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BIO-EFFICACY OF CYANTRANILIPROLE 10% OD- AN ANTHRANILIC DIAMIDE INSECTICIDE AGAINST SUCKING PESTS OF COTTON

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ABSTRACT
Field studies were conducted during two consecutive kharif seasons of 2010-11 and 2011-12 in order to evaluate the field bio-efficacy of a newer molecule cyantraniliprole 10% OD (Cyazypyr @ 45, 60, 75, 90 and 105 g a.i./ha) along with indoxacarb 14.5 SC (Avaunt @ 75 g a.i./ha) and endosulfan 35 EC (Thiodan @ 350 g a.i./ha) as standard checks against the cotton aphid, *Aphis gossypii* Glover; thrips, *Thrips tabaci* Lindeman and whitefly, *Bemisia tabaci* (Gennadius). The two higher doses of cyantraniliprole 10% OD *i.e.* 90 and 105 g a.i./ha was found highly effective in managing the population of aphid, thrips and whitefly during both the year compared to endosulfan and indoxacarb. The seed cotton yield was recorded significantly higher in treatments cyantraniliprole 10% OD @ 90 (31.97 q/ha) and 105 (33.33 q/ha) g a.i./ha with an increase of 50.80 and 52.81 per cent over untreated control, respectively. Considering the bio-efficacy and yield, cyantraniliprole 10% OD @ 90 g a.i./ha is recommended for effective control of sucking pests in cotton ecosystem.

INTRODUCTION

Cotton is an important commercial crop unanimously designated as 'king of fibre crops' and prone to insect pests attack at various stages of crop growth. World total cotton production was recorded as 120.97 million bales from the 34.35 million hectares of total cultivated area and 767 kg/ hectare productivity (Anon., 2013). In India, about 160 species of insect pests have been reported to be associated with cotton and among them, only a dozen of pests cause economic damage to the crop (Agrawal, 1978). Among them, sap feeders aphids, *Aphis gossypii,* Glover, leafhoppers, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci,* Lindeman and whitefly, *Bemisia tabaci* (Gennadius) are deadly pests. The estimated loss due to sucking pests complex was up to 21.20% (Dhawan *et al.,* 1988). Whitefly causes great damage by sucking the cell sap, secreting the honey dews and transmitting the leaf curl viral disease to cotton (Khan and Ahmad 2005). A broad range of insecticides available in market have proved as effective in reducing the pest population. However, negligence in following the principles of crop protection, indiscriminate and extensive use of synthetic insecticides led to development of insecticidal resistance, pest resurgence, residues, destruction of natural enemies etc. Hence, it is require to move on other molecules with different mode of action to overcome such types of consequences. Keeping in mind with these objectives, the bio-efficacy of cyantraniliprole was undertaken with recommended insecticides for the control of sucking pests (aphid, thrips and whitefly) of cotton. Scanty information is available of in efficacy on insect pests infesting cotton. However, field bio-efficacy with different doses of cyantraniliprole was evaluated by few workers earlier against sucking pests (Patel *et al.,* 2011, Mandal 2012, Misra 2012, Patel and Kher, 2012a and Patel and Kher, 2012b) on other crops.

Cyantraniliprole (IRAC MoA 28) is a second generation anthranilic diamide insecticide discovered by DuPont Crop Protection. It has unique mode of action targeting the ryanodine receptors (RyR) in insect muscle cells (Sattelle *et al.,* 2008; IRAC 2012). Cyantraniliprole is the first to control a cross-spectrum of chewing (Lepidoptera) and sucking (Hemiptera) pests (Anon., 2012). This group of insecticides also possesses the anti-feedant properties (Gonzales-Coloma *et al.,* 1999).

MATERIALS AND METHODS

Field experiment was conducted during kharif seasons of 2010–11 and 2011–12 to evaluate the bio-efficacy of a new anthranillic diamide insecticide, cyantraniliprole 10% OD in a Randomized Block Design (RBD) at the Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. For the purpose, Gujarat Cotton Hybrid-12 was raised in plots of size 6.0 × 3.6 m with a spacing of 90 cm × 60 cm with recommended standard agronomical package of practices for the state except plant protection. There were eight treatments and replicated four times. The insecticidal

treatments included cyantraniliprole (Cyazypyr™) 10% OD @ 45, 60, 75, 90 and 105 g a.i./ha and two standard checks viz., indoxacarb (Avaunt) 14.5 SC @ 75, endosulfan (Thiodan) 35 EC @ 350 g a.i./ha and untreated control. The respective chemical treatments were sprayed on cotton when sucking insect pest population reached to or crossed 5 per leaf on the crop by manually operated knapsack sprayer fitted with hollow cone nozzle. Altogether, four applications were made at 15 days interval during both the seasons. The observations on population of sucking pests (*A. gossypii*, *B. tabaci* and *T. tabaci*) were recorded on five plants selected randomly in each plot. 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 3, 7 and 15 days after each spray. Seed cotton yield was recorded plot wise and converted in to q/ha. The data on population of the pests were subjected to square root transformation before statistical analysis following Gomez and Gomez (1984) to test the significance of treatment effects.

RESULTS AND DISCUSSION

The aphid, *A. gossypii* population (Table 1) was uniform in all the treatments before first spray as treatment difference was non-significant ranging from 8.14 to 10.46 during 2010-11 and 7.79 to 10.46 per leaf during 2011-12. Among the insecticidal treatments, cyantraniliprole at highest dose i.e. 105 g a.i./ha significantly reduced the aphid population and recorded 1.38 and 2.22 per leaf at 3rd day after spray and 0.17 and 0.42 per leaf at 7th day after spray during 2010-11 and 2011-12, respectively. The treatment of cyantraniliprole @ 90 g a.i./ha stood next to this and was at par with the highest dose cyantraniliprole of 105 g a.i./ha. The superiority of cyantraniliprole against *A. gossypii* revealed in present study is in accordance with the report of Mandal (2012) who reported that cyantraniliprole @ 90 and 105 g a.i./ha was more effective in reducing the pest population in tomato. Cyantraniliprole applied @ 75 and 60 g a.i./ha and endosulfan @ 350 g a.i./ha found at par and proved equally effective against *A. gossypii*. Among the tested insecticides, highest aphid population was recorded in indoxacarb 75 g a.i./ha (2.39 and 2.89 at 7th day after spray during 2010-11 and 2011-12, respectively) and was at par with cyantraniliprole @ 45 g a.i./ha (lower dose). After 15 days, the aphid population slightly increased in all the treatments during both the years. Pooled over spray and periods data revealed that all the insecticidal treatments were significantly superior than untreated control. Cyantraniliprole @ 105 g a.i./ha was found most effective in reducing aphid population (0.85/leaf) and was at par with cyantraniliprole @ 90 g a.i./ha (0.94/leaf). Both these doses of cyantraniliprole were found more effective than the standard checks *i.e.* endosulfan and indoxacarb.

During 2010-11 and 2011-12, the population of thrips, *T. tabaci* recorded before initiation of spray was uniform with a range of 6.90 to 8.44 and 7.28 to 11.33 per leaf, respectively (Table 2). After the 3rd and 7th day of spray, cyantraniliprole @ 105 g a.i./ha found significantly more effective in controlling thrips and it was at par with cyantraniliprole @ 90 g a.i./ha. The next lower dose of cyantraniliprole @ 90 g a.i./ha recorded 1.22 and 0.40 thrips per leaf at 3rd day after application during 2010-11 and 2011-12 and 0.78 and 0.11 per leaf at 7th day after application during 2010-11 and 2011-12, respectively. Cyantraniliprole @ 75 g a.i./ha, cyantraniliprole @ 60 g a.i./ha and endosulfan @ 350 g a.i./ha proved more or less equally effective against this pest. Among the evaluated insecticides, the highest thrips population was recorded in plots treated with indoxacarb @ 75 a.i./ha and it was at par with cyantraniliprole @ 45 g a.i./ha. Pooled data revealed that all the insecticidal treatments were significantly superior to control. Thrips population (0.52/leaf) was effectively managed with application of higher doses of cyantraniliprole @ 90 and 105 g a.i./ha and differed significantly from rest of the insecticidal treatments. According to Misra (2012), both the doses of cyantraniliprole i.e. 105 and 90 g a.i./ha were found equally effective against *T. tabaci* infesting tomato. This is in agreement with the present finding. Cyantraniliprole @ 60 as well as 75 g a.i./ha and endosulfan @ 350 g a.i./ha were moderately effective against *T. tabaci* infesting cotton. Indoxacarb 14.5 SC @ 75 g a.i./ha and cyantraniliprole @ 45 g a.i./ha treated plots registered higher population of thrips and were least effective treatments.

The whitefly, *B. tabaci* population (Table 3) was uniform in all the treatments before first spray as treatment difference was non-significant. It ranged from 8.68 to 10.19 whitefly/leaf during 2010-11 and 7.01 to 8.03 per leaf during 2011-12. After 3rd day, newer molecule cyantraniliprole @ 105 g a.i./ha was found significantly more effective than all the doses of cyantraniliprole, except 90 g a.i./ha and recorded lower population of whitefly *i.e.* 0.92 and 0.75 per leaf after 3rd day

Table 1: Bio-efficacy of cyantraniliprole 10% OD against aphid, *A. gossypii* on cotton

Insecticides	Dose (g a. i./ha)	Number of aphids/leaf								
		2010-11 (Pooled over spray)				2011-12 (Pooled over spray)				Pooled over spray and periods
		BS	3 DAS	7 DAS	15 DAS	BS	3 DAS	7 DAS	15 DAS	
Cyantraniliprole 10% OD	45	9.93 (3.23)	4.30 (2.19)	2.36 (1.69)	2.89 (1.84)	10.46 (3.31)	5.21 (2.39)	2.85 (1.83)	3.30 (1.95)	3.42 (1.98)
Cyantraniliprole 10% OD	60	10.46 (3.31)	2.74 (1.80)	1.32 (1.35)	1.78 (1.51)	9.80 (3.21)	3.62 (2.03)	1.66 (1.47)	2.16 (1.63)	2.16 (1.63)
Cyantraniliprole 10% OD	75	8.20 (2.95)	2.70 (1.79)	1.24 (1.32)	1.69 (1.48)	10.52 (3.32)	3.54 (2.01)	1.60 (1.45)	2.09 (1.61)	2.09 (1.61)
Cyantraniliprole 10% OD	90	9.68 (3.19)	1.43 (1.39)	0.29 (0.89)	0.56 (1.03)	7.79 (2.88)	2.32 (1.68)	0.54 (1.02)	0.92 (1.19)	0.94 (1.20)
Cyantraniliprole 10% OD	105	9.93 (3.23)	1.38 (1.37)	0.17 (0.82)	0.50 (1.00)	8.68 (3.03)	2.22 (1.65)	0.42 (0.96)	0.87 (1.17)	0.85 (1.16)
Indoxacarb 14.5 SC	75	8.99 (3.08)	4.34 (2.20)	2.39 (1.70)	3.00 (1.87)	9.80 (3.21)	5.26 (2.40)	2.89 (1.84)	3.38 (1.97)	3.50 (2.00)
Endosulfan 35 EC	350	9.93 (3.23)	2.92 (1.85)	1.40 (1.38)	1.87 (1.54)	9.55 (3.17)	3.83 (2.08)	1.81 (1.52)	2.29 (1.67)	2.29 (1.67)
Control	-	8.14 (2.94)	5.95 (2.54)	3.66 (2.04)	4.17 (2.16)	9.36 (3.14)	6.95 (2.73)	4.25 (2.18)	4.61 (2.26)	4.88 (2.32)
SEm ±		0.12	0.06	0.04	0.03	0.20	0.05	0.03	0.04	0.02
CD (p = 0.05)		NS	0.17	0.11	0.10	NS	0.16	0.09	0.13	0.05
CV%		7.48	12.00	10.45	8.94	12.83	10.32	7.81	10.55	10.45

BS = Before spray, DAS = Days after spray, NS = Non significant, Figures in parenthesis are $\sqrt{x+0.5}$ transformation; those outside are retransformed

Table 2: Effectiveness of cyantraniliprole 10% OD against thrips, *T. tabaci* in cotton

Insecticides	Dose (g a. i./ha)	Number of thrips/leaf 2010-11 (Pooled over spray) BS	3 DAS	7 DAS	15 DAS	2011-12 (Pooled over spray) BS	3 DAS	7 DAS	15 DAS	Pooled over spray and periods
Cyantraniliprole 10% OD	45	8.44 (2.99)	3.50 (2.00)	3.22 (1.93)	3.58 (2.02)	8.03 (2.92)	1.49 (1.41)	0.87 (1.17)	1.14 (1.28)	2.19 (1.64)
Cyantraniliprole 10% OD	60	7.23 (2.78)	2.26 (1.66)	1.90 (1.55)	2.26 (1.66)	7.57 (2.84)	0.92 (1.19)	0.44 (0.97)	0.64 (1.07)	1.32 (1.35)
Cyantraniliprole 10% OD	75	7.79 (2.88)	2.22 (1.65)	1.87 (1.54)	2.16 (1.63)	7.97 (2.91)	0.87 (1.17)	0.40 (0.95)	0.62 (1.06)	1.27 (1.33)
Cyantraniliprole 10% OD	90	7.28 (2.79)	1.22 (1.31)	0.78 (1.13)	1.06 (1.25)	7.28 (2.79)	0.40 (0.95)	0.11 (0.78)	0.21 (0.84)	0.58 (1.04)
Cyantraniliprole 10% OD	105	7.28 (2.79)	1.11 (1.27)	0.69 (1.09)	0.96 (1.21)	11.33 (3.44)	0.36 (0.93)	0.08 (0.76)	0.16 (0.81)	0.52 (1.01)
Indoxacarb 14.5 SC	75	6.90 (2.72)	3.58 (2.02)	3.26 (1.94)	3.62 (2.03)	9.17 (3.11)	1.54 (1.43)	0.89 (1.18)	1.16 (1.29)	2.22 (1.65)
Endosulfan 35 EC	350	6.90 (2.72)	2.32 (1.68)	1.93 (1.56)	2.26 (1.66)	9.61 (3.18)	0.96 (1.21)	0.48 (0.99)	0.71 (1.10)	1.38 (1.37)
Control	-	8.08 (2.93)	5.16 (2.38)	4.52 (2.24)	4.74 (2.29)	11.33 (3.44)	2.16 (1.63)	1.38 (1.37)	1.72 (1.49)	3.11 (1.93)
SEm ±		0.18	0.03	0.05	0.06	0.18	0.03	0.02	0.02	0.08
CD (p = 0.05)		NS	0.10	0.14	0.17	NS	0.08	0.07	0.06	0.26
CV %		12.91	11.67	15.09	13.55	10.31	8.52	9.73	9.91	10.01

BS = Before spray, DAS = Days after spray, NS = Non significant, Figures in parenthesis are $\sqrt{x+0.5}$ transformation; those outside are retransformed

Table 3: Effectiveness of cyantraniliprole 10% OD against whitefly, *B. tabaci* in cotton

Insecticides	Dose (g a. i./ha)	Number of whiteflies/leaf 2010-11 (Pooled over spray) BS	3 DAS	7 DAS	15 DAS	2011-12 (Pooled over spray) BS	3 DAS	7 DAS	15 DAS	Pooled over spray and periods
Cyantraniliprole 10% OD	45	10.19 (3.27)	3.03(1.88)	1.90(1.55)	2.39(1.70)	7.51 (2.83)	2.29 (1.67)	1.30 (1.34)	1.60 (1.45)	2.06 (1.60)
Cyantraniliprole 10% OD	60	10.13 (3.26)	2.00(1.58)	1.06(1.25)	1.52(1.42)	7.45 (2.82)	1.49 (1.41)	0.69 (1.09)	0.96 (1.21)	1.27 (1.33)
Cyantraniliprole 10% OD	75	9.36 (3.14)	1.96(1.57)	1.01(1.23)	1.43(1.39)	7.45 (2.82)	1.46 (1.40)	0.64 (1.07)	0.92 (1.19)	1.22 (1.31)
Cyantraniliprole 10% OD	90	8.68 (3.03)	1.01(1.23)	0.31(0.90)	0.67(1.08)	7.97 (2.91)	0.82 (1.15)	0.17 (0.82)	0.40 (0.95)	0.54 (1.02)
Cyantraniliprole 10% OD	105	9.30 (3.13)	0.92(1.19)	0.26(0.87)	0.58(1.04)	8.03 (2.92)	0.75 (1.12)	0.14 (0.80)	0.36 (0.93)	0.48 (0.99)
Indoxacarb 14.5 SC	75	9.36 (3.14)	3.11(1.90)	1.93(1.56)	2.46(1.72)	7.01 (2.74)	2.32 (1.68)	1.32 (1.35)	1.66 (1.47)	2.09 (1.61)
Endosulfan 35 EC	350	9.74 (3.20)	2.06(1.60)	1.11(1.27)	1.57(1.44)	7.51 (2.83)	1.57 (1.44)	0.75 (1.12)	1.01 (1.23)	1.32 (1.35)
Control	-	8.74 (3.04)	4.17(2.16)	2.78(1.81)	3.38(1.97)	7.45 (2.82)	3.07 (1.89)	1.87 (1.54)	2.29 (1.67)	2.89 (1.84)
SEm ±		0.12	0.04	0.04	0.04	0.09	0.04	0.03	0.03	0.03
CD (p = 0.05)		NS	0.13	0.12	0.11	NS	0.12	0.09	0.08	0.11
CV%		11.19	10.59	12.49	9.80	10.93	11.11	11.23	8.90	8.87

BS = Before spray, DAS = Days after spray, NS = Non significant, Figures in parenthesis are $\sqrt{x+0.5}$ transformation; those outside are retransformed

Table 4: Impact of different insecticidal treatments on seed cotton yield

Insecticides	Dose (g a.i./ha)	Seed cotton yield (q/ha) 2010-11	2011-12	Mean	Increase yield over control (%)
Cyantraniliprole 10% OD	45	20.26	22.04	21.15	25.63
Cyantraniliprole 10% OD	60	24.88	27.48	26.18	39.92
Cyantraniliprole 10% OD	75	25.18	28.09	26.63	40.93
Cyantraniliprole 10% OD	90	30.63	33.31	31.97	50.80
Cyantraniliprole 10% OD	105	32.08	34.58	33.33	52.81
Indoxacarb 14.5 SC	75	19.97	21.47	20.72	24.08
Endosulfan 35 EC	350	24.00	26.51	25.26	37.73
Control	-	15.33	16.14	15.73	-
SEm ±		1.45	1.27	0.91	
CD at 5%		4.27	3.74	2.57	
CV %		12.10	9.71	10.88	

and 0.26 and 0.14 per leaf after 7th day of spray during 2010-11 and 2011-12, respectively. In case of cyantraniliprole @ 90 g a.i./ha, it was 1.01 and 0.82 after 3rd day of spray and 0.31 and 0.17 per leaf after 7th day of spray. Similarly, cyantraniliprole (90 and 105 g a.i./ha) was also effective against whitefly on okra, brinjal and tomato as reported by Patel *et al.*, 2011, Patel and Kher, 2012a and Patel and Kher, 2012b. These results are closely associated with present finding. There was no significant difference among the cyantraniliprole @ 75 g a.i./ha, 60 g a.i./ha and endosulfan as they were statistically at par. During both years, the highest pest population was observed in plots treated with indoxacarb. Pooled data over years showed that all the insecticidal treatments were significantly superior to control. Cyantraniliprole @ 105 g a.i./ha (0.48 whitefly/leaf) and 90 g a.i./ha (0.54 whitefly/leaf) were found more effective than rest of the insecticidal treatments.

Data on seed cotton yield over years (Kharif, 2010-11 and 2011-12) revealed that there was significant impact of insecticidal treatments on seed cotton yield (Table 4). Cyantraniliprole at 105 g a.i./ha recorded highest yield (33.33 q/ha) and was at par with cyantraniliprole @ 90 g a.i./ha (31.97 q/ha); but differed significantly from rest of the treatments. Further, increasing yield over control in cyantraniliprole @ 90 and 105 g a.i./ha was ranged from 50.80 - 52.81% which was higher than the standard check i.e. endosulfan 35 EC (37.73%) and indoxacarb 14.5 SC (24.08%).

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