm damage and yield losses have been documented in Bt-cotton in numerous regions of Gujarat, as well as some sections of Andhra Pradesh, Telangana and Maharashtra since 2014 (Kranthi, 2015) [9].

Materials and Methods
A field experiment was conducted to revalidate the recommended insecticides against sucking insect pests of transgenic cotton (RCH-BG II) during 2012 to 2014 at cotton Research Station,

Nanded. Five plants from each plot were randomly selected for recording observations of sucking pests three leaves (top, middle and bottom). The observations were recorded before spraying, 7th and 14th days after each sprays and three sprayers were applied to evaluate the insecticides. The observation of 7th and 14th days after each sprays were used for statistically analysis and accordingly mean/average values of pooled data were used for discussing the result. The seed cotton yield was recorded plot wise from each picking and was converted into quintal per hectare before analysis and comparison.

Results and Discussion

All the interaction of chemical dosage were significantly superior over untreated control against aphids, jassid, thrips and whiteflies.

The results (Table 1) indicated that the recommendation dose of acephate @750 g a.i./ha (0.32 aphids/three leaves) and label claim dose of diafenthuron @ 300 g a.i./ha (0.39 aphids/three leaves) significantly superior over all other dosage against aphids. The label claim and recommendation dosage of acephate as well as diafenthuron were found to be at par with each other against aphids. The next best treatments were fipronil @ 87.5 and 50 g a.i./ha followed by acetamiprid @ 10 and 20 g a.i./ha against aphids.

The recommendation dose of acetamiprid 20 SP @20g a.i./ha was found significantly superior in lowering the population of jassid (4.30 jassids /three leaves) on cotton after third sprays (Table 2). However, the label claim dose of fipronil @ 87.5 g a.i./ha as well as diafenthuron @ 300 g a.i./ha were also observed effective treatments against jassid and these two treatments were at par with each other. There were significant intraction observed with two doses of each treatment against jassids.

Population of thrips significant difference were observed between insecticides, doses and interactions. Among the different insecticides recommended dose of fipronil 5 SC @ 50 g a.i./ha recorded significantly lowest population of thrips (3.22 thrips / three leaves) followed by recommended dose of acephate 75 SP @750 g a.i./ha (3.50 thrips/three leaves) and fipronil 5 SC @87.5 g a.i.g/ha (3.67 thrips/three leaves) and those three treatments were at par with each other. However, the other treatments of different insecticides with doses were also found significantly effective in reducing the population of thrips over the untreated control.

The label claim doses of diafenthuron 50 WP and fipronil 5 SC were recorded significantly least number (3.38 and 3.62 whiteflies / three leaves) respectively. These treatments were at par with each other. The next best treatments were recommended dose of acephate 75 SP (4.32 whiteflies / three leaves) and diafenthuron 50WP (4.53 whiteflies / three leaves) which were at par with each other.

The significant maximum seed cotton yields of 10.87 and 10.24 q/ha were recorded in the university recommended dosages of fipronil 5SC @ 50 g a.i./ha and acephate 75 SP @ 750 g a.i./ha respectively and these two treatments were followed by the university recommended dose of acetamiprid 20 SP @20 g a.i./ha and label claim dose of diafenthuron 50 WP @ 300 g a.i./ha with respect to seed cotton yields and these two treatments were also found to be at par with each other.

The present finding are in confirmation with Bheemanna *et al*, 2015 reported that the insecticides fipronil 5 SC @ 87.5 g a.i./ha and diafenthuron 50 WP @ 300 g a.i./ha were effective in reducing population of thrips as well as leafhopper and higher seed cotton yields.

Table 1: Efficacy of insecticides against cotton aphids.

Population of Aphids /3 leaves						
Tr. No.	**Treatments**	**Dose (D1/D2) g.a.i. /ha.**	**Pre Count**	**First spray**	**Second spray**	**Third spray**
T1	Acephate 75 SP	292*	1.14 (1.43)	0.32 (0.90)	1.31 (1.28)	0.54 (1.01)
T2	Acephate 75 SP	750**	1.17 (1.44)	0.17 (0.82)	0.79 (1.07)	0.32 (0.90)
T3	Acetamiprid 20 SP	10*	1.40 (1.52)	0.65 (1.07)	2.27 (1.61)	1.28 (1.30)
T4	Acetamiprid 20 SP	20**	1.14 (1.43)	0.56 (1.02)	2.01 (1.53)	1.29 (1.32)
T5	Imidacloprid 17.8% SL	22.5*	1.00 (1.40)	1.03 (1.22)	2.62 (1.70)	1.73 (1.46)
T6	Imidacloprid 17.8% SL	25**	1.24 (1.47)	0.86 (1.15)	2.41 (1.63)	1.58 (1.41)
T7	Thiamethoxam 25% WG	25*	1.30 (1.49)	0.72 (1.09)	2.34 (1.62)	1.55 (1.41)
T8	Thiamethoxam 25% WG	50**	1.13 (1.43)	0.70 (1.08)	2.10 (1.54)	1.32 (1.32)
T9	Fipronil 5 SC	87.5*	1.05 (1.40)	0.60 (1.03)	1.76 (1.45)	1.09 (1.24)
T10	Fipronil 5 SC	50**	1.20 (1.45)	0.38 (0.93)	1.37 (1.30)	0.71 (1.09)
T11	Diafenthuron 50 W	300*	1.47 (1.54)	0.21 (0.84)	1.14 (1.19)	0.39 (0.94)
T12	Diafenthuron 50 W	200**	1.20 (1.45)	0.41 (0.95)	1.61 (1.39)	0.67 (1.06)
T13	Untreated control	--	1.47 (1.54)	4.27 (2.18)	6.11 (2.56)	4.63 (2.26)
T14	Untreated control	--	1.74 (1.63)	4.26 (2.18)	5.96 (2.53)	4.55 (2.24)
F Test (Interaction)			NS	Sig	Sig	Sig
S.E. ±			0.07	0.07	0.09	0.06
C. D. at 5%			NS	0.20	0.27	0.19
CV %			5.21	12.27	6.67	9.90

Figures in parantheses are $\sqrt{x + 0.5}$ transformed values. * Label claim dose D_1 ** University recommendation dose D_2

Table 2: Efficacy of insecticides against cotton jassids

Population of Jassids /3 leaves						
Tr. No.	**Treatments (C1/C2)**	**Dose (D1/D2) g.a.i. /ha.**	**Pre Count**	**First spray**	**Second spray**	**Third spray**
T1	Acephate 75 SP	292*	8.30 (3.03)	5.74 (2.46)	6.66 (2.64)	6.35 (2.61)
T2	Acephate 75 SP	750**	8.44 (3.06)	5.19 (2.36)	6.52 (2.62)	5.55 (2.45)
T3	Acetamiprid 20 SP	10	8.77 (3.11)	6.01 (2.52)	7.84 (2.85)	7.03 (2.73)
T4	Acetamiprid 20 SP	20	8.50 (3.07)	4.18 (2.13)	5.10 (2.34)	4.30 (2.18)
T5	Imidacloprid 17.8% SL	22.5	9.53 (3.23)	6.60 (2.65)	8.03 (2.88)	7.13 (2.75)
T6	Imidacloprid 17.8% SL	25	9.60 (3.24)	6.15 (2.56)	7.41 (2.77)	6.57 (2.65)
T7	Thiamethoxam 25% WG	25	9.10 (3.16)	5.95 (2.51)	7.55 (2.80)	6.03 (2.54)
T8	Thiamethoxam 25% WG	50	9.43 (3.22)	5.56 (2.44)	6.68 (2.64)	6.03 (2.55)
T9	Fipronil 5 SC	87.5	8.37 (3.04)	4.71 (2.24)	5.58 (2.43)	4.82 (2.29)
T10	Fipronil 5 SC	50	9.90 (3.29)	4.93 (2.29)	6.18 (2.55)	5.39 (2.42)
T11	Diafenthuron 50 W	300	9.77 (3.27)	4.83 (2.27)	5.70 (2.45)	5.00 (2.33)
T12	Diafenthuron 50 W	200	9.50 (3.23)	5.73 (2.47)	7.05 (2.71)	6.21 (2.58)
T13	Untreated control	--	9.47 (3.22)	14.0 (3.80)	13.25 (3.71)	13.87 (3.79)
T14	Untreated control	--	9.47 (3.22)	13.72 (3.76)	13.56 (3.75)	12.14 (3.54)
F Test (Interaction)			NS	Sig	Sig	Sig
S.E. ±			0.18	0.09	0.08	0.06
C. D. at 5%			N/A	0.26	0.23	0.18
CV %			10.23	7.21	5.99	4.97

Figures in parantheses are $\sqrt{x + 0.5}$ transformed values. * Label claim dose D_1 ** University recommendation dose D_2

Nemade *et al.* (2017) [2] who revealed that fipronil 5 SC, diafenthiuron 50 WP and diafenthiuron 50% WP most suitable insecticides for management of sucking pests or minimum population of sucking pests compared to standard check and present studies no deleterious effect on population of natural enemies and higher seed cotton yield were recorded in higher doses of acetamiprid and Imidacloprid insecticides. Halappa and Patil (2014) [4] evaluated bioefficacy of different insecticides against leafhopper, *Amarasca biguttula biguttula* (Ishida). Dinotefuran were found most effective against leafhopper with 79.57, 76.59, 76.23 and 73.69 per cent reduction over untreated check respectively. Nemade (2015) [3] was reported that imidacloprid, fipronil 5 SC, acetamiprid, acephate 75 SP, diafenthiuron 50 WP, buprofezin 25 SC, triazophos 40 EC, azadirachtin 10000 PPM (1%), dimethoate (Std check) all the insecticidal treatments were at par with each other did not showed any detrimental effect on predator's population. Patil *et al.* (2009) [5] recorded the highest seed cotton yield in the plot treated with fipronil 5% SC and imidacloprid 17.8 SL @ 0.008% and acetamiprid 20 SP @ 0.002% compared to other treatment.

Table 3: Efficacy of insecticides against cotton Thrips

Population of Thrips /3 leaves						
Tr. No.	**Treatments (C1/C2)**	**Dose (D1/D2) g.a.i. / ha.**	**Pre Count**	**First spray**	**Second spray**	**Third spray**
T1	Acephate 75 SP	292	6.97 (2.80)	7.65 (2.76)	5.35 (2.35)	4.63 (2.19)
T2	Acephate 75 SP	750	6.03 (2.63)	6.17 (2.48)	4.07 (2.05)	3.50 (1.94)
T3	Acetamiprid 20 SP	10	5.27 (2.48)	9.07 (3.00)	6.84 (2.65)	6.02 (2.49)
T4	Acetamiprid 20 SP	20	5.34 (2.49)	6.50 (2.55)	4.65 (2.20)	4.07 (2.07)
T5	Imidacloprid 17.8% SL	22.5	5.10 (2.44)	8.83 (2.96)	4.17 (2.57)	5.64 (2.42)
T6	Imidacloprid 17.8% SL	25	5.37 (2.50)	8.23 (2.85)	6.04 (2.49)	5.05 (2.28)
T7	Thiamethoxam 25% WG	25	5.00 (2.42)	8.77 (2.94)	6.27 (2.54)	5.18 (2.31)
T8	Thiamethoxam 25% WG	50	5.50 (2.52)	7.07 (2.64)	4.80 (2.24)	4.18 (2.09)
T9	Fipronil 5 SC	87.5	5.23 (2.47)	6.55 (2.54)	4.23 (2.10)	3.67 (1.98)
T10	Fipronil 5 SC	50	5.77 (2.58)	5.70 (2.39)	3.47 (2.91)	3.22 (1.86)
T11	Diafenthuron 50 W	300	5.00 (2.42)	7.25 (2.68)	5.07 (2.29)	4.37 (2.13)
T12	Diafenthuron 50 W	200	5.84 (2.59)	8.12 (2.83)	5.68 (2.42)	4.70 (2.21)
T13	Untreated control	--	4.20 (2.25)	14.37 (3.73)	14.22 (3.80)	10.12 (3.21)
T14	Untreated control	--	6.00 (2.62)	13.60 (3.65)	15.42 (3.91)	10.02 (3.20)
F Test (Interaction)			NS	Sig	Sig	Sig
S.E. ±			0.23	0.07	0.06	0.05
C. D. at 5%			NS	0.21	0.19	0.15
CV %			9.15	5.20	5.32	4.73

Figures in parantheses are $\sqrt{x + 0.5}$ transformed values. * Label claim dose D_1 ** University recommendation dose D_2

Table 4: Efficacy of insecticides against cotton Whiteflies

Tr. No.	Treatments (C1/C2)	Dose (D1/D2) g.a.i. / ha.	Population of Whiteflies /3 leaves				Seed cotton yields
			Pre Count	First spray	Second spray	Third spray	
T1	Acephate 75 SP	292	8.04 (2.99)	7.10 (2.71)	7.78 (2.86)	5.58 (2.44)	8.56
T2	Acephate 75 SP	750	8.27 (3.03)	5.95 (2.49)	6.47 (2.62)	4.32 (2.17)	10.24
T3	Acetamiprid 20 SP	10	9.97 (3.30)	8.10 (2.88)	8.90 (3.06)	6.85 (2.69)	8.29
T4	Acetamiprid 20 SP	20	9.57 (3.24)	6.55 (2.61)	6.95 (2.71)	4.99 (2.31)	9.12
T5	Imidacloprid 17.8% SL	22.5	8.47 (3.06)	7.73 (2.82)	8.52 (2.99)	6.18 (2.56)	7.52
T6	Imidacloprid 17.8% SL	25	9.94 (3.29)	7.21 (2.73)	8.09 (2.91)	5.69 (2.46)	7.74
T7	Thiamethoxam 25% WG	25	9.43 (3.22)	7.47 (2.77)	8.28 (2.95)	5.97 (2.52)	7.81
T8	Thiamethoxam 25% WG	50	8.93 (3.14)	6.82 (2.66)	7.54 (2.82)	5.33 (2.39)	8.51
T9	Fipronil 5 SC	87.5	8.74 (3.11)	5.77 (2.45)	6.13 (2.56)	3.62 (2.01)	8.56
T10	Fipronil 5 SC	50	8.73 (3.10)	6.44 (2.59)	7.40 (2.79)	5.15 (2.35)	10.87
T11	Diafenthuron 50 W	300	8.73 (3.10)	5.32 (2.36)	5.39 (2.41)	3.38 (1.95)	8.84
T12	Diafenthuron 50 W	200	9.47 (3.22)	6.40 (2.58)	6.84 (2.69)	4.53 (2.21)	8.47
T13	Untreated control	--	9.20 (3.18)	13.92 (3.78)	13.28 (3.71)	13.44 (3.73)	3.90
T14	Untreated control	--	9.30 (3.19)	13.15 (3.67)	12.93 (3.66)	14.20 (3.83)	4.21
F Test (Interaction)			NS	Sig	Sig	Sig	Sig
S.E. ±			0.18	0.12	0.08	0.09	0.40
C. D. at 5%			NS	0.34	0.23	0.26	1.16
CV %			10.31	8.85	5.60	7.36	8.71

Figures in parantheses are $\sqrt{x + 0.5}$ transformed values. * Label claim dose D_1 ** University recommendation dose D_2

Conclusion

In the present investigation, fipronil 5 SC, difenthiuron 50 WP, imidacloprid 17.8 SL and acetamiprid e found more effective against sucking insect pests *viz*., aphid, leafhopper, thrips and whitefly infesting cotton. These insecticides can be recommended for the management of sucking insect pests in cotton looking to their effectiveness, economics and safety to the natural enemies.

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